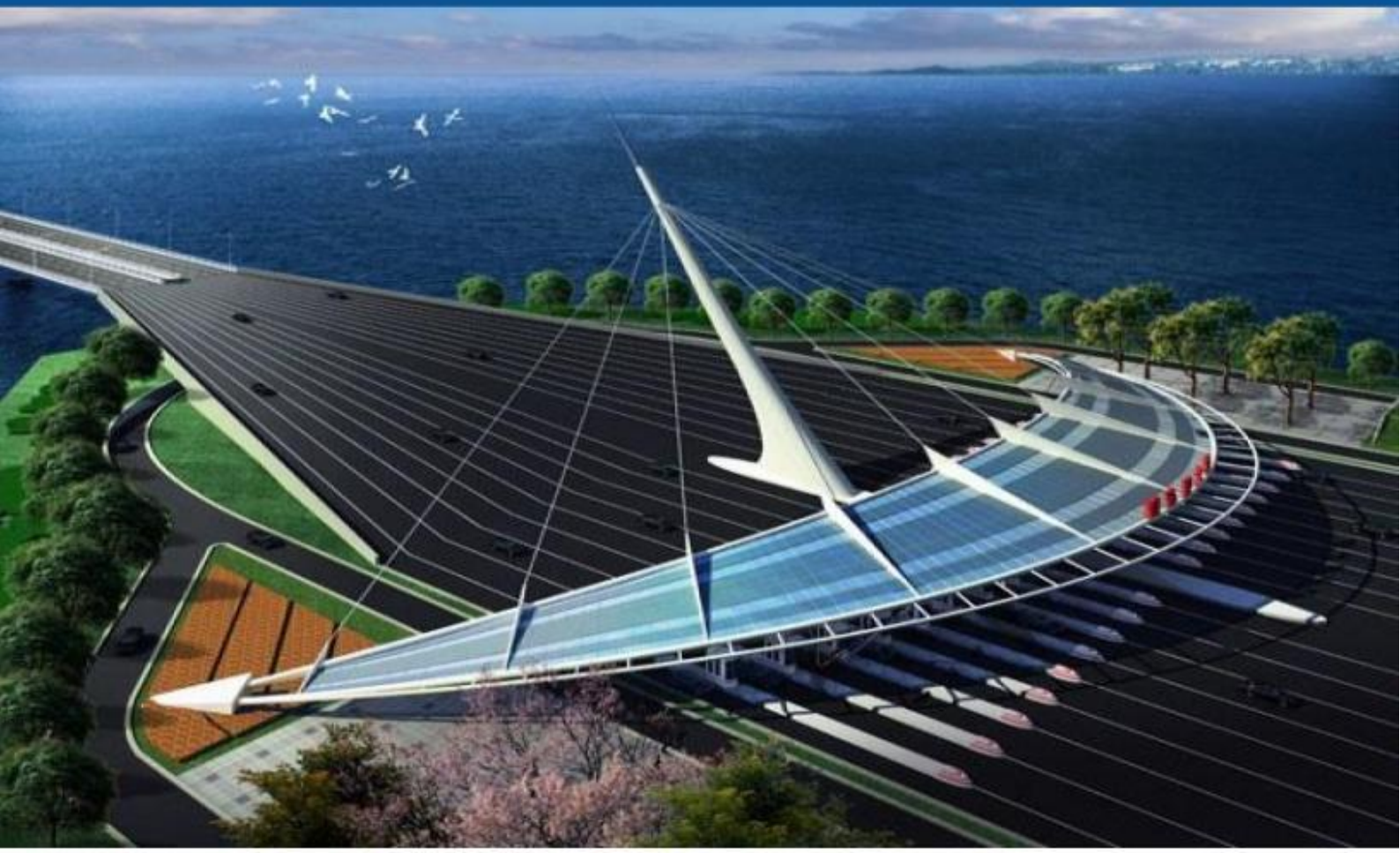
Identifying opportunities in large infrastructure projects for enhancing project value



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Colophon

REPORT TITLE
IDENTIFYING OPPORTUNITIES IN LARGE INFRASTRUCTURE PROJECT FOR ENHANCING PROJECT VALUE

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Preface

As a final step for master's in Construction Management & Engineering, a graduation research work is required and should be submitted as a thesis document. This report is the result of my graduation work which is required in partial fulfillment to obtain MSc degree in Construction Management & Engineering from Delft University of Technology.

During my graduation work, I worked towards opportunity identification in large infrastructure projects and how it can help in enhancing the project value and would take a step closer towards project success. This study is mainly focused towards exploring opportunities during the tender phase and how contractors could be in a better position to identify opportunities in such projects. I investigated crucial factors that would act as a foundation for opportunity identification along with a roadmap that could act as a tool for the project team for opportunity identification and overall opportunity management. It is prepared after investigating upon the current approach towards opportunities, existing constraints for opportunity identification and required focus areas needed to create a logical stepwise process for better exploration of opportunities.

Reflecting on this several months of graduation work, I could collect a lot of good learnings and experiences which in fact molded my thinking towards opportunity management. There are a lot of people without whom this research would not have been possible.

First of all, I would like to thank Kenzo for giving an initial introduction regarding the thesis topic along with the required support needed from the company side for this study. Secondly, this study would not have been possible without guidance from the university. I would like to thank Maedeh for her continuous feedbacks and suggestions during the entire research period. I would like to express my gratitude towards Professor Hertogh and Martijn for their guidance during this study. Together, I am very much grateful to my graduation committee for their overall support.

I am much grateful to all the experts from HOCHTIEF and other related organization who could manage some time for this thesis out of their busy schedule. I would like to thank all 24 participants who were involved for the interviews and validation session along with the questionnaire survey respondents. Without their insights and shared experiences, I could not have finalized this study.

Furthermore, I would like to thank my family and friends for their constant support and morale boost which kept me motivated not just during the thesis but for the entire two years of my master study.

Hope you will enjoy reading this report.

Sharad Adhikari
Delft, August 2019

Executive Summary

Study goal and scope

Delivering large infrastructure projects generally comes with a debate regarding its inefficient execution in terms of cost overrun, missing deadline or under quality final product. One of the reasons for this is due to project uncertainty and changing project dynamics. Risk management is being used as a tool for managing these uncertainties that could affect the project objectives but its primary focus in practice has been towards managing the threats in projects. Thus, the attention is mainly towards preventing and correcting the events that could hamper the project's goal and objective. However, there is also a positive side to the uncertainty that could benefit the project if identified and managed properly. These events or conditions benefiting positively to a project is termed as an opportunity which has the potential to enhance the project's initial objective and could add more value to the project. However, due to lack of an effective approach for opportunity identification and several constraints prevailing in such large projects, opportunities are not being identified properly.

Among the literature reviewed during this study, constraints for opportunity identification in large infrastructure projects are not mentioned properly. Also, the effect of such constraints and suggestion for its minimization are not available. Moreover, along with constraints, a holistic approach towards opportunity exploitation is lacking in the literature creating a research gap that has been tried to fill through this study.

This study investigates the concept of opportunity in infrastructure projects and crucial factors that could stimulate opportunity identification in such projects along with constraint's study that hinders such identification process. Here, a roadmap is developed for opportunity identification consisting of a procedure for identifying opportunity during tender phase with an assessment model that could help in identifying value-creating opportunities for the project. This identified opportunities could be then used by the project team to exploit benefit for the contractor involved in execution but also to the client for whom the project will be delivered.

Tender phase is believed to be crucial for opportunity identification since major project opportunities could be identified in this phase and could drastically improve the project's overall value. These opportunities if identified early, could be incorporated in the project, preventing big changes at later stages while opportunities explored at later stages could seek changes and adaptation in the project plan. Thus, a balance between control and flexibility is needed in the adopted approach.

Since the study is done in collaboration with a construction company, the developed roadmap mainly focuses on the opportunities identified from a contractor's perspective. To achieve the goal of this study, following research question is formulated to mark the study scope for this research.

How can opportunities in large infrastructure project under Design & Construct contract be identified during the tender phase for enhancing project value for the contractor after contract award?

This research question is further supported by fours sub-questions to help achieve the target result of this study.

a) What is an opportunity and project value for a large infrastructure project under Design & Construct contracts?
b) What are the important factors which could stimulate creating and identifying project opportunities?
c) What could be a procedure for identifying opportunities by a contractor during the tender phase of large infrastructure projects?
d) How can it be known that the identified opportunity creates value to the project?

Adopted Methodology

This study adopted a qualitative research method to answer the formulated research question. The study started with a literature review of previous research done in the area of opportunity management. After finding relevant information regarding the concept of opportunity and project value along with other related terms, study toward stimulating factors for opportunity identification and approaches for creating and identifying opportunities in large infrastructure projects was done.

The second step as empirical study started with initial exploratory interviews within the company, followed by detailed interview within and outside the company regarding the perception of various experts towards opportunity, activities for turning ideas into opportunities, stimulating factors for identifying opportunit, and suggestion on improving the current approach towards opportunity identification. A questionnaire survey was conducted for finding the relative importance of 33 factors identified during the previous steps. Two reference case studies which were executed by Hochtief were done to find the approach towards opportunity identification along with constraints and suggestions for creating a better approach towards overall opportunity management. Meanwhile, an opportunity database is also built collecting the examples of opportunity occurrence in similar projects through the literature, detail interviews, questionnaire survey and case study. Finally, a roadmap for opportunity identification is proposed based on the information collected from previous steps.

Study Results

To answer the main research question, four sub-questions were formulated in this research as stated above and the results were found during various steps taken during this study. First, from the literature study, the concept of project opportunity and project value were found as;

Opportunity is an uncertain event or condition, factors, or variation that causes change within a project setting which will have increased positive effect than planned in at least one of the project's objectives and would increase project value. An idea or solution perceived as opportunity should benefit at least one of the stakeholders (contractors in this case) involved in the project to be considered as an opportunity. These benefits are in terms of added value for them in a project. Opportunities could be of three types based on the scope of this study and they are:

Type 1: Opportunity identified during the tender phase to win the bid
Type 2: Opportunity identified during the tender phase to exploit the benefits after contract award
Type 3: Opportunities identified during the execution phase of the project i.e., design and construction phase

Project value is the benefits getting out of a project against the invested resources for gaining those benefits. The benefits are seen in terms of one or any combination of nine project value drivers (performance criteria, also termed as success criteria in various literature) which are divided into tangible (cost, time, quality, safety, and sustainability) and intangible (company recognition, relation with the client, satisfaction of project team and, end-user satisfaction) groups. Opportunities in a project should increase project value and fixing the value drivers in advance would allow understanding how the company wishes to enjoy the benefits from a project when an opportunity is encountered.

The 33 stimulating factors found in this study will create a strong foundation for opportunity creation, identification, and overall opportunity management. These factors would also help in minimizing the constraints' effects towards opportunity identification which are currently prevailing in such large projects. Thus, the company should focus towards the implication of these 33 factors while dealing

with such large projects. These factors are clustered into six groups as per their similarity in character along with its group weightage which can be seen in figure 1.

Identifying opportunities generally faces several constraints while executing such large projects. In this study, five constraints were identified as high time/work pressure, low-profit margin, scope change, perception of people, and contractual restriction. These constraints cannot be fully omitted but could be minimized using proper approach while dealing with such projects. Some suggestions have been forwarded in this study regarding the needed approach for its effect reduction.

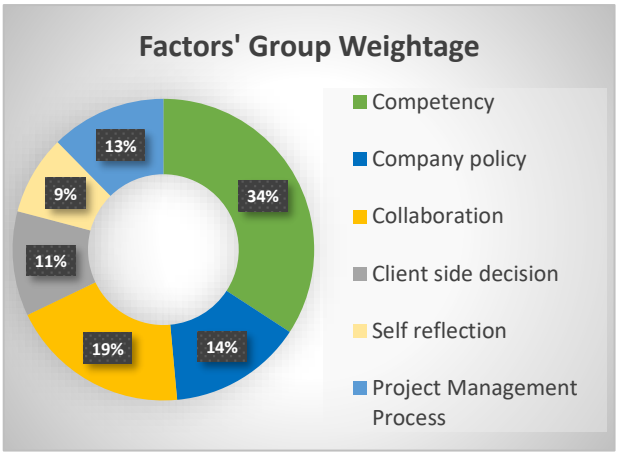

Figure 1: Factors' group weightage

A procedure for opportunity identification during the tender phase of such large infrastructure projects has been developed in this study which can be used by project team members in an opportunity workshop setting. The procedure is an answer to sub-question c and consists of 9 steps with inputs required for some steps and output expected from each step. The steps are listed below.

1) Pre-workshop Preparation
2) Confirm Scope and Objectives
3) Prioritize project value drivers
4) Brainstorm for opportunities
5) Assumption/Constraints analysis
6) Opportunity log review
7) Impact assessment of opportunities
8) Prioritize opportunities
9) Adjustment in estimates

Step 7 of this procedure acts as an assessment model for value-creating opportunities occurring in such large projects which is an answer to sub-question d. The model consists of a comparative assessment of an opportunity in terms of benefit gained against the resources invested while exploiting an opportunity in the project. The benefits gained should be more than the resources invested to call it a value-creating opportunity. Out of nine value drivers identified in this study, the tangible ones are given their importance level as per project's goal and each identified opportunity is assessed for its impact/benefit level in terms of these tangible value drivers. While, the intangible value drivers could be assessed only as an increment or decrement effect (benefit) caused by an opportunity. After knowing the value-creating opportunities during tender phase, the project team could then choose on when to use that opportunity i.e., to use it to win the bid (type 1 opportunity) or to use it after contract award (type 2 opportunity). Based on the decision taken by the project team, adjustments can be made in the estimates prepared during tender.

Finally, an opportunity roadmap has been proposed in this study which is developed from collecting the information from four sub-questions and answers the main research question.

Opportunity identification needs an increased focus with flexible approach for its exploitation in the project. To build a robust foundation for improved identification while minimizing the prevailing constraints for opportunity identification in projects, a sincere effort and focus is needed from various levels towards 33 stimulating factors identified in this study. An organization should make opportunity

management a mandatory part of the tender preparation process for such large projects since it would ensure the needed focus, while preventing the loss of potential benefits from the project which the project team might not be aware of if not concerned towards it.

Opportunity identification needs a common and clear understanding of concepts like opportunity and project value and these should be established in an organization. For exploring possible benefits before the project starts, opportunities could be explored by conducting opportunity management workshop during the tender phase with effective follow up of selected opportunities. Moreover, the identification process should be continued at a regular interval with feedbacks from previous steps for exploring new opportunities created from changing project dynamics.

For exploiting the new opportunities or the opportunities that are not included in the bid would require change in the project planning. Thus, the contract should be made flexible to incorporate those opportunities for exploiting them after contract award. Moreover, the focus should be shifted from a controlled approach on fulfilling the project objective by sticking to the initial baseline to a flexible approach on focusing on the end result to enhance the project value. So, the approach should be incorporating changes in project after assessing the impact of change towards project planning and outcome.

Recommendation for future research

- During tender phase, it is difficult to classify which opportunities should be used to win the bid and which ones should be used after contract award. Thus, it is recommended to study more towards how to differentiate between type 1 and type 2 opportunities.
- To exploit opportunities with sharing strategy, it is recommended to research towards developing a benefit-sharing mechanism between the involved parties including major stakeholders during tender phase.
- Study regarding how to decide the benchmark towards the minimum gap between investment and benefit could be done for categorizing an opportunity as value creating opportunity.

Practical Recommendation

- Opportunity management should get enough attention and opportunity identification process should be repeated on a suitable interval as per the duration and dynamics of the project.
- It is recommended to maintain a well descriptive opportunity log by the company that could be used to store all the identified opportunities in similar projects.
- For type 2 opportunities, it is recommended to identify them during the tender phase in an opportunity workshop while the resources should be invested to exploit those opportunities only after contract award to make it worth the resource invested.
- Identifying opportunities needs open minded and dedicated project team members. Thus, it is suggested to involve highly motivated team members for the opportunity identification process, who are passionate and enthusiastic about creating overall value to the project.
- Company policy should focus towards retaining key employees in such large project as it was found as a major suggestion for knowledge transfer between project phases which could improve the chances of opportunity identification.

KEYWORDS: *Opportunity, Project value, Opportunity Management, Infrastructure, Tender, Design & Construct, Contractor.*

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List of Abbreviations

Abbreviations	Full forms/Explanation used
FN	Factor Number
EI	Exploratory Interview
DI	Detail Interview
CS	Case Study
QR	Questionnaire Response
OM	Opportunity Management
RII	Relative Important Index (Yucelgazi et. al., 2019)
P15	Probability of occurring an event has a 15% certainty, thus less amount is needed as a contingency reserve (Nicholas & Steyn, 2012)
P85	Probability of occurring an event has an 85% certainty, thus more amount is needed as a contingency reserve to improve the estimate to 85% certainty (Nicholas & Steyn, 2012)
RAMS	Reliability, Availability, Maintainability, and Safety
MEAT	Most Economically Advantageous Tender
SMART	Specific, Measurable, Acceptable, Realistic, and Time-bound (Wasson, 2006)
D&C	Design & Construct
DBMFO	Design, Build, Maintain, Finance, Operate
BIM	Building Information Modeling
RBS	Risk Breakdown Structure
ATOM	Active Threat and Opportunity Management (Hillson & Simon, 2012)
SHEQ	Safety, Health, Environment, Quality

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1. Introduction

This chapter states the context of this research and explains why this study is needed. Here, the research objective is presented as a goal of this study, and the relevance of this research for the practical and academic world is explained as well. The chapter closes with a thesis outline with short introduction to each following chapter presented in this report.

1.1 Research Context

Construction projects of any scale have a large failing percentage in terms of budget overrun, missing deadlines and under quality final product (Mansfield et. al., 1994; Meng, 2012). This percentage is even more for large scale projects (Johansen et. al., 2018). This makes it obvious that there is a need for improvement in project handling and execution techniques. Project execution can be improved if the involved manpower has reliable tools to back their process. Seeking opportunities within a project could enhance its value but, the question is how to identify an opportunity. If a new idea comes to a project member, how could they decide if it's an opportunity for the project.

Much of the study has been done towards negative risk, while limited study has been done towards the positive risk or opportunity side of the project (Lehtiranta, 2014). Here, the research is mainly focused on understanding project opportunities in large infrastructure projects. The identification of such opportunities is done from a contractor's perspective that allows them to compare the project value from what the expectation was during the project tender phase where the baseline performance is generally decided for a project. The research is mainly focused on projects with Design & Construct contracts where the contractor is responsible for both design and construction phase of the project.

Generally, construction projects should adjust their scope or time to meet their cost expectations (Kendrick. T.,2015). Most of the companies participating in complex projects are struggling with the implementation of practices and knowledge to truly exploit the potential opportunities (Olsson, 2007; Rutten *et al.*, 2009) inherent in such projects. Also, scholars have not paid much attention to the processes and practices of managing opportunities (Olsson,2007; Lechler et al., 2012; Lehtiranta, 2014). Although a wide range of tools address the management of risks and opportunities, strengths-weaknesses-opportunities-threats (SWOT) analysis, cause-effect diagrams and root-cause analysis (Hillson, 2002; Thamhain, 2013), the practical tools and methods do not seem to sufficiently support active opportunity management in project organizations and there is a lack of focus in exploring opportunities within projects especially in the execution phase (Johansen, 2015). Thus, there is a need for conducting research in opportunity identification and management.

1.2 Problem Definition

To understand the need for opportunity identification, first it must be understood what an opportunity is for a project. There are several interpretations of opportunity in different literatures. Hillson (2004) suggests opportunities are positive risks and can be managed with the same approach as risk management with some modifications. While others argue that opportunity is a positive side of uncertainty (Galbraith, 1977; Lechler et al., 2012; Johansen, 2015). Exploiting opportunities in projects could enhance project objectives and relationship with stakeholders (Hillson, 2004; Eskerod et. al., 2018). For its organizational sustainability, contractor company should proactively look for opportunities (Setiawan et. al., 2015). Opportunity exploitation is also believed to increase project value which is stipulated as expected benefits minus expected costs due to the project (Eskerod et. al.,2018). This means project value could be increased if we increase the expected benefit out of it. Some say project value is related to costs and benefits (Ahola et al., 2008) while others argue that

value in infrastructure projects is more than cost and benefits and involves different dimensions because of their public nature (Koppenjan et al., 2008). Thus, identifying and exploiting opportunities in the project is also dependent on what type of benefits it would bring to each actor in the project (Johansen, 2015). For this research, the benefits are seen from the contractor's perspective and thus, the identified opportunities and project value would also be from the contractor's viewpoint.

Although we have discussed the benefits of identifying and exploiting opportunities in the projects, much of the attention is still towards managing threats (Olsson, 2007). There is a lack of focus towards exploring opportunities in the projects and because of that many companies still lack the knowledge on proper implementation of opportunity exploitation in practice (Olsson,2007; Rutten et al., 2009; Lechler et al., 2012; Lehtiranta, 2014). In their research, A. Johansen, Langlo; Johansen (2013; 2015) did case studies with six different organizations for several projects where 76% of the interviewee responded that the focus is mainly on risks (threats) and less on opportunities, 15% said they have equal focus on both sides, while 7% responded that they focus towards threats only. This gives a clear indication that projects could take a lot of benefit through opportunity exploitation but for that, it needs more attention from both researcher's as well as practitioner's side. Johansen (2015) also argues that there has been a trend of exploring opportunities in the initial phases of the projects, while there is a lack of attention to follow up the opportunities towards the execution phase which leads to opportunity loss during the process.

Thus, it is evident that there is a need to study opportunity identification and exploitation from a contractor's perspective while executing large infrastructure projects and improve the current approach towards opportunities for enhancing project value.

1.3 Research Objective

The research objective is seen as a part of the thesis which helps in recognizing and exploring parts of the project which is attainable and acceptable to the client, to the research supervisor, and to the researcher himself/herself (Verschuren et. al, 2010). Research objective helps in fixing the scope of research, as a single research is not enough to extensively give a conclusion on the chosen project context (Verschuren et. al, 2010).

As we have found out from section 1.1 and 1.2, current working methods and knowledge of dealing with opportunities in infrastructure projects are not fully efficient and lack a solid knowledge and framework to create, identify and exploit opportunities. This has led to a lot of missed opportunities during project execution (Johansen, 2015). The objective of this research is to develop a roadmap which would allow to create and identify opportunities during the tender phase of the project to exploit it in both tender and execution phase of the project. These identified opportunities can then be exploited by the project developer adding extra value to the project. A clear understanding of opportunities within a project and a proper guideline for creating and identifying them would act as an additional tool for the project team which would contribute towards exploring more benefits within a project and will eventually improve the efficiency of these projects.

1.4 Research Question

While modeling the content of the research, conceptual design of the research project must be formulated first (Verschuren et. al, 2010) where research objective and goal are formulated along with a research question. This section consists of the main research question and it will act as the main guideline throughout the thesis and is termed as the most critical part for a successful research project (Verschuren et. al, 2010). After closely looking at the capability of fulfilling the requirements of this study, the research question is formulated as:

"*How can opportunities in large infrastructure project under Design & Construct contract be identified during the tender phase for enhancing project value for the contractor after contract award?*"

This research question will be answered with the contribution of four sub-questions presented below.

e) What is an opportunity and project value for a large infrastructure project under Design & Construct contracts?
f) What are the important factors which could stimulate creating and identifying project opportunities?
g) What could be a procedure for identifying opportunities by a contractor during the tender phase of large infrastructure projects?
h) How can it be known that the identified opportunity creates value to the project?

These sub-questions are closely related to answer the main research question and the motivation for formulating them as sub-question is presented below.

Sub-Questions	Motivation
a	To suggest an approach for identifying opportunities within projects, first the concept of opportunity must be clarified as what opportunity really means in a project. After understanding the term opportunity and project value then only the project team could approach further for opportunity identification.
b	Knowing the important contributing factors for opportunity identification would help in understanding what influences opportunity creation and identification positively and what should be done for increasing the chances of opportunity identification within a project.
c	A procedure to identify opportunities in infrastructure projects during the tender phase would act as a tool for the project team and suggests on required activities to carry out for identifying project opportunities.
d	Knowing that the identified opportunities would indeed create value within the project would act as a proof and will encourage the project team for exploiting those opportunities and spending time and resources over them.

1.5 Research Relevance

This research contributes toward existing knowledge on project opportunities and its stimulating factors through the accumulation of literature's view and construction practitioners' (project manager, risk manager, finance manager, design manager, consultant, client and so on) perception, making a proper link with project value. A roadmap is designed based on theoretical and practical study which could improve current approach on opportunity identification in practice. For the roadmap, further investigation is done through case studies of relevant projects as a reference where the opportunity management process, the constraints for opportunity identification and recommended solution to overcome such constraints are discussed. The recommended roadmap for opportunity management based on project value perception would also help in identifying opportunities from project uncertainties and thus will act as a tool for future infrastructure projects during tendering/project development. This would also be an addition to the literature and practice as it collects the lacking information to strengthen the current approach for investigating opportunities in such large projects through focus areas and improved working method.

1.6 Thesis outline

Here, a brief introduction and overview of each chapter used in this report are presented as the thesis outline.

Chapter 1: Introduction

This chapter introduces the research context which explains the need for this study. Research question(s) and objective are also presented that act as a guideline for the development of this thesis.

Chapter 2: Research approach

After understanding the problem and problem domain, this chapter discusses the research strategy and method that are used in this study. Here, the method used for data gathering is also presented.

Chapter 3: Literature Review

This chapter consists of an extensive literature review of relevant past studies used for the collection of theoretical data regarding opportunity in infrastructure project and its management. Based on the literature, concepts, factors, and methods that would help in opportunity creation and identification are discussed. The data collected in this chapter acts as a primary source for further analysis.

Chapter 4: Interviews

This chapter consists of the result collected from two rounds of interviews i.e., initial interviews and detail interviews along with the result that were obtained from the questionnaire survey based on the information gained till the detail interview.

Chapter 5: Case Study

In this chapter, two cases were investigated as a reference for finding case-specific constraints towards identifying opportunities in large infrastructure projects. Possible solution regarding the identified constraints is also discussed here.

Chapter 6: Roadmap for Opportunity Identification

This chapter consists of a roadmap proposed for opportunity creation and identification based on information collected in previous steps. A procedure is also suggested that could be followed while conducting opportunity workshop for exploring opportunities. An assessment approach for identifying value-creating opportunities is also proposed in this chapter. The proposed roadmap is validated by the experts from the company for its usability.

Chapter 7: Conclusion, Limitation, and Recommendation

To conclude this study, research question and sub-questions are answered in this chapter. Discussion on limitations of this research is done here and recommendation to improve the research as further study, as well as final recommendation for the company to improve the opportunity identification process is also presented in this chapter.

2. Research approach

A clear knowledge of the research method gives a working framework for the thesis. Thus, after understanding the problem domain, research strategy and methods that are used in this thesis are discussed in this chapter. The chosen strategy is explained of their relevance regarding this study.

2.1 Research Method

To fulfill the research objective and answer the research question, an approach is needed to develop a strategy to reach the conclusion (Verschuren et. al, 2010). This section consists of the methodology to be followed for this research.

EXPLORATORY STUDY

a) Literature Study

The first step of this research is focused on scanning an overview of the concept opportunity and related terms within projects and the value it carries for the project, understanding the idea behind it to make a good base for further steps. This step is needed to understand the relevant concepts, forming a theoretical framework to work further with the empirical data collection. To gain this concept overview and able to compare the existing knowledge on this topic (Verschuren et. al, 2010), literature study as a qualitative research approach is done. The purpose of a literature study is to find out what has been already researched regarding the topic and identify any pattern in previously published literature (Johansen, 2015). The literature review is also focused on identifying important factors for opportunity identification, the process used for opportunity identification in a project, and various approaches that can help in creating more opportunities with additional value in infrastructure projects. The discussion and findings from the current literature can be found in chapter 3.

EMPIRICAL STUDY

b) Initial Interview

As a first step in the practical study, experts are interviewed within HOCHTIEF to understand the current procedure of risk management at the company. Current activities and approach of the company towards opportunity management are also investigated with the help of two interviews. Space and importance given to the opportunity side during tender and execution phase of large infrastructure projects are reviewed. The findings from the initial interview can be found in section 4.2.

c) Detailed Interview

Following the above steps, detailed interviews are done for collecting practitioners' perception from contractor, client and consultancy companies regarding project opportunities and how they see or define opportunity in a project from a contractor's perspective. Collecting information from a contractor's perspective with the client and consulting companies would give extra information which the contractors might not have thought of or usually overlooks during tender preparation. The interview sessions are also focused on investigating the views and experiences of the interviewees with opportunity identification in their past projects. Also, suggestions are collected on what can be done to improve the current approach of opportunity management in large infrastructure projects. During these interviews, the perception regarding perceived project value and factors which stimulates in creation and identification of opportunities in infrastructure projects are also collected.

A list of factors that would stimulate in creating opportunities within a project are prepared with the help of literature and is further extended based on the outcome of detailed interviews. Knowing the

factors influencing creation and identification of opportunities is important because it provides the base for starting the process of opportunity management and helping in reducing the effect of constraints regarding opportunity exploration.

Now, as a second approach, collection of the importance level of these factors and project value drivers are done from company experts through a questionnaire survey. The respondents scored each factor in the list within a scale of 1 to 5 which provides a final list from most to least influential factor for opportunity creation and identification in large infrastructure project from a contractor's perspective. Also, project value drivers are scored by the interviewees from a contractor's perspective. Prioritizing value drivers based on the importance level in each project would allow the project team to decide on exploiting opportunities towards more important areas. This would also help the team to assess an opportunity by comparing the benefits in terms of value drivers, to check the value enhancement of the project. The findings from the detail interviews can be seen in section 4.3.

d) Case Study

To know the process of opportunity management and importance given regarding opportunity exploration in actual projects, case studies are done as a reference to observe relevant pattern that occurs in such projects. Apart from this, the constraints experienced in each case along with the recommended solution for improving the current approach is presented in this section. The investigation also shows what kind of opportunities are generally identified in these projects. The first case is also used as a reference to compare with the opportunity identification process suggested in the literature. The findings from case study are presented in chapter 5.

e) Roadmap Preparation

The focus of this research is towards Design & Construct contract where the opportunities, project value, and stimulating factors are investigated for the tender phase and execution phase i.e., design and construction phase only. The reason for focusing on D&C contract is:

1) To limit the scope of work for investigating opportunities occurring only until the design and construction phase of the project, while excluding the operation and maintenance phase.

2) Integrated contracts like DBM, DBFM, DBFM(O) are becoming more complex and difficult to execute effectively. So, more projects are coming in the form of D&C contracts to ease the execution and increase the success rate of projects (Deketh et. al., 2018).

After identifying the top contributing factors which suggest crucial elements to incorporate in opportunity creation and identification, a roadmap is developed which acts as a guideline for recommending required procedure and activities for creating, identifying and exploiting opportunity with regard to large infrastructure projects. The developed roadmap also consists of a procedure to identify opportunity during tender phase through an opportunity workshop and is suggested based on existing literature and practitioners' view regarding opportunity exploration. This roadmap would be helpful to compare the value gained by an opportunity and the resources needed to exploit that opportunity.

Thus, the roadmap is a combination of crucial factors that should be checked and incorporated initially, along with a procedure for opportunity workshop where various activities are recommended that need to be followed for opportunity identification, along with an assessment framework to check if the identified opportunities are indeed creating some value to the project. The proposed roadmap can be found in chapter 6.

f) Validation

A validation session is done for the proposed roadmap along with experts from HOCHTIEF having good knowledge of the subject and suggestions are applied to the proposed roadmap for improving its effectiveness and usability. The validation session is done in two steps as opportunity workshop followed by a feedback session. The explanation on validation session is presented in Appendix J. Finally, conclusions, limitations, and recommendations are presented as a result of this study in chapter 7.

The research method could be seen from the research framework presented in figure 2 with additional information on chapters indicating information for four sub-questions formulated in section 1.4. The research approach can also be seen in figure 3 as a process outcome model for each step.

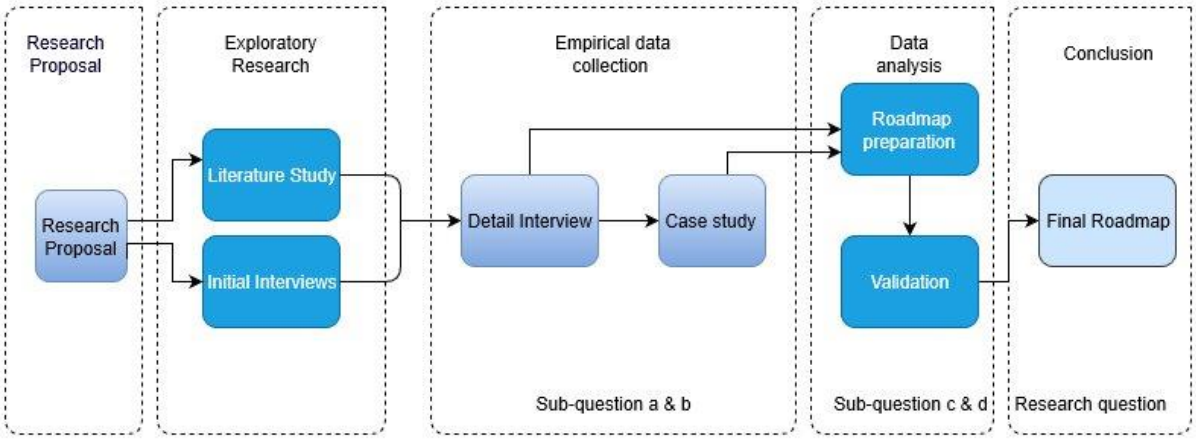


Figure 2: Research Framework

2.2 Data Gathering and Analysis

This section explains about the data gathering methods and analyzing techniques that are used in this study. The primary source of data for this research is the existing literature on opportunity management. These literatures are in the form of published books, research articles, executed thesis report, and lecture slides. Apart from using literature, interviews are conducted with the construction practitioners like project manager, risk manager, design manager, financial manager, consultant, client, and stakeholder manager from construction company and consultancy who have knowledge regarding large infrastructure project. The reason for using practitioners as one of the main sources for data collection is that a wide variety of data can be collected in very less amount of time (Verschuren et. al, 2010) which makes it easy and more accurate to analyze opportunity identification from various perspectives. The techniques used for questioning and data gathering through interviews are all face to face interviews except one, where phone interview is performed due to the unavailability of the interviewee. All the interviews are recorded and transcribed for accurate and complete information.

For preparing the final list of factors stimulating opportunity creation and identification, a questionnaire survey is used where respondents, who are experts from relevant field scored each factor as per their importance level. The questionnaire survey is done online, and the reason is that the data gathering method is easy to collect results and is remotely accessible. Besides, some respondents who were interviewed during the initial and detailed interviews might not have the time to meet again in person and scale the factors. In this method, practitioners are given the choice of scoring different factors from most to least important and influential regarding opportunity creation and identification in a D&C contracted project from a contractor's perspective. This gives a nice

collection of shared views from different practitioners. Apart from factors, the project value drivers are also assessed for their importance level by dividing 100 points among 9 value drivers for large infrastructure D&C project and from the contractor's perspective. For validation of the result, opinion from 6 experts who have good knowledge and experience of working on large infrastructure projects, are used. These experts are 2- Senior Project Engineer, 1- Contract Manager, 1- Stakeholder Manager, 1- MEAT "EMVI" Coordinator, and 1- Project Engineer. These experts are selected based on their experience in large infrastructure projects executed under Design and Construct contracts.

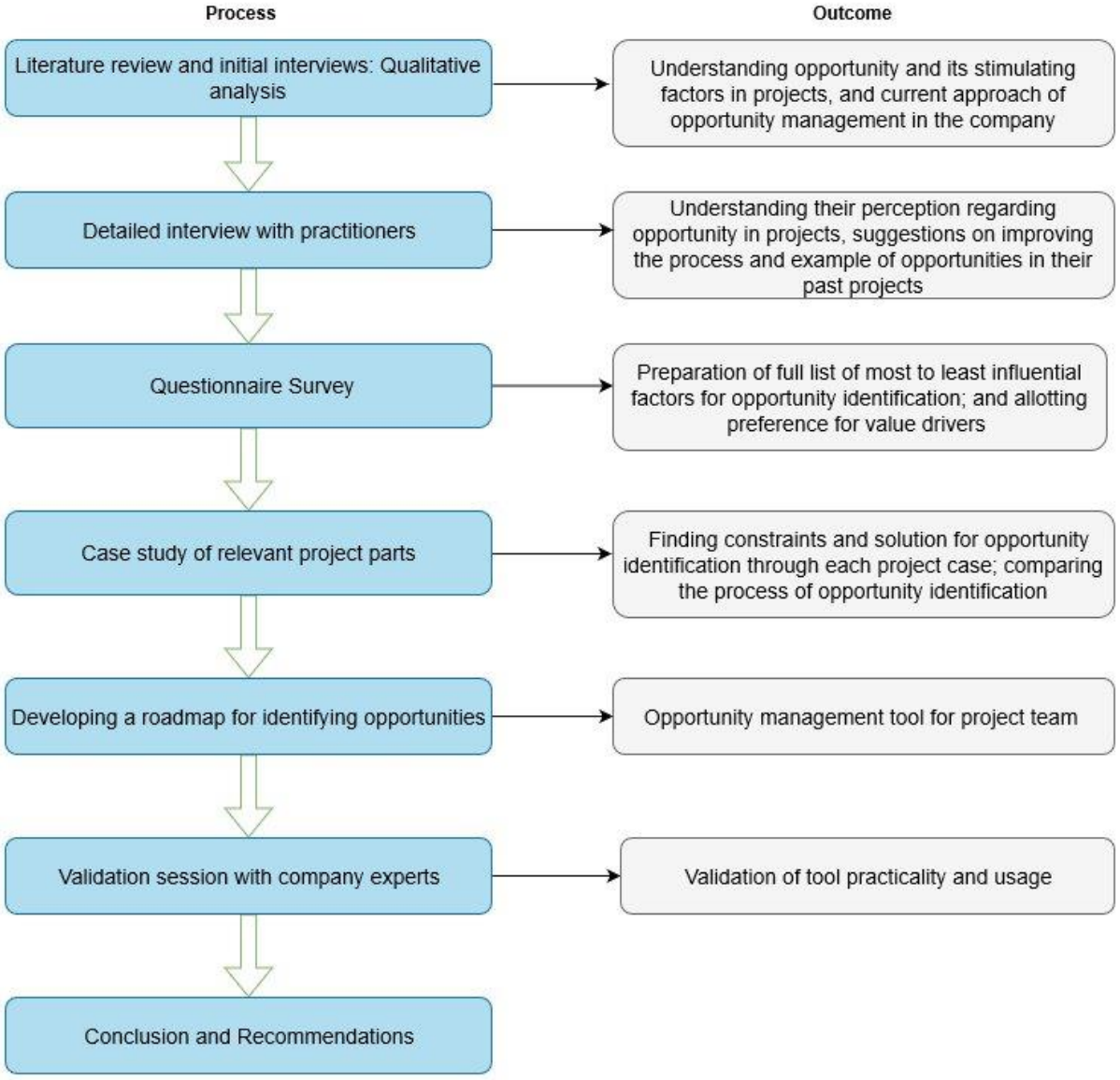


Figure 3: Research method flowchart

To summarize, data gathering for this research is done through the following steps.

1) Literature Review
2) Initial Interview
3) Detail Interview
4) Questionnaire survey
5) Case study Interview
6) Validation session

Part 1: EXPLORATORY RESEARCH

3. Literature Review

This chapter provides a theoretical basis on project opportunities and various concepts related to it. The main source of information for this chapter is the current literature that is available in the field of project opportunity and its management. A stepwise explanation of various concepts related to this research, factors influencing the creation and identification of opportunities, and approaches available for creating opportunity in projects are presented here. Information regarding the four sub-questions formulated in section 1.4 is also presented in this section and is tried to answer from literature findings. The information gap that is needed to answer these sub-questions completely is investigated further during the empirical study of this research.

3.1 Introduction to Concepts

As per the research question formulated in section 1.4, several concepts are needed to be explained first to set the context of this research. Since this study is focused on finding opportunities in large infrastructure projects under Design & Construct Contract and during the tender phase, these concepts are explained here.

3.1.1 Contextual Concepts

Here, concepts like infrastructure project, large project, Design & Construct contracts, and tender phase of a project is explained briefly along with their relation in opportunity identification.

a) Infrastructure Project

This research deals with identifying opportunities in large infrastructure projects, so it is important to understand the concept of infrastructure first. As Masrom et. al. (2015) describes, large infrastructure comprises basic physical system of a business or nation and consists of transportation, sewage, water, electric, communication systems and so on. These systems are generally high in cost for investment but are vital for country's economic growth and prosperity (Grimsey & Lewis, 2002; Masrom et. al., 2015).

Infrastructure projects have various phases between their starting and finishing points. As an infrastructural system, their lifecycle can be seen as 1) definition phase 2) procurement phase 3) development phase 4) operation & support phase, and 5) disposal phase (Wasson, 2006). This study mainly focuses on procurement and development phase of the infrastructure as this is where a contract is awarded, and the project is executed by the contractor.

Large infrastructure projects generally span for a long period of time for its execution thus susceptible for high degree of uncertainty due to changing client's need and expectation from the project (Johansen et. al., 2018). Thus, there is a need for a flexible and adaptive approach from the project team in order to allow changes onto the initial planning and exploiting possible opportunities on the way.

b) Large projects

The term large is relative based on organization to organization. A project of 2 million euros could be considered large for a small company but the same project would not fall in the category of large for a giant organization. Hillson and Simon (2012) have given several features that a large project typically exhibits.

a) *Strategic importance*: The project is critical for ensuring successful business of the organization.
b) *Technical and contractual complexity*: High technical challenges with unresolved contractual issues.
c) *Requirement stability*: Requirements are generally not finalized and are subject to negotiation with the client.
d) *Project cost and duration*: Large project cost and time period compared to other projects in the organization.
e) *Project resources*: Generally, an international project team or joint venture is needed to execute the project.

Thus, large projects are crucial to an organization and need a robust approach to tackle the challenges along the way while exploring possible benefits to ease the process.

c) Design and Construct Contracts

Design and Construct Contracts, which is a common term used in the Netherlands, is also known as Design and Build Contracts where the contractor both designs and provides the works for its client (Ridder et. al., 2009; Aandahl et.al., 2017). In this type of contracts, the employer's i.e., the owner's main concern is towards the definition of the requirements in the project whereas the actual design and construction is done by the contractor (Ridder et. al., 2009) unlike more traditional contracts where completion of design is needed prior to procurement process (Aandahl et. al., 2017). This early definition by owner consist of performance specification where desired quality and result from the project is described. Ridder et. al. (2009) provides a process diagram which can be seen in figure 4 further clarifying the procedure followed in Design & Construct contracts.

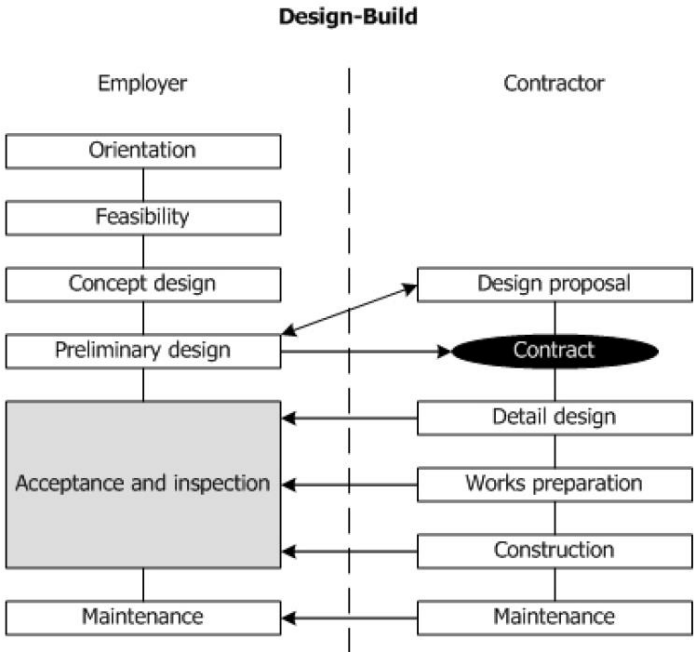


Figure 4: Process of a Design Build procurement procedure (Source: Ridder et. al., 2009)

In this contract type, contractor can also develop the design and technical solutions simultaneously during an ongoing execution which gives them the freedom in choice of materials, execution and technical solutions, as long as it is in accordance to requirements stated in the contract (Gordon, 1994). This freedom also allows certain amount of risks (threats) to the contractor because if something goes wrong with the design, then the contractor bears responsibility and additional cost for modification during construction (Aandahl et. al., 2017).

Opportunities as positive risks within a project can be mostly identified during its planning phase but keeps on decreasing towards project execution phase (Samset, 2003; Rolstadås et al., 2011). It may be true considering the choices taken during the project but, on the other hand in this dynamic, evolving world new opportunities could evolve even in later phases of the project (Johansen, 2015).

In his research, Johansen (2015) argues that opportunities do not linearly decrease during the later phases of the project, rather it could have frequent highs and lows as per the decisions and tactical choices taken throughout the project. A direction towards this argument can also be seen in Miller & Lessard (2001) as well as Krane, et al.'s, (2010) works. There has been a trend of assessing opportunities only in the initial phase of the project, but later phases don't get equal attention because of which a project could not exploit later opportunities. Johansen (2015) referred these as lost opportunities or the "blind spot of uncertainty".

d) Tender Phase

To understand the features and activities during tender phase first the concept of tendering should be clear. As defined by Brackmann et al. (2011), tendering is an act of asking several parties for offer to execute certain task and objectively assess the offers to choose the best contractor for that task. Tender phase is where the client plans the whole procurement process before handing the job to a party for execution. In this phase, the client recognizes a project that needs to be executed, seeks parties who can help, sets requirements for selection, evaluates their proposal and reaches an agreement with a chosen party i.e., the contractor (Nicolas & Steyn, 2012). Volpe & Volpe (1991) found two main challenges to be successful in contractor's business: to win the bid and get the project, and to deliver the project successfully.

In order to work towards winning the bid, first a contractor should apply for the tender, and have to fulfill various criteria set by the client. These criteria include: grounds for exclusion, minimum requirements, suitability requirements, selection criteria, and award criteria (Chao-Duivis et al., 2013). A pictorial representation of a restricted tender procedure can be seen in figure 5.

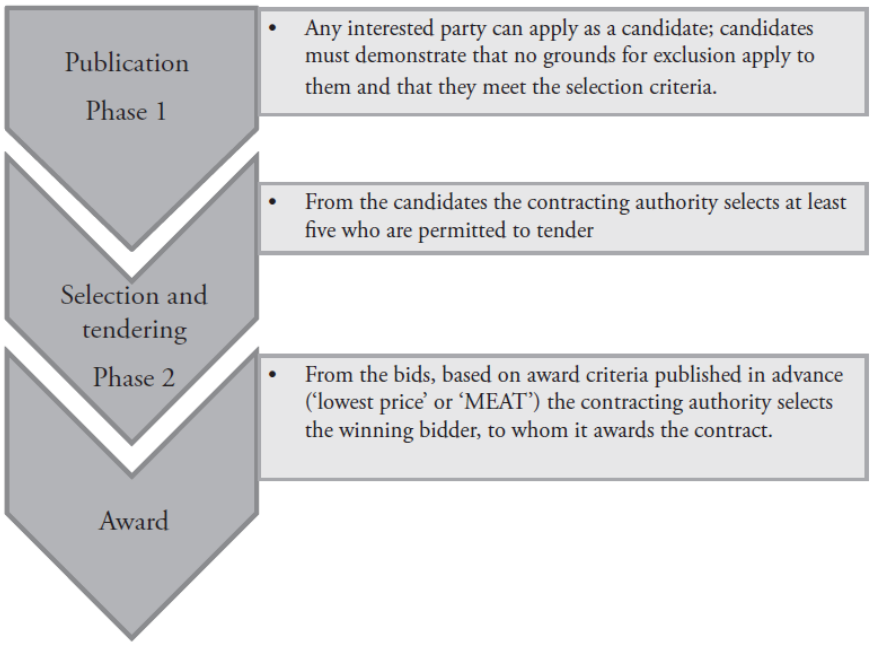


Figure 5: Restricted tender procedure (Chao-Duivis et al., 2013)

Olsson (2007) claims that most of the project opportunities are generally identified in bid/tender phase of the project which also makes this phase very crucial in exploring opportunities that could be interesting for both contractor and client (employer). Hietajärvi et. al. (2017) also supports that activities for idea generation should be done especially during the tender phase of the project. Hillson (2004) claims missing an opportunity which can give tangible benefits to the project is as bad as allowing an avoidable threat to mature into a problem. Thus, the tender phase is a crucial time to identify maximum opportunities in a project and for that, various tools and techniques must be used as per size of the project (Hillson & Simon, 2012).

Concepts related to opportunity

Exploring opportunities in the project is not a direct task and needs a clear concept of several terms related to it. Here, a stepwise explanation of each term will be presented along with the relation it has with project opportunities. For understanding project opportunity, two more key terms need to be understood: uncertainty and project value.

3.1.2 Project Uncertainty

Risk management was introduced as a concept to manage project and the uncertainties involved in it (Lehtiranta, 2014) where risks originate from uncertainties in a project. Risk is defined as effect of uncertainty on objective (International Organization for Standardization, 2009) and consist of both opportunity (risk with positive outcome) and threat (risk with negative outcome), while in practice risk management is more focused towards identifying and managing threats while failing to consider the management of opportunities (Ward & Chapman 2003; Lehtiranta, 2014).

Classic project management offers tools and techniques to manage risks but unlike risks, uncertainties cannot be managed in a similar manner because they are unknown until they occur making long-term initial planning inadequate for identifying them (Lechler et. al., 2013). Johansen (2015) also supports that risk management and uncertainty management deal with different things, where uncertainty is the source of opportunity and threat in a project. Risk management process assumes that the events can be known, and the probabilities could be quantified before the project implementation whereas it is conceptually not possible to treat uncertainty in the same way since they are just not known at the beginning of the project (Lechler et. al., 2012).

There are several interpretations of uncertainty by various researchers which are mentioned below.

- Uncertainty is defined as the difference between the amount of information required to perform the task and the amount of information already possessed by the organization (Galbraith, 1977). In his case study, Olsson (2007) found that project managers consider uncertainties as a lack of overall, holistic view of the events, affecting the project and its efficiency in organizational execution and effectiveness and towards the customer, causing the project suffered by this lack.
- Hillson (2004) states that risk has two dimensions namely uncertainty (described as probability) and the effect on objectives (described as impact) which is also supported by Rolstadås, et al. (2011). Hillson (2004) has also mentioned that when it is measurable, uncertainty is considered as risk. Thus, risk involves situation when the probability of outcome is known whereas uncertainty is the situation when the probability of outcome is not known (Olsson, 2007; Gu & Gudmestad, 2011). Project Management Institute (2013) defines risk as, “an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more of the project’s objectives, such as scope, schedule, cost or quality”.
- Uncertainty is a two-sided coin where activities could go better than planned or it could go worse (Lichtenberg, 1974). Uncertainty with positive impact is termed as opportunity while

uncertainty leading to negative impact is termed as threat for a project (Chapman & Ward, 1996; Loch, De Meyer, & Pich, 2006; Perminova, Gustafsson, & Wikström, 2008; Johansen, 2015). Johansen et al. (2012) defines uncertainty as controllable and non-controllable factors that may occur, and variation and foreseeable events that occur during a project execution and that have a significant impact on the project objective.

Initially, Rolstadås et al. (2011) proposed a structure for categorizing factors into controllable and non-controllable factors which was further elaborated by Johansen (2015) and can be seen in figure 6.

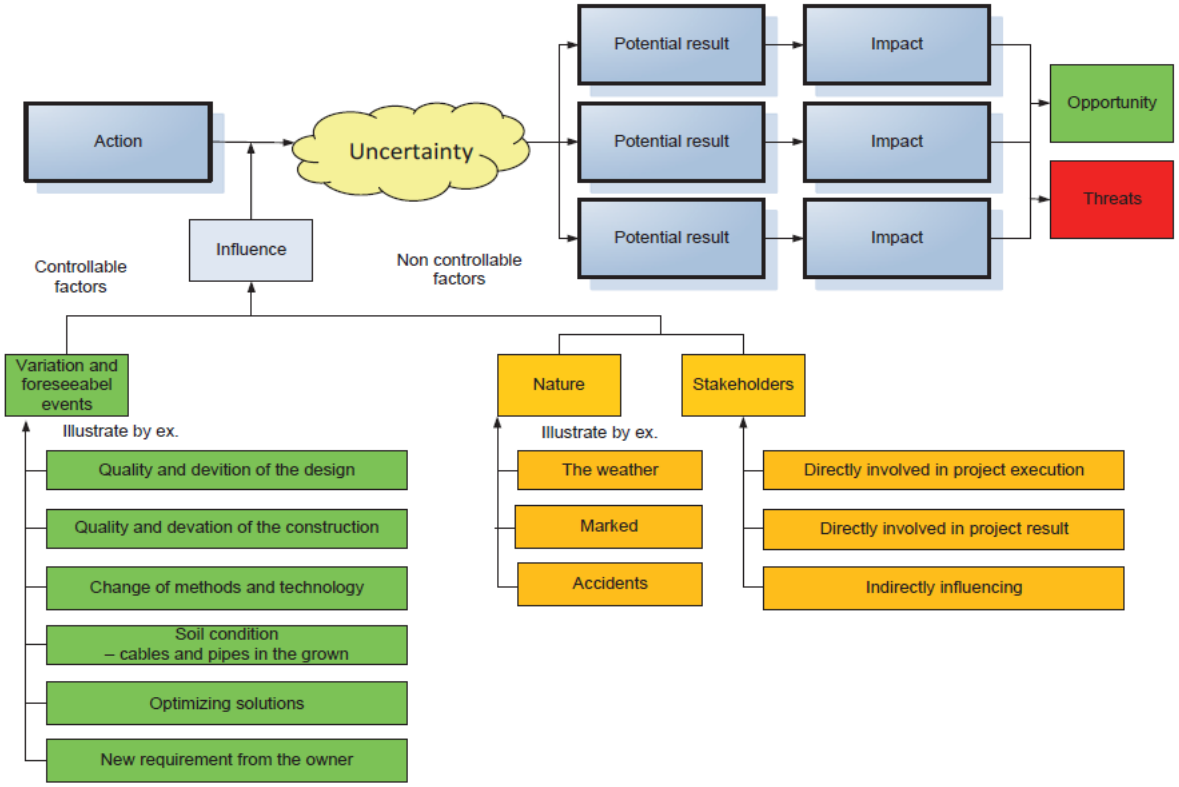


Figure 6:Uncertainty- Opportunity and Threats (Source: Johansen, 2015)

Leijten (2017) has suggested the basic difference between risk and uncertainty are in the level of predictability and monitorability. Risks can be reasonably estimated for its probability and impact, so the risk event consequence can be known but, for uncertainty one cannot do the same for at least one of the two dimensions. He has proposed six different types of uncertainties which can be seen in figure 7. Incognition-driven uncertainty consists of four categories and is occurred due to variance and knowledge of manager whereas interaction driven uncertainty is due to behavioral aspects like relation between information owner and decision maker in a project.

For this study, two of the above six uncertainties categories will be taken as a source of opportunity as it is proposed by Lechler et. al (2012) that opportunity could be discovered or created from uncertainties in a project setting. From the study of Leijten (2017), it was found that these two categories of uncertainties are mostly present in projects.

a) Variability also known as instability uncertainty is the result of natural instability in work of project managers where each time a project is done within similar circumstances, things go differently. This kind of uncertainty could be random or any unplanned deviation. It includes variation in prices, interest rates, exchange rates, inflation, weather, and so on. This type of uncertainty is also termed as aleatory uncertainty which cannot be foreseen in advance

(Frank, 1997; Ward & Chapman, 2003). Here, risk event, its cause and effect can be known but the probability or impact of occurrence is not known due to inability of quantification (Leijten, 2017). Variability, for instance, could bring opportunity in the project like sudden drop of prices of construction material creating the opportunity to buy them cheaper than expected.

	Incognition-driven uncertainty		Interaction-driven uncertainty
	Ever-present uncertainty	Potential uncertainty	
Knowable to manager	**Instability uncertainty** (aleatory uncertainty, i.e. stochastic uncertainty and parametric variability)	**Incompleteness uncertainty** (epistemic uncertainty as a result of incomplete information)	**Interpretation uncertainty** (sponsor-instigated deviations in assessments and decision-making)
Unknowable to manager	**Inscrutability uncertainty** (tacit knowledge)	**Inconceivability uncertainty** (black swan events)	**Intention uncertainty** (strategic behaviour)

Recap
There are six types of uncertainty in the management of complex projects, to be distinguished on the basis of

- **whether uncertainty is incognition-driven or interaction-driven**
- **within the incognition-driven uncertainties, whether it is ever-present or potentially present**
- **applying to all uncertainties, whether it is mostly knowable to the manager or not**

Figure 7: Six different types of uncertainties (Source: Leijten, 2017)

b) Discrete risk events also known as incompleteness uncertainty which results from incomplete information. It consists of deviations that, in principle could be known but are not known due to impracticality like; too expensive, too time-consuming to collect relevant data. For this reason, managers take a calculated risk for this type of situations (Leijten, 2017). This type of uncertainty is also termed as epistemic uncertainty which derives from lack of knowledge (Frank, 1999). For example, in Randstad rail project, during preparation phase, the project scope changed frequently, resulting in terms of reference (TOR) documents not being up to date which resulted in incompleteness uncertainty due to lack of knowledge (Leijten, 2017). While in other cases, an incomplete contract document (flexible specification) from the client could create opportunities for a contractor for improvements and finding better solutions which could be beneficial to both parties or to the contractor alone.

In his study, Johansen (2015) suggests five characters of project uncertainties.

1. Projects are fundamentally uncertain where zero contextual and operational uncertainty is impossible if a project is truly unique and consists of different stakeholders.
2. Project's operational uncertainty declines during later phases of the project because of accumulated information and learning but, this does not mean that the contextual uncertainty will follow the same pattern.
3. Zero uncertainty in a project means that the project has exploited all opportunities at the beginning and being better than planned is not an option.

4. Avoiding uncertainty comes at a cost because although it makes cost overrun less likely if the project succeeds on handling threats well, but it could also mean that increased benefit from the project would be less since opportunities will not be explored.
5. From a project's perspective, uncertainty should be as low as possible thus avoiding variations and changes of plan but, from an owner's perspective uncertainty to some extent is desirable as it gives the owner more flexibility and opportunities.

Ward & Chapman (2003) has suggested that for managing uncertainties in projects, the focus should not be only on managing threats, opportunities, and their implications, but should also identify and manage the sources of uncertainties that give rise to and shape the perception of threats and opportunities in any project. Kolltveit et. al. (2004) divided uncertainty sources as internal and external to a project. Internal uncertainty is lack of information related to project's internal factors like: project's technical concept, project's goal, and available competence and organization, that may affect the project's performance. External uncertainty is defined as shortage of information related to external factors such as: political situation, contract, local infrastructure, the nature, cultural situation and currency stability. All these factors could become potential source for both opportunity or threat in a project.

Kolltveit et. al. (2004) explained it through an example as, a Norwegian company who is supposed to build a ship has a robust design department but has less capacity towards construction of ship. Here, they could outsource the construction part to a low costing eastern Europe shipyard manufacturer which is well known to them. Although this case would have high external uncertainty, this created them additional savings in terms of cost while controlling the threat involved because of their good relationship with the eastern Europe shipping company.

To summarize, uncertainty is an unknown situation or event which may occur due to influenceable and non-influenceable factors during the project which could or could not be foreseeable at the start due to lack of knowledge and would cause both positive or negative effect to the project making a significant impact on project's objective. Uncertainty has various types and is the source for both threats and opportunities occurring in the project. To exploit opportunities in a project, team members should look towards the benefits that an uncertain event or situation could bring to the project. Thus, the focus should be to identify potential sources of uncertainty in large infrastructure projects so both threats and opportunities could be better identified and managed properly.

3.1.3 Project Opportunity

As per current practices, opportunity identification and exploitation are not seen as an activity related to project management which leads to missing the potential benefits to the project which could have been achieved if the project representatives would have focused on it (Eskerod et. al.,2018). To understand an opportunity in projects, few studies have been already done. Different researchers have different perception of what project opportunity is and some of their perceptions are summarized below.

- As discussed by Hillson (2004) in his book, opportunity is risk with positive effects and threat is risk with negative effects. Here, risk is defined as any uncertainty that if it occurs, would affect one or more objectives. Thus, opportunity is an uncertain event or set of conditions, that if it occurs, would benefit the project or business (Hillson, 2004). Opportunities in projects could create the chance to enhance project objectives, deliver early, cost less, increase customer satisfaction, improve competitiveness, enhance company reputation and so on.

- In his research, Johansen (2015) suggests that sometimes a project in itself could act as an opportunity whereas mostly opportunities are factors, variations, and events that may lead to higher benefits for the project or for the project owner than originally planned. For a project, opportunity in terms of cost could be delivering more with same cost or delivering the required quality with low cost. Also, it can be argued the same for time and quality (Johansen, 2015).
- In his later research, Johansen et.al., (2016) states "factors, variation, and events that cause changes that could make the project deliver higher functionality or lead to higher positive net present value (NPV) after the project has been delivered should be considered as opportunities for the project". Opportunities could also be solutions that were not seen at the beginning, something that just occurred, something positive that we could not foresee, or something that is more or less out of control but still favorable for the project (Johansen et. al., 2015).
- Lechler et. al. (2012;2013) defines project opportunities as an unconventional solution to a specific project situation that was not known or foreseeable at the planning stage which carries the potential of creating extra value to the project. They also point out two types of project value opportunities (PVO):
    1. achievement of stakeholder benefits that nobody has thought of or mentioned at project initiation
    2. fulfilling the intended stakeholder benefits to a larger extent than expected.
- Project opportunities can be seen as situations where additional value can be created during the project execution and operational phase than the originally stipulated baseline value when the project was approved. Project opportunities can generate positive consequences if they are identified and exploited like: application of new technology that was not known during project approval time (Eskerod et. al., 2018).

In his study, Johansen, (2015) has also proposed four characteristics of opportunities in projects.

1. Project has a high degree of focus on opportunities till the objectives are fixed and later the focus shifts towards threats.
2. Project opportunity should give benefit to at least one of the stakeholders which is worth more than the investment needed for that opportunity to occur.
3. Opportunities identified in the later stages will not give any benefits if there is no acceptance of change in the project plan.
4. Opportunity for the owner is generally connected to future benefits by the project whereas, the project team seeks some benefit in planning and execution phase of the project.

According to Lechler et. al. (2012), opportunities have different characteristics, but all represents potential for a significant increase in value to a project. They have summarized project opportunities into four categories based on a case study of 20 different projects.

1. *Technical innovation*: Developing of technological innovation or alternate technology in the project.
2. *Opportunities in implementation process:* Opportunities like improvement of processes at different management level, outsourcing of simpler low-cost jobs, and developing a common build process that will save time and money.
3. *Business opportunity:* Opportunities such as early market penetration or new market solution, creating multiple beneficiaries from the project, and identifying new opportunity than the planned solution.

4. *Future project business opportunity:* Opportunities generating value beyond the project such as new contracts creating higher value with acquired knowledge from previous projects, if properly managed. The knowledge of a solution gained in one department can also be applied in some different area of the company.

In his paper, Olsson (2007) has also categorized that opportunities could occur from three kinds of uncertainties: tame, messes and wicked problem. Tame problem could be identified in bid/sales phase using risk management process because it consists of structural complexity (associated with mechanical problems like broken parts of machinery) which could be managed by analytical and algorithmic reasoning. But when it involves interaction with customer or external stakeholders, it goes into the category of messes problem with dynamic and behavioral complexity which needs enhanced communication with the stakeholders and holistic view of both organizational and client expectations. A holistic view on project objectives is also important along with secondary effects on the objectives after realizing the opportunity. Wicked problem category cannot be solved fully as it involves behavioral complexity since it requires an understanding of customer's view on project result and needs interaction with them for finding a solution which could be out of the scope of the project. It is also mentioned that opportunities are mostly developed from messes and wicked problem type of uncertainties and thus it is difficult to design a step approach to identify and realize opportunities (Olsson, 2007).

In his case studies carried out with six companies of Norway, Johansen et.al. (2016) found that the main reason for harvesting fewer opportunities compared to threats is because of less focus given towards exploring opportunities. At the start of a project, the process of managing uncertainty starts with a focus on both threats and opportunities but, along the way while handling and managing them, threats generally dominate opportunities, and this pattern was found similar in all six companies' risk register. This does not mean that such opportunities do not exist, but it means that many projects miss such opportunities because of lack of focus and attention while managing risks and uncertainty in the project (Johansen et.al., 2016).

Researchers have argued that one of the most significant barriers for opportunity management in a project is due to unfavorable organizational culture (Hietajärvi et. al., 2017). Work practices and culture supporting open discussion helps in sharing ideas thus, uncertainties can be managed, and new opportunities can be exploited. Asking fundamental questions like: why do we do that we do and why do we do it the way we do, can lead to identify and utilize new opportunities (Johansen, 2015). Johansen (2015) claims that identifying and exploiting opportunities requires understanding what kind of benefits the opportunity will bring to each actor in a project. It could be in the form of schedule, budget, quality, stakeholder and shareholder satisfaction as so on (Lechler et. al., 2012).

Johansen et. al. (2014) has listed some examples of opportunities that could usually occur during project execution and can be seen in table 1. These are just some examples of opportunities and the project team should not be limited to only these categories of opportunities in such large projects.

Table 1: List of opportunities during execution phase of a project (Source: Johansen et. al., 2014)

Factors	**Opportunities**
A. External factors	
Resource	Unexpected access to more and better resources
Owner priority	Easier access to better resources
Strategic alliance	Access to new methods or technology

Technology	New product with better performance, New technology in the market, Better management performance (than usual)
B. Internal factors	
Management	Good planning process – decision making, Good execution, More or better resources than planned or expected
Team Performance	Better team performance, more productive in work
Design	More robust design that fits together with other solutions that the company has chosen
Technology	New product with better performance
Time	Less rework, Faster execution than planned (better performance than expected), Faster deliveries of products than planned, Faster deliveries of services
Cost	More money than expected from the owner, Cheaper material – price of the material goes down, Currency exchange rate– cheaper than expected, Inflation and taxation – more favourable than expected
Quality	Less mistakes (than usual), Less rework, Less change orders (than usual)

To summarize, Opportunity is an uncertain event or condition, factors, and variation that causes change within a project setting which will have increased positive effect than planned in at least one of the project's objectives and would increase project value. The uncertain event or condition could also be a solution that was not foreseen at the beginning, something that just occurred, or something that is or is not in our control but still favors the project. This perceived solution should either enhance project objectives, deliver early, cost less, increase customer satisfaction, improve competitiveness, enhance company reputation to be considered an opportunity for that project. An idea or solution perceived as an opportunity should benefit at least one of the stakeholders (contractors for this study) involved in the project.

3.1.4 Project Value

Exploiting opportunities in projects could bring more benefits than stipulated in the initial business case, and even stakeholder benefit that nobody thought of at the project initiation (Eskerod et. al., 2018). Different researchers gave their views on what project value is which are mentioned below.

- Eskerod et. al. (2018) presents the term, which was previously mentioned by Martinsuo & Killen (2014), project value as the expected benefits from the project minus the expected costs for project realization, which means project value could be increased if we increase the expected benefit out of it. This is from a basic project management wisdom and business logic.
- Project value can be defined as the "quotient of benefits/ costs, where value is not absolute, but relative, and may be viewed differently by different parties in differing situations" (Laursen & Svejvig, 2016). As per (Ahola et al., 2008; Martinsuo & Killen, 2014; Ang et al., 2016), value is a multi-dimensional concept and subjective in nature so to reduce its subjectivity, there is a need of incorporating different stakeholder's viewpoint for understanding project value well.
- Lechler et. al. (2012) proposes project value as one or any combination of performance criteria such as efficiency, technical effectiveness and the satisfaction of project's stakeholders with emphasis on client and shareholders. This definition of project value is also supported by Eskerod et. al. (2018) leaving the basic definition of the sum of benefits minus the sum of costs. However, current project management discipline focuses on optimization within the constraints of time, cost, specifications and does not include the notion of value maximization (Lechler et. al., 2012).

- A value going beyond what was preplanned for a project i.e. satisfaction beyond preplanned satisfaction of the shareholders is termed as enhanced project value by (Lechler et. al., 2012). To maximize project value, they suggest focusing on unexpected and unforeseen project situation i.e. project uncertainties that have the potential to impact the value of the project in a positive direction. They suggest a concept "Project Value Opportunity (PVO)" as project opportunities that provides the potential to exceed the predefined stakeholder value of a project during the project's implementation or in other words PVO provides the potential for creating value that is beyond the project stakeholder's expectation and requirements (Lechler et. al., 2012; Eskerod et. al., 2018).
- According to Venkataraman & Pinto (2008), value can be added in a project by either providing greater level of client satisfaction by the same amount of resources or by maintaining acceptable level of satisfaction while lowering the resources used or a wise combination of both.

Environmental, social, systemic, and financial values are four general dimensions of project value as suggested by Vuorinen et.al (2018) whereas other researchers (Ahola et al., 2008; Martinsuo & Killen, 2014) have also supported that project value is more than just financial benefit to the company. Various stakeholders in a project have different view on what is valuable, and this is due to their unique knowledge, goals and expectation from that project (Mancini & Derakhshanalavijeh, 2017). Thus, value co-creation is needed in a project with involvement of main actors in the project for overall value enhancement.

From the study of Willumsen et.al (2019), it was found that project value is a broad concept and could be seen in terms of project output, success, or benefits. In this study, project performance criteria are termed as project value drivers which are also termed as project success criteria in many literature (Serrador, 2015).

Project value in simple term is the benefits getting out of a project against the invested resources for gaining those benefits. Since, project value is a multi-dimensional concept and subjective in nature these benefits could be in terms of one or any combination of performance criteria such as efficiency, technical effectiveness and the satisfaction of project's stakeholders especially, client and shareholders of the project. To enhance the project value, it is important to know the priorities on project objectives and value drivers of a project reflecting the requirements from the client. This should be done in advance by the project team by scrutinizing the expectation of client and major stakeholders involved in the project and deciding the project value drivers accordingly. Opportunities in a project should increase project value and fixing the value drivers in advance would allow team members to understand how a project wishes to enjoy the benefits when an opportunity is encountered and what kind of opportunities are to be focused in the project.

3.2 Theoretical Framework

In this section, identification of existing or potential relation between the concepts explained in section 3.1 will be presented. It is important to investigate factors that influence opportunity creation and identification in large infrastructure projects. This section also presents current working practices in risk management (both threat and opportunities) and few studies done for improving opportunity enhancing approach in infrastructure projects.

3.2.1 Stimulating factors for opportunity identification

In this section, a collection of various factors which could help stimulate the creation and identification of opportunities in large infrastructure projects is presented in table 2 and is also related with second sub-question to answer it partially. The factors presented are based on existing literature which

suggests that considering these factors would have a positive influence on opportunity identification in projects. These factors act as a crucial element for opportunity identification and some researchers has also termed few factors as enablers for opportunity identification.

Here, a list of 22 factors has been summarized that was found in various past researches in the field of opportunity management. This list is extended further in section 4.3.3(d) of this thesis and a final list is presented in section 4.4 along with importance level of each factor regarding D&C contracts from a contractor's perspective. An extended description of each factor is presented in appendix E.

Table 2: Factors stimulating creation and identification of opportunities in large infrastructure projects

S.N.	Factors	Explanation
1	Project manager with business-oriented mindset	Opportunities can be discovered or created through uncertainties in project settings and to identify them project managers should perceive uncertainty correctly. Project managers with business-oriented mindset are more likely to identify opportunities since critical project decisions are not solely driven by technical considerations (Lechler et. al., 2012).
2	Ability to capture stakeholders' view of value	The ability to capture stakeholders' views of value can assists project managers with identifying further opportunities and enhance decision making for future outcome and value maximization (Ang & Killen, 2016).
3	Ability of project manager to develop holistic view within the project	Olsson (2007) suggested three major factors needed for managing opportunities: the ability of project manager to develop holistic view within the project, the organizational support and interest, and the ability to understand how other organizations affect the project objectives. He also stresses on finding commonality of viewpoint between different project managers and their ways of approaching uncertainties within a project.
4	Ability to understand how other organization affects the project objectives	
5	Organizational support and interest	
6	Formation of collaborative work culture	Various enablers for active opportunity management: formation of collaborative work culture as well as open communication with client organization, individual and project-based incentives and existence of idea generating process, ability to balance between control and flexibility i.e. degree of formalization in opportunity management process. They also point that demanding goals challenges project team and encourage them to look for improved, better solutions, for opportunities within project (Hietajärvi et. al., 2017).
7	Open communication with client organization	
8	Individual and project-based incentives	
9	Ability to balance between control and flexibility	
10	Demanding goals in project	
11	Ability to analyze the impact of change	As an implication for project management practice, (Lechler et.al., 2013; Lechler, 2014) suggests three skills to be developed by project managers: flexible management expertise to quickly assess situations and identify opportunities, ability to analyse the impact of the change, and ability to communicate the potential value of the opportunity.
12	Ability to communicate potential value of the opportunity	
13	Taking the lead for opportunity exploitation	Requirement of leadership and shared commitment is needed in project team and involved stakeholders for opportunity framing (Hertogh et.al., 2016).
14	Shared commitment among involved parties	

15	Stakeholders being proud of the project	Opportunities are exploited more in projects when stakeholders are proud of the project because this creates a chance of engaging or even initiating activities by them that generates further benefits to themselves and others. Eskerod et. al. (2018) also indicates that, opportunities exploitation has its own time where some opportunities are exploited early, and others are in the later phase of the project but, exploitation of all opportunities created by a project needs involvement from many categories of stakeholders. He proposes that to enhance project opportunity exploitation, the project needs to be so present in the minds of these stakeholders so that they choose to identify and exploit opportunity through a shared vision. He also gives a proposition that celebrating achievements of the projects stimulates stakeholders to exploit the opportunities created by the project which could contribute to further benefits of the project.
16	Involvement of different categories of stakeholders	
17	Celebrating achievements of the projects	
18	Acceptance of change in the project	Opportunities identified in the later phase will not give any benefits if there is no acceptance of change in project plan from the project owner and project team (Johansen, 2015).
19	Will and power to change the originally planned solutions and deliverables	Exploiting opportunities often requires project owner and project management team to accept changes and have both the will and power to change the solutions and deliverables described in the initial plan. Identified opportunities must be significantly better than originally planned solutions as if it is to be worth considering since implementing them costs money and time. He recommends companies should focus on learning and knowledge sharing so that new methods, tools and techniques could be applied in new projects for better opportunity management. He also claims that, if a company wants to develop skills in better opportunity management, then there should be a focus on understanding human behaviour along with developing tools and techniques. The companies need to understand its employee's behavior, the culture in the company, the project owner's role, and how stakeholders interact with opportunity management process. In his case studies it was found that projects where project management team believes that the budget is too small or tight, they will start to seek opportunities and more actively exploit new ideas and willing to make changes to deliver the project within budget (Johansen, 2015).
20	Learning and knowledge sharing	
21	Understanding human behavior	
22	Tight project budget	

3.2.2 Opportunity management approach

Several approaches have been suggested in previous studies regarding opportunity management and its implementation. Here, few of the approaches are discussed as proposed by various researchers.

a) Opportunity framing through value creation

Some studies have been done towards understanding opportunities within a project. Opportunity framing is a structured approach for understanding and defining an opportunity (Hertogh, 2014). In their paper, Hertogh et. al (2016) states how adding societal value to infrastructure projects could bring opportunities for various involved actors. The essence of opportunity framing is to determine what is important for a project and what is not. It is also about adding scope or (re)framing the concept of the project and could also be applying new technology or new concept in a project. De Bruijn et. al (2010) also claims that sometimes adding scope to a project and making it more complex could engage

wider audience of stakeholders because each member could see something beneficial, if a project is delivering multiple benefits. In their paper, Hertogh et. al (2016) also indicates that opportunity framing is not easy, and the added value is not easily achieved. They have indicated three challenges for opportunity framing as:

- Premature convergence of solutions where a solution is chosen early in the process, which excluded many other better options that could be present at the later phase of the project.
- Relatively small windows of opportunity are generally observed in projects because of restricted schedule, budget, and untimely decisions from the stakeholders.
- Lack of leadership and shared commitment is generally observed in many projects when a new concept arises where, it is unclear who is taking the lead in the project and who is going to fully involve and invest their time and resources for chasing that idea for the project.

Hertogh et. al (2016) has indicated a "fit for purpose area centered approach" taken by Dutch province of Friesland to frame opportunities where the infrastructure project is considered as an integral part of its physical and social surrounding for extra value creation and it is realized considering effective landscaping, connecting synergies between projects, connecting the functions, and creating overall social value. This concept can also be seen in figure 8. They have suggested that interaction between people is a key factor in creating a well-defined scope where opportunities could be framed, and the project could be realized successfully. This study gives a nice approach on understanding and framing or creating opportunities in infrastructure projects.

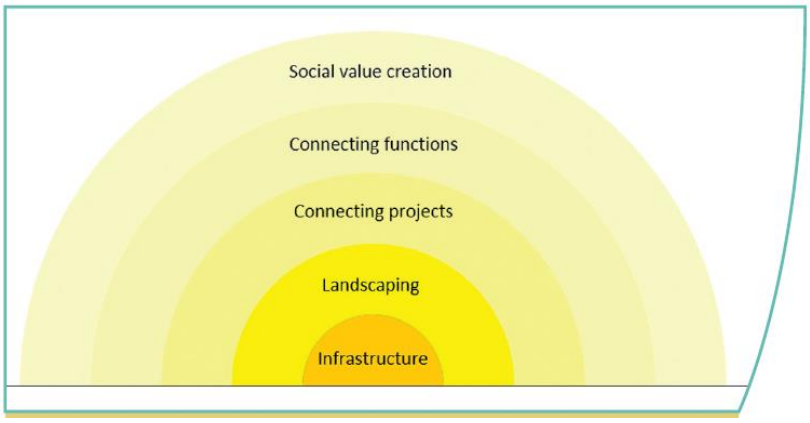


Figure 8: Value creation by area centered approach of the Province of Friesland (Source: Hertogh et. al, 2016)

Creating integrated solutions by adapting such approach would make the solution more beneficial and relevant to the client, thus making the bid stronger, increasing the chance of winning the contract (Johansen, 2015; Setiawan et. al., 2015).

b) Creating opportunity and future value

In their study, Jonker et. al., (2013) introduces a concept of multifunctionality which could reduce the cost and adds value to the project. The concept of multifunctionality is an advance form of multiple use of space where the idea is not only to use the space but to reinforce each function coupled in the solution. The solution could be use of space above or below the ground or in relationship with time as future value that could be added logically to a solution. A simple multiple use of space would be a building above a tunnel which indeed makes use of limited space, but the building doesn't improve the functioning of tunnel and vice versa. However, in solutions with multifunctionality, one should improve the functionality of others. For example, using road surface in the vicinity of buildings as a

heat exchanger for a hot and cold storage system (Thermal Energy Storage). One advantage would be extra space available as a heat exchanger for the nearby buildings whereas, roads could also use the function of heat exchanger by cooling down road temperature during extreme heat or warming the road surface during extreme cold. This enhances the flow of traffic on road and abundant supply of heat and cold to the buildings.

Hanneke & Jurgen (2017) describes the concept of future value in projects that could act as a basis for multiple investments where the project bill can be shared by involved parties. By exploring the options and linking them in a wise way, opportunity of multiple financing is possible. Demonstrating future values will motivate initiators, financers, and investors to agree to projects with multifunctionality and financing structure. Revaluing an old investment and adding extra functions to it creates a chance of co-investment which would help in reduced cost in purchasing resources, such as land or building, and construction costs of the project.

For example, a water collection area, that can also be adopted for water purification and nature development. Here, the water manager and nature manager can share the costs for the project and both the functions, water body and nature when coupled together enhance each other's functions, causing revenue to increase. The ground helps to retain the water and develop nature, thus also improving water purification process and generating extra money. Next step to this project could be recreational space or agriculture which would generate extra revenue and added value. Combining all these functions would enhance the quality of living in this area. Thus, a future value ladder, which can also be seen in figure 9, can be built making the project smart and alluring for the client.

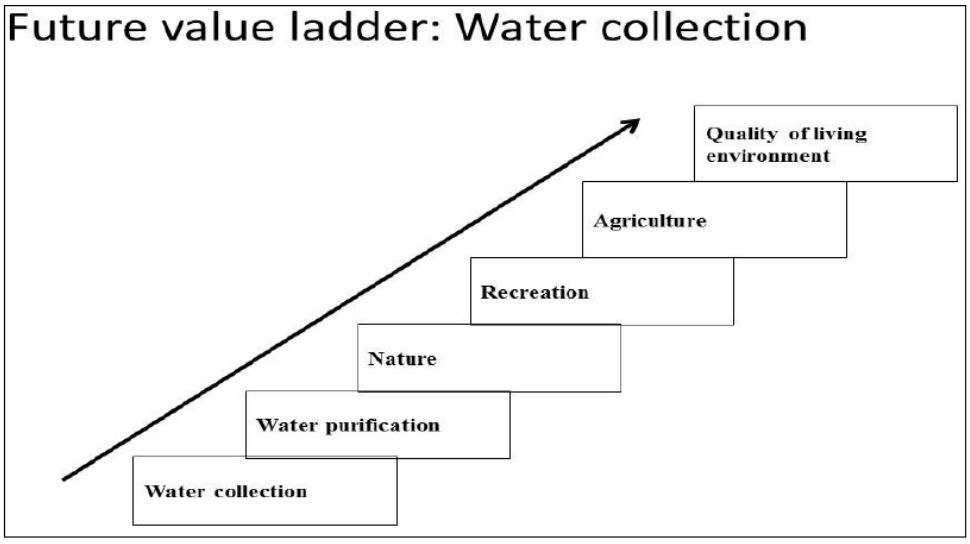


Figure 9: Future value ladder water collection (Source: Hanneke & Jurgen, 2017)

The sequence of function and its additions should be carefully decided because it could block the accumulation of future values. This happens when a choice is made too early in the process where the project's capability hasn't been explored properly. This phenomenon of early choice in the process is also supported by Hertogh et. al. (2016) and they gave it the term "premature convergence". For example, in a building project, a concept of green roof can lead to chronological addition of other functions like insulation from noise and energy which creates the possibility of capturing water and would allow the roof to be disconnected from the sewer. Furthermore, the roof now offers a possibility to grow small crops and even generating solar energy which generates more revenue in a green and cool roof. On the other hand, if the solar panels were installed first at the roof then adding other functions would be much more difficult and the added value cannot be achieved. This creates a

lock-in situation in the value ladder. Thus, the choice made for creating future value is important and it also add a lot of scope for creativity allowing more opportunities in the project (Hanneke & Jurgen, 2017). They suggest opportunities for achieving future values are already present in the physical space. The trick is to recognize that value and turning existing investments into new opportunities to add value, share costs and look for integral solution that serve the goal of multiple parties.

In their study on Megaprojects, Mancini & Derakhshanalavijeh (2017) tried to answer three elements related to opportunities and value creation in a project. Their first suggestion is project managers can involve local community during the design and execution phase of the project to maximize project value. Project organization policy can totally change the perception of the inhabitants living nearby towards the project. Value co-creation is possible in a project, by identifying and considering local community's concern and constraints, by keeping constant contact with local community and keeping them informed about the effects and benefits of the project. If possible, using the local manpower in the project by providing necessary training, so that along with infrastructural benefits the inhabitants also get financial and social benefits from the project which would also increase the project support from local community.

Another suggestion provided by Mancini & Derakhshanalavijeh (2017), *knowledge management helps in increasing the amount of value obtained from a project*. Knowledge gathering is important in projects and especially related to past data on completed projects, milestones, identification of real risks, approaches and techniques used to alleviate them, skills for communication with stakeholders and so on. Also, organizations can shape their long-term policies as such they could retain their skilled and experienced human resource so that the gained knowledge could get transferred to future projects.

Third suggestion given by Mancini & Derakhshanalavijeh (2017) was regarding project managers being able to identify unforeseen opportunities during execution phase of a project. For this, when an organization wants to invest in a new technology for a project, if factors such as availability of monetary resources and procurement of machinery, operator license, etc. are flexible, it would help the process. Also, changes in external stakeholder's needs, demand and perception towards the project should be closely monitored in order to tailor the scope of the project. This would allow the project to get benefit from values created and captured from perception change.

c) Five-step process for risk management

After discussing various approaches to create opportunities and value in such large infrastructure projects from the above two sections a & b, actual opportunity identification process in a project setting becomes relevant for practical implication. In his book "Effective opportunity management for projects", Hillson (2004) suggested a five-step process for risk management containing both threats and opportunities. Those five steps are as follows:

1. *Definition Phase*: In this phase, the objective of the project should be defined properly, and projects goals should be agreed upon by different stakeholders. This allows for a shared understanding and commitment to the purpose of risk process. Also, all parties involved should understand a common risk definition and it includes both threats and opportunities, and both needs effective management for maximizing the chances of reaching project objectives. The outcome of the definition phase is a document capturing project objective, risks process scope, risks process aims and objectives, risks methodology and approach. This documentation would help in determining how risk management should work for this project.

2. *Risk Identification Phase:* Risks (including both threats and opportunities) will be identified in this phase using different techniques like brainstorming with all members of project team with representative of key stakeholders, review of standard risk checklist, discussion on lesson learned from project knowledge database, SWOT Analysis workshops, and a preparation of preliminary risk register for further assessment. However, future risks (*uncertain events or combinations of circumstances that have not yet occurred and that cannot be predicted from the perspective of this point in time*) and emergent risks (*these risks arise only as a result of actions to be taken in the future, and since those actions have not yet occurred the risk may be hidden*) cannot be identified in current time. Thus, it is encouraged to repeat the identification process throughout the project at a regular interval of time.

   While identification of risks, the project team must distinguish in causes of risks, actual risks and the effects of risks.

   - Causes: Definite events or set of circumstances that exists in the project environment and which gives rise to uncertainty
   - Risks: Uncertainties that, if they occur, would affect the project objective in both negative and positive way
   - Effects: Unplanned variation from project objectives

   An example of an opportunity registration could be: "*We have to outsource production; we may be able to learn new things from our selected partners, leading to increased productivity and profitability"* (Hillson, 2004, pg. 91). While identifying opportunities, apart from focusing on both positive or negative sides, one should also take the assistance of others when it is difficult to see the positive sides of an uncertainty to get a complete view of identifying opportunities along with threats.

3. *Risk Assessment Phase:* In this phase, probability and impact assessment of each identified risks should be prepared with a dual PI-grid for prioritizing risks for action using standard scoring calculations. Risk register is prepared to determine potential effects on project objectives. Initial estimates of the project can also be adjusted from identified opportunities which can also be seen in appendix L.

4. *Risk Response Planning Phase:* In this phase, appropriate response strategy selection is done for each identified threats and opportunities. For threats, the responses are generally avoid, transfer, mitigate or accept whereas for opportunities, the responses are exploit, share, enhance or accept. Risk register is updated with these response data.

5. *Risks Monitoring, Control and Review phase:* This phase contains proper review meeting to check the status of key risks and to identify new risks and repeating the process of implementing agreed responses while checking to their effectiveness.

Hillson & Simon (2012) has suggested a step wise process in Active Threat and Opportunity Management (ATOM) for identifying risks including both threats and opportunities in projects which can also be seen in figure 10.

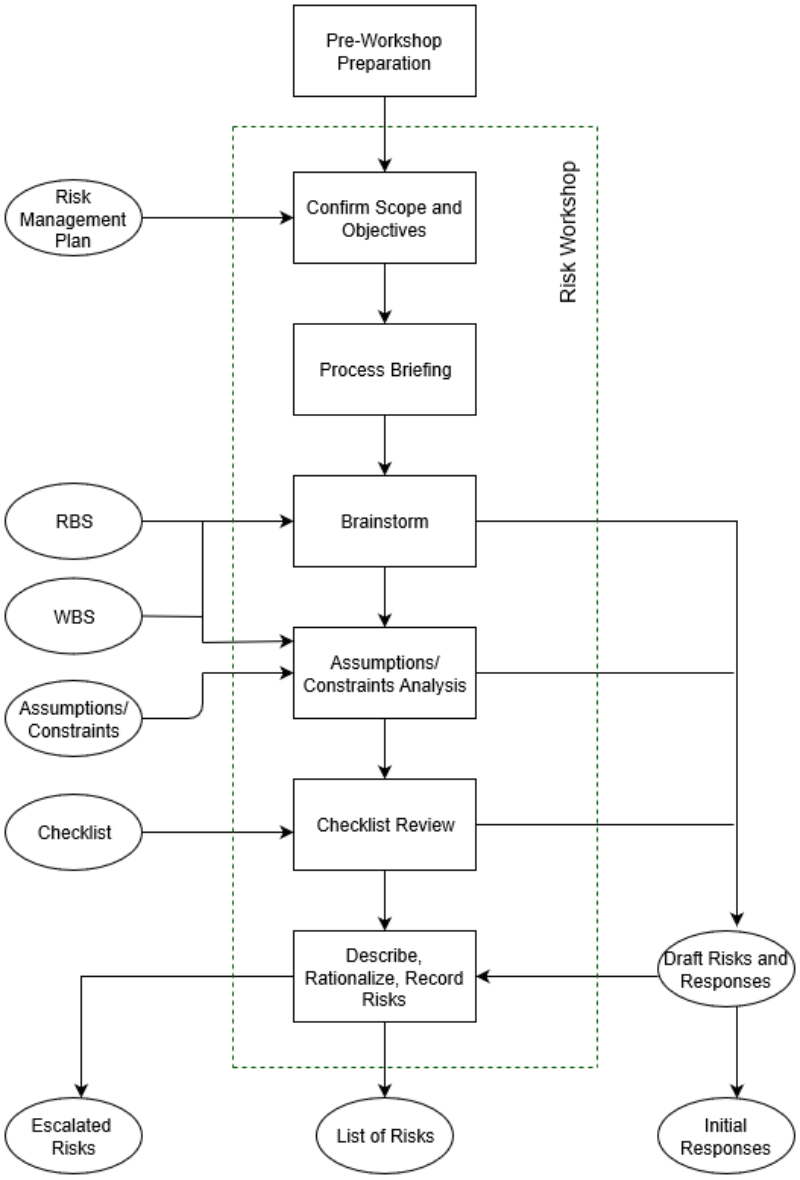


Figure 10: Flowchart for identification of risks (Source: Hillson & Simon, 2012)

This flowchart can be used by project team members in identifying all knowable risks within a project. For risk identification in large projects, Hillson & Simon (2012) suggests that along with the above framework, the project team should also perform SWOT analysis, structured interviews and review of past projects because of increased project complexity.

- SWOT analysis where identification of organizational strengths and weaknesses is done through brainstorming session and deriving opportunities from strengths and threats from weaknesses.
- Interviews should be conducted in groups immediately after risk workshop while ensuring each member is heard for their opinions. Level of trust should be maintained by avoiding judgmental attitude, demonstrating respect and acknowledging confidentiality between the participants.
- Review past projects to find areas of commonality that can be successfully applied to the new project. Risk identification tools like checklists/risk log can be used as a reference for planning future projects.

As we have discussed in section 3.1.2 that opportunities in a project come from other uncertainties as well apart from risks and should increase the project value rather than just fulfilling the objectives. Thus, some additional elements are required in the above procedure which is explained further in section 6.2.1.

In classic project management, since it is based on optimization and not maximization, opportunities are seen as threat on a project level because opportunity seeks variation and change from the baseline whereas, any variation from the baseline is seen as threat to a project by the project team (Lechler et. al., 2012; Johansen, 2015). In a Project Management Institute webinar, Lechler (2014) describes principles of uncertainty management which is different from risk management. As a precondition, uncertainty management should have well-defined project value proposition apart from well-defined project objectives. The management focus should be towards maximizing project value and identifying value drivers rather than just sticking to initial objectives with minimum variation to the baseline. As a process for project opportunity management, it should discover, select and exploit opportunities and change value proposition. Thus, the focus should be shifted from sticking to initial plan and avoiding plan changes in situations of risks to focusing on project results by changing plans in situation of uncertainty and exploiting opportunities.

In their paper, Hietajärvi et. al. (2017) identified four key activities for opportunity management: knowledge acquisition and requirement definition during strategy phase, pre-idea generation and engagement during procurement phase, opportunity management and process initialization during development phase, and exploitation during implementation phase of the project. For implementation phase, they suggest practices like: systematic idea generation and development by informal meetings and workshops, technological integration mechanism by using Last Planner and BIM, competence building training of new comers in opportunity thinking, and contractual and commercial activities such as incentives for improved performances, are helpful in successful identification and exploitation of opportunities.

d) Approach for assessing identified opportunity for its benefits

(Johansen, 2015; Johansen et.al., 2016) claims that identifying and deciding which opportunities are worth assessing is not an easy task and consists of three different views: project view (value of project in terms of benefited cost, time and quality if the opportunity occurs), project owner view (value and benefit to the owner in production phase if the opportunity occurs), and society/user view (value and benefit to the society if the opportunity occurs). They proposed a small framework to assess these views on a new opportunity which can also be seen in figure 11.

In an economically rational decision, these values would be compared against the amount of time, cost and resources needed to exploit the opportunity. If this cost of exploitation exceeds the expected return, then the opportunity is unfavorable for the project and should not be exploited. Thus, starting of managing an opportunity always comes with this decision-making scenario where a new idea emerges, that needs to some extent let go of the prior invested time and resources, and assessing on whether the opportunity will increase the project value and is beneficial to the project or its owner or to the society.

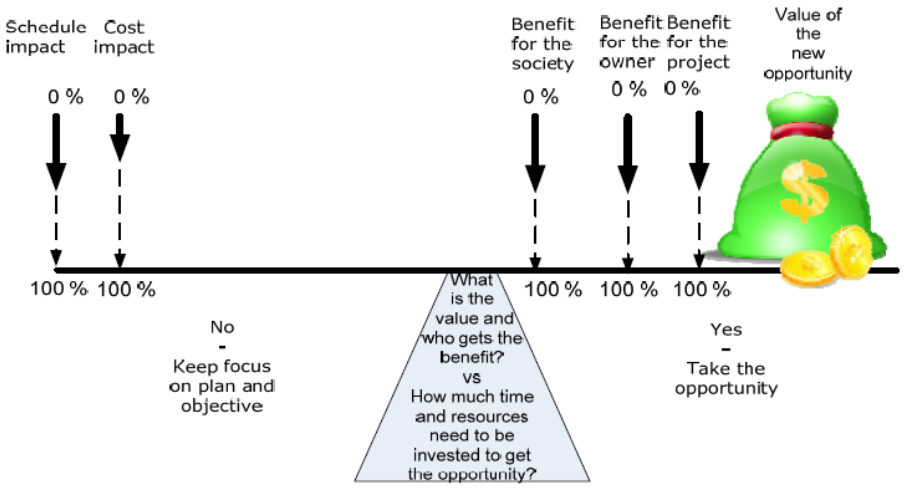


Figure 11: What is the value and who will receive the benefit (Johansen et.al., 2016)

For deciding which opportunity would create value to a project, a comparison needs to be done between the needed resources and added value to the project. Johansen et. al., (2016) has provided decision making scenario example for an opportunity during a project. Suppose, a project of 10 million euros is already one month into the planning phase and has invested 10 thousand euros on its planning. Suppose an idea comes to the project team which has a potential of adding financial benefit of 5 million euros, which would make the total financial benefit of 15 million euros if the idea succeeds. This gives following decision-making scenario for the project manager;

- Loss of one month's planning work of 10 thousand euros
- Extra work required for calculating the additional financial benefit of the idea and in the worst-case re-planning of entire one month's work, thus additional 10 thousand euros.
- If the probability of idea is estimated as 50% then the consequence of the idea is probability (50%) multiplied by new project financial value (15 million) i.e., 7.5 million euros which is 2.5 million euros less than original plan.

This example suggests that for an idea to be implemented in a project, either it should have a higher probability of occurrence or a higher impact value from a financial point of view. Johansen et.al., (2016) also suggests a scheme which can be used for assessing opportunities in a project.

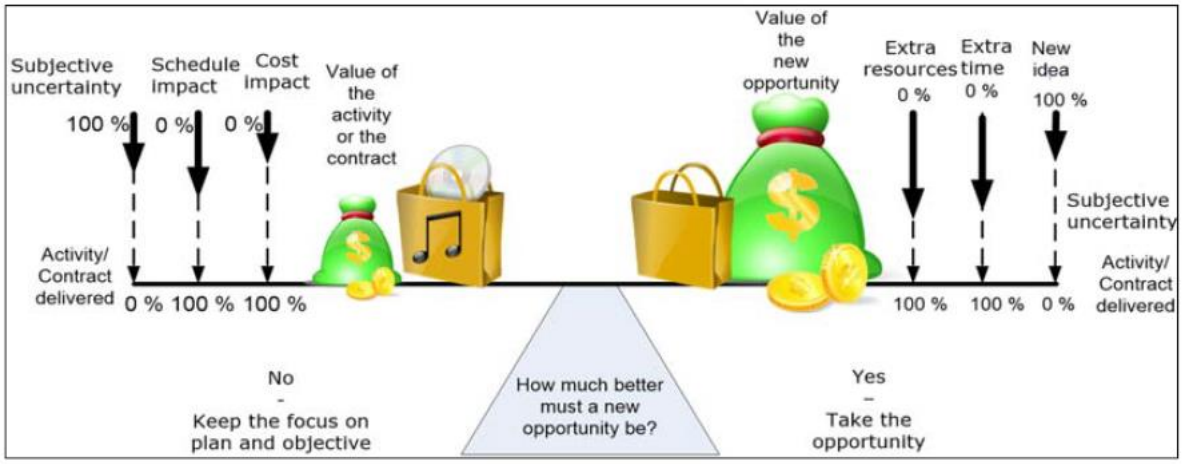


Figure 12: How much better must an opportunity be (Source: Johansen et.al., 2016)

Here, the scheme is given from a financial value point of view but, a value in a project is more than that as discussed in section 3.1.4. Thus, other value drivers for each project should be identified first in order to assess a new idea to be incorporated into a project. These value drivers could be different as per project's characteristics. Thus, to answer sub-question d, various project value drivers from a contractor's perspective is presented in section 4.5 and based on each project characteristics, the importance level can be decided by the project manager at the start of the project so that it can be compared with an identified opportunity in terms of added value against the required resource in order to exploit that opportunity. A complete answer to sub-question d is given in chapter 6 after conducting detail interviews and case study.

3.3 Conclusion

Risk and uncertainty are terms whose concepts are not straightforward and different researchers have their own definition and perception towards it. However, from past studies, it can be clearly seen that both risk and uncertainty have effects on the project's objectives and goals. The effects could be both in favor or against the project. Uncertainty is divided into six categories, as discussed in section 3.1.2, out of which only discrete risk events and variability is taken for this study. If an uncertainty is influenceable and the probability of the event occurring can be known, then it is termed as risk. Discrete risk event is also a type of uncertainty but with some information that can be worked upon for determining the future behavior associated with it. Whereas, variability are uncertainties which cannot be foreseen in advance and are non-influenceable. Both discrete risk event and variability include opportunity and threat for a project and should be dealt with accordingly.

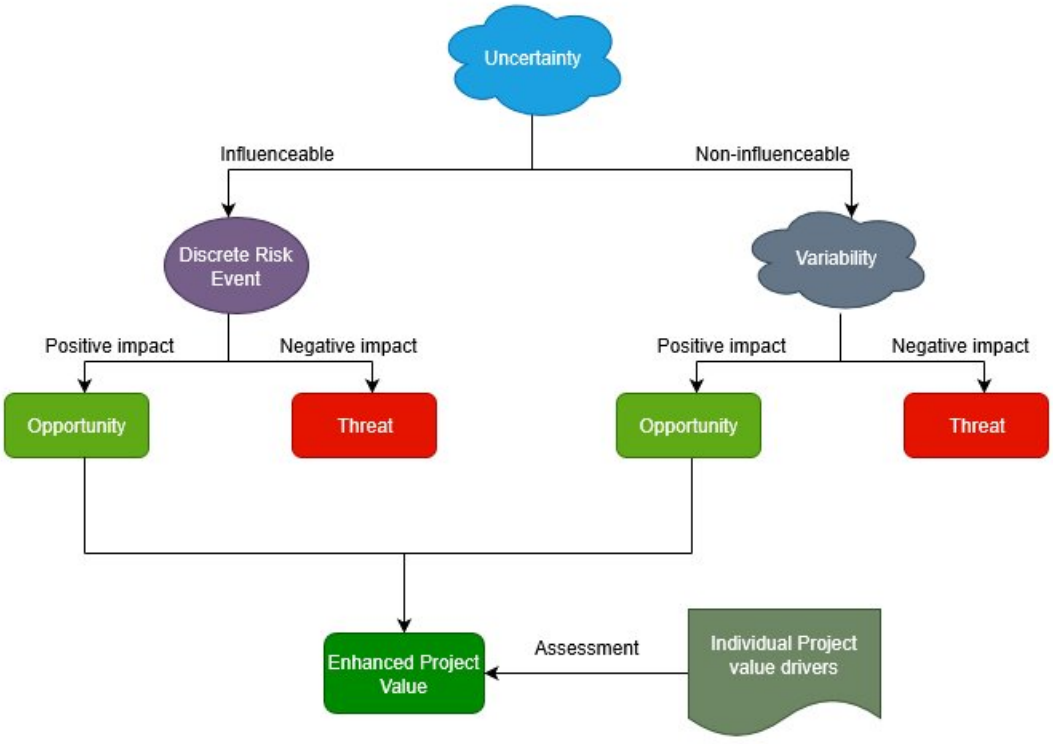


Figure 13: Relation between uncertainty, risk, threat, opportunity and project value (Source: own illustration)

Opportunity and threat are seen as risk or variability which can have both positive or negative impact on the project's objective and perceived project value. If the concept of opportunity is further elaborated, then it is a positive impact of uncertainty to a project which enhances project value. Project value is a multi-dimensional concept and subjective in nature and could be one or any

combination of performance criteria such as efficiency, technical effectiveness and the satisfaction of project's stakeholders especially, client and shareholders of the project. Thus, there is a need for incorporating different stakeholder's viewpoint for understanding project value well. To enhance the project value, it is important to know the priorities on project objectives and value drivers of a project reflecting the requirement of various parties and stakeholders involved along with a clear understanding of the responsibilities of each party involved in the project (Ward & Chapman, 2003).

Project value can be enhanced by the optimization of both cost and benefit in the project where most of the current practices are still narrowed to enhancing value by reducing capital cost. Thus, the focus should also be given towards benefits maximization within a project (Mancini & Derakhshanalavijeh, 2017). Benefit maximization is possible if the project team is more flexible and accept changes which could be a source of potential opportunity to a project. Since large infrastructure projects generally last for many years, this becomes more important due to changing client demand and expectation from the project. Also, apart from the client, project team themselves could develop better solutions and ideas once they are engaged in the project because of the knowledge development compared to the early project phase. This indicates the importance of being adaptive and flexible during the process. Opportunity within these projects can be created and identified more if the project team are well aware of the stimulating factors presented in section 3.2.1. Knowing the important factors in this process would help in understanding what influences opportunity creation and identification in large infrastructure projects and could act as a starting point for a project team towards the preparation of this process.

In Design & Construct contracts, contractors could improve their approach by making the tender more appealing because of the opportunity to both design and build the project within their capability as such, it provides multiple benefits for themselves, to the client and to other important stakeholders. This can be done by using various tools and techniques during the tender phase to identify more opportunities for the project. Since, both the design and construction will be done by the contractor, value-enhancing solutions can be found through an effective and well-coordinated opportunity management process. Thus, the creation, identification, and exploitation of opportunities are important in order to improve the performance of large infrastructure projects and their success rate.

Part 2: EMPIRICAL STUDY

4. Interviews

This chapter consists of information related with the interviews done with various practitioners within and outside HOCHTIEF and also the result of questionnaire survey given by various field experts. Interviews are divided into two parts; initial interviews and detailed interviews. Initial interviews are taken within the company experts while detail interviews involve experts also from management & engineering consultancy, clients and research university. First, a brief introduction of the company is presented, followed by initial interview findings and then detail interviews, and questionnaire survey result.

Information regarding sub-question a and b are presented in this chapter

4.1 Company Introduction

HOCHTIEF is the largest construction company based in Germany which was established in 1873 A.D and has their headquarter in Essen Germany. In 2014, HOCHTIEF started with an office in Diemen-in the vicinity of the SAAone (A1/A6) project as HOCHTIEF Nederland. HOCHTIEF Nederland consists of three separate companies: HOCHTIEF Infrastructure, HOCHTIEF PPP Solutions and HOCHTIEF Engineering and all three of them work closely together. Infrastructure designs and builds, PPP Solutions develops, finances and maintains, and Engineering part is focused on design specifically supporting Infrastructure. Due to the growth of the company, now they are better located at Amstelveen since 2017 (https://HOCHTIEF.nl/over-ons). In the Netherlands, apart from SAAone (A1/A6) project, they are now involved in Zuidasdok-Amsterdam, which is another large project with the contract volume of approximately a billion euro.

HOCHTIEF is comparatively new in the Dutch market and has a team of 82 professionals. Moreover, the company is supported by the international knowledge of their parent company. HOCHTIEF Nederland as a company tries to maintain and reflect their theme of integrity, durability, safety, innovation, responsible and performance through their projects. From last one year, the company is trying to be more focused towards exploring opportunities in projects and incorporate it into the risk management process.

4.2 Initial Exploratory interviews

4.2.1 Goal and Interviewee selection

Initial interviews are taken with two of the practitioners at the company to know more regarding the current approach and focus of the company towards opportunity management. These interviews focused on collecting information about the risk management procedure of the company and how much focus is given towards the opportunity side while executing projects. The findings of the initial interviews are also supported by detailed interviews done within the company and with other practitioners since few of the question are same for HOCHTIEF's employees in both the sessions. Two interviewees are selected for the initial interview, Project Director who has overall view of the projects being executed at the company and Risk Manager who is more involved in the process of risk management at a project level.

The details of the interview can be seen in table 3 where EI denotes to Exploratory Interview.

Table 3: Details of interviewees for Initial Exploratory Interview

S.N.	Interviewee Code	Role	Organization	Experience (years)	Duration (minutes)
1	EI01	Project Director	HOCHTIEF	32	35
2	EI02	Risk Manager	HOCHTIEF	10	45

4.2.2 Interview findings

The outcome of initial interviews is summarized below and explains about the current approach of the company towards opportunity management. The questions for the initial exploratory interview are presented in appendix B.

a) Benchmark for large infrastructure project classification

HOCHTIEF as a company does not have its own benchmark or minimum amount in cost to classify a project as a large infrastructure project. Both interviewees replied that there are no such amount criteria for classifying a project as a large infrastructure project. In this EI01 added, since they are a big company and new to the Netherlands, they are focusing on large projects for optimal use of their resources. EI02 suggested a project of 50 million or more can be considered as a large infrastructure project for the company.

b) Risk Management Process

HOCHTIEF Infrastructure Netherland has already established a standard procedure for risk management that has to be followed for each project in compliance with the company policy for reporting. There are reviews and audits done for assessing the benefits and quality. Risk management procedure has a team of different experts within the company, and in addition to this risk managers also come from their head office in Germany, who are mainly focused during the tender phase of the project to find optimal solutions for the project. Risk managers are mainly responsible for technical risks whereas contract managers mainly deal with the legal risks related to the project. These sessions are not fixed and depend on the risk manager's preference. Of which one interviewee pointed, big group tends to get initial ideas but at a surface level whereas, small groups could go deep to work on the detail solution. Thus, the focus of risk management is towards the tender phase but is also regularly updated in other phases of the project.

Opportunities are also identified during the risk management process and there are no separate sessions dedicated for identification of opportunities only. However, there are very few opportunities identified when compared to threats, thus generally less focus is given to them. There is no policy that tells the project team to identify opportunities in the projects but, it is generally expected out of them.

c) Activities for Opportunity Management

The activities done at the company towards opportunity management for a project are brainstorming sessions generally done during the initial few months before tender. These brainstorming are done under a single umbrella of risk for both threats and opportunities. Various tradeoffs are made at this time for optimal solutions. Listing of opportunities is done during the tender phase but contains very few opportunities in comparison to negative risks. These activities also depend on the latest experience of the project team or risk manager whether they would act as a risk-taker or risk-averse for next project. These activities are maintained in later phases of the project as well. Sometimes these activities are also jointly done with the client where they identify opportunities and negotiations are done for sharing the benefit. This helps in building a good relationship with the client.

d) Change Management in projects

Opportunity exploitation during the execution of projects generally requires change. Changes are managed in these large infrastructure projects by maintaining change orders which describe deviations in the project plan. If there is a deviation in the current plan, analysis is done to find the cause of deviation. The process followed is, first to work according to the initial plan, if circumstances come that is asking a change to the project plan, consultation is done with the client to apply that change in the planning. These change orders are generally handled by contract managers. Positive change adding profit to the project is always beneficial and is applied accordingly in the project plan. The authority to apply change in the project by project team members depends on their role/designation, for which standard criteria and rule of the company allows till what amount of change different members can apply to the project.

e) Improvement of current approach

To improve the current approach towards opportunity management in the company, the interviewees suggested the need for a clear concept of what opportunities are in the project. Clarifying the concept of opportunity and sticking with a common concept so during identification sessions everyone agrees to the definition and work accordingly to identifying them. This helps in the implementation and preparation of unbiased opportunity register. Also, enhancing the capability of the project team is important to better explore and identify opportunities in projects. Meanwhile, the company is open to any suggestions that would help its current approach and would increase the efficiency of the process.

4.2.3 Observation

From the initial interviews, it can be observed that there's been some effort made to focus on the opportunity side, but the approach is not matured yet. Thus, for this the key requirements are;

- Clear concept of opportunity in projects
- Important factors to help in the opportunity identification process
- A reliable approach towards opportunity identification and exploitation in projects

4.3 Detailed Interviews

4.3.1 Goal

The goal of this step is to collect information from the practical world to add to the findings from the literature reviewed during this study. These interview sessions are mainly focused on knowing experts' perspective towards project opportunities and crucial factors in a Design & Construct contracted large infrastructure project for opportunity creation and identification. These interviews also focus on collecting the experience of interviewees regarding opportunity exploitation in their past projects. Project value drivers that are important from a contractor's perspective are discussed as well. Apart from this, suggestions are collected on the improvement of the current approach on opportunity management and interviewee's perception of where the current practices lack in exploring more opportunities in such projects.

4.3.2 Interviewee selection and data collection

After the initial interviews, detailed interviews are taken from various practitioners with varied job role in the field of construction and infrastructure. To get the complete overview, interviewees selected are from various organization types such as contractor company, management & engineering consultancy, client and research university. Each interviewee selected has a high level of practical experience of working towards large infrastructure projects.

To collect the complete information from these interviews, all the conversations are recorded except one. For the conversation which isn't recorded, the response was noted down during the conversation and the extra information which aren't able to write down then is completed immediately after the interview. All the recorded conversations are transcribed into written documents for further analysis.

A description of interviewees for detail interviews can be seen below in table 4 where DI denotes to Detail Interview.

Table 4: Participants for the Detailed Interviews

S.N.	Interviewee Code	Role	Organization	Roles of Organization	Practical Experience (years)	Duration of Interviews (minutes)
1	DI01	Design Manager	HOCHTIEF	Contractor	15	60
2	DI02	Financial Director	HOCHTIEF	Contractor	20	67
3	DI03	Execution Manager	HOCHTIEF	Contractor	30	45
4	DI04	EPC Director	HOCHTIEF	Contractor	25	80
5	DI05	Senior Consultant	AT Osborne	Management Consultancy	15	95
6	DI06	Stakeholder Manager	HOCHTIEF	Contractor	20	55
7	DI07	Consultant (Value Manager)/Researcher	Witteveen+Bos/ TU Delft	Engineering Consultancy	9	40
8	DI08	Researcher	TU Delft	University	1	35
9	DI09	Client (Urban Planner/Policy Maker)	Province Zuid Holland	Client	20	58
10	DI10	Client (Project Manager)	Rijkswaterstaat	Client	25	58

These interviews are semi-structured in nature and the findings from these interview sessions are discussed below. The questions for these interviews could be found in appendix C. The findings from these conversations are merged at once and presented in several points to avoid repetition of information.

4.3.3 Interview findings

The interview findings are presented in five sections where section a, b and c relate more towards the concept of opportunity and project value (sub-question a), while section d relates towards stimulating factors for opportunity identification (sub-question b). Section e relates towards the important elements, approach and activities that can be done for identifying opportunities in projects which is related to sub-question b and c.

a) Opportunity in a project

Opportunity in a project is defined by one interviewee from the contractor side as *"it is something that is not definite but should be work upon in order to increase the contract value or to optimize the efficiency. So, it is items where in the future you could have claims out of which you create value*".

It can be observed from the above definition as opportunities are related to uncertainties in the project. Opportunities are generally expressed in money and time and where time is money, so either making the work more economical or executing it in lesser time would be an opportunity for a project. Executing projects in an efficient way and finding smart solutions could also be an opportunity. Opportunity adds value to a project, and it needs co-operation from various stakeholders within a project while maintaining a healthy relationship between client and contractor.

Another interviewee who works as a researcher added, if a project is about to happen then, an opportunity would be to serve more from a spatial perspective like doing more in a limited area. So, from an area development perspective, trying to fulfill multiple interests from the same area by aligning the agendas with interested external parties like housing corporations, energy companies, etc. *"For example, in multi-functional flood defense projects, the main goal is flood safety but very often something more can also be done at the same time such as creating an underground parking space"*.

Identifying opportunities in projects requires a lot of research. One interviewee who works as a consultant explained opportunity as, finding the right combination/fusion of solutions which enhances each other's quality if kept together. He further elaborated it with an example;

"Let's look into dwelling and care, the quality of dwelling goes up when we know that we will be able to receive care in our own home until old age. Here, care enhances the quality and financial value of the dwelling. On the other hand, receiving care at home enhances the quality of care. So, a patient is better off receiving care in his home rather than receiving it in a nursing home. This fusion between care and dwellings is an important example to understand the opportunities in projects. Also, it can be seen with water and energy, water enhances the quality of energy as clean energy and if the energy is extracted from water, it enhances water quality like fighting botulism (poisoning caused by the toxin from anaerobic bacteria) and blue algae".

So, the fusion between two entities that enhances one another should be known and investigated which is a new thing in the current economy. These would need specialization in different fields and correct integration of different specializations for creating extra value. Two effects can be retrieved from this, on the profit side, getting extra quality and on the cost side, using common area/space for two functions and sharing the cost. Thus, the secret is knowing fusion between solutions.

One interviewee from client-side explained opportunity from a sustainability point of view. The Netherlands is a low-lying country and climate change is now a major concern. The country's whole economy is mostly based on fossil fuel, so the big oil companies practically run the national government. An opportunity on a policy level could be making decisions on the main concerns for further action. As a suggestion, the focus should be now towards solutions with low carbon emission, and for that combination of investments from all kind of governmental bodies like; provincial and municipal bodies for buying low carbon or energy neutral products or services should be done. A joint effort like this would make a huge difference overall but, the question remains how to do it. Thus, more emphasis should be given towards sustainable solutions in projects during contracting a project by each governmental body.

b) Opportunity for the contractor

Opportunity in a large infrastructure project from a contractor's perspective is explained in the following ways; There are two types of opportunities that could come in a project, one that benefits the contractor only and another which benefits both client and the contractor. For the contractor, it is generally fulfilling the requirements and trying to do it with less time and cost. Besides this, maintaining the recognition of the company by providing better innovative solutions would help in developing the project's recognition. A project being architecturally astounding would play a vital role in maintaining recognition if successfully delivered and should also be considered by the contractor while proposing a project. Multifunctional solutions like a safety barrier with parking space provided by the contractor, also builds their portfolio and would help in being recognized in the eyes of future clients, which is good for company's market sustainment and can be considered as a long-term investment. One interviewee added as the ability to avoid the money into the risk reserve is also an

opportunity. It also depends on the project, its work specification, the contractual situation and so on. Exploiting opportunities in a project is not always in control of the contractor, so there might be a need of other parties' involvement to exploit opportunity like client's approval for any change in the requirements to have the possibility to exploit an opportunity.

One interviewee from client-side further explained, "*for contractors, obviously financial benefit is very important thus they generally look for a good business case while proposing an idea to the client or accepting an idea from the client. When the client proposes an idea and it's not a good business case for the contractor then it's not much exciting for them, thus the client must pay extra to apply that idea to the project. Obviously, contractors also want to give better solutions and be proud of what they have provided but, most of the time financial restrictions like banks asking for a positive business case for granting them money restricts too risky ideas to implement as an opportunity*".

One interviewee from contractor side had a slightly different view and explained as, if it is seen from an execution viewpoint, keeping the project simple and not making it too complex would be a wise way to execute it. Instead of trying to incorporate everything for all stakeholders and making the project more complex, it should be kept simple and doable. Sticking to what is proven and trying to connect proven methods from various past projects and a combination or recombination of the past knowledge could bring more opportunities in the project. Trying unproven or completely new techniques in a project could bring more threats associated with it. For example, in DBFM contracts, there is generally a timeframe restriction because of the finance part also involved in the contract, so not much innovative ideas can be explored compared to D&C contracts where timeframe could be discussed with the client in agreement with the additional scope or scope change. Not all innovations are opportunities because it is not known where the project will or could end up.

Opportunities in large infrastructure under Design & Construct contracts can be divided into three categories based on their occurrence and exploitation of benefits which can also be seen in figure 14.

Type 1: Opportunity during the tender phase to win the bid
Type 2: Opportunity during the tender phase to exploit the benefits after contract award
Type 3: Opportunities during the execution phase of the project i.e., design and construction phase

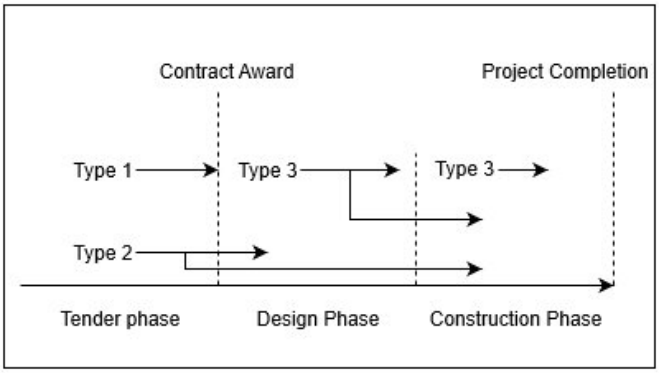


Figure 14: Opportunity categories in Design & Construct Contract (Source: Own illustration)

All three categories have opportunities that could either benefit the contractor and the client or to the contractor only. Out of these three categories, only the first two could occur during the tender phase and the findings are also related to type 1 and type 2 opportunities.

Opportunities benefitted for contractors could be a design and scope related solution. For example; A contractor being able to optimize the given design better after a contract has been awarded to them during the design phase and using the developed solution for meeting the performance requirement given by the client but an extra benefit for themselves. An opportunity like excluding a bridge construction in a highway project from the reference design given by the client by finding a better solution which saves cost and time to the contractor (see appendix A, entry 5). It could also come as a work method optimization (see appendix A, entry 27).

Opportunities could also come as a technical solution for the contractor. For example; finding new construction concept during the construction phase of the project which could be learned from some other projects and applied in the current project (see appendix A, entry 2,6). Opportunities could also come as better planning and scheduling the project (see appendix A, entry 7).

Contractors could also find opportunities which could be beneficial for both the client and the contractor. Finding innovative solutions and alternatives in a project could help in making the bid stronger for the contractor but also help in getting the client's exception fulfilled. For example, in a highway project, the contractor found various innovative solutions which helped to attain the main target of the project as sustainability and resulted in the road being energy positive which benefited both contractor and client (see appendix A, entry 14). *This project was awarded to the contracting party based mainly on their sustainability solution.*

Optimized contractor involvement during the tender phase of the project could also help in reducing downside risk while exploring opportunities through contractors' knowledge early in the process. In one of the rail projects, this resulted in improved solutions submitted during tender which was better for both client and contractor (see appendix A, entry 9). Opportunities could also result in the form of good co-operation and better decision making together with client and contractor. This could lead to a better solution for current project situations (see appendix A, entry 11,12,16).

Contractors could also use the approach of multifunctionality which is discussed in section 3.2.2 where during tender phase, this approach would help in finding better solution and thus making the bid stronger. But, also during the execution phase, the contractors could propose better solution to the client with the same approach of multifunctionality. *If the client agrees on the proposed solution, then the contractor has an added scope of work on an already won contract which is an opportunity to earn extra benefits from the project.*

c) Project value from a contractor's perspective

The interviewees are asked about their perception on project value from a contractor's perspective and is found that project value contains multiple performance criteria and not just cost, time and quality. These performance criteria are termed as project value drivers in this report. Table 5 presents the interviewees' preference on which project value drivers should be considered important by the contractor during executing a large infrastructure project.

Projects are always judged in terms of how much money is being made by the project. Saved time or improved quality by introducing some ideas or solution is always a focal point and all of it comes down to extra money made in the project. Interviewees also agree on these three performance criteria (time, cost and quality) as project value drivers. But they also suggested that these are not the only criteria that a project team should limit their focus on. In total, 9 criteria were found as project value drivers which are divided into tangible and intangible category. Sustainability categorized as tangible value driver is meant in terms of CO_2 and other greenhouse gases emission, energy consumption and

overall carbon footprint which could be measured. The intangible categories are also very important while executing such projects, as conveyed by several interviewees.

Contractors generally seek on maximizing revenue and minimizing cost which is one of the crucial criteria to sustain their business. For this, contractors could use optimized solutions or seek for ideas which would help to get the project done faster, saving valuable time and with desired or enhanced quality. Also, optimum solution to maintain or enhance the safety level during the project execution is an important criterion to be considered. Beside finding solution on improvement of time, quality, and safety, sustainability is also an important criterion to be considered by the project team. Finding sustainable solutions will not only be less impactful for the environment but would also be well appreciated by the client and the end-users which are two of the drivers from intangible category. As one interviewee from client-side added;

"Sustainability is a very important criterion and we as a client organization are now giving more emphasis on it during putting the projects for tender. We create these ambition web where main criteria are listed and each of them is given some points to assess the bid submitted by the contractors and see who would be the most suitable to award the contract. Sustainability subjects like CO_2 emission, eco-friendly material use, impact on ecology and energy consumption are getting more and more attention for our recent projects".

Table 5: Project value drivers for large infrastructure projects from a contractor's perspective

	Project Value drivers	DI 01	DI 02	DI 03	DI 04	DI 05	DI 06	DI 07	DI 08	DI 09	DI 10
Tangible	Cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Quality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Safety		✓	✓				✓			
	Sustainability	✓	✓			✓		✓	✓	✓	
Intangible	Company recognition/reputation	✓	✓		✓		✓				✓
	Relation with client/Trust building		✓			✓	✓	✓			✓
	Satisfaction within project team/people-centric activities										✓
	End-User satisfaction					✓				✓	✓

When looking towards the intangible category, maintaining and uplifting the company's reputation is also very important. If contractors could deliver a complex project with better results then, this would help the company to get recognized in the construction market thus, creating future projects to them. One of the interviewees from contractor side added*; "projects being aesthetically astounding could become an icon of a city or a country like Burj Khalifa of Dubai and getting the chance of associating company's name with it is a nice opportunity for enhancing the reputation"*.

One of the important performance criteria to consider as project value is to maintain a good relationship with the client and proposing and executing solutions which would help in building trust among the two parties. An interviewee from the contractor side expressed her perception as;

"Cooperation with the client is very important to identify and exploit opportunities in a project. Meeting the project requirement would help in building trust and for that project team should also investigate stakeholder's interest and involve them in the process. This can be done through proper stakeholder analysis. As an example, hundreds of lawyers live around the Zuidasdok project area, and you don't want any complaint letters from them, so try to involve them in the process and see what is better for everyone. Also, for gaining trust, contractors could show their expertise in the field that they have the capability to deliver the project by fulfilling all the requirements and for this proper planning is required with timely delivery of allocated tasks".

Contracting company should also consider which solutions and ideas proposed within a project would satisfy their team members as a solution going against their interest won't bring much good to the project in a bigger picture. Team members need to be motivated while doing a project and for that, the procedure and developed solutions should be people-centric. As one of the interviewees added, "*In a project, you are investing in people, so motivation is more important than paying them extra".*

Any infrastructure projects have a goal of serving their target audience, in the best way possible. Thus, ideas and solutions which would help in increasing end-user satisfaction is an opportunity to such projects. This is an important criterion while deciding solutions during a project. An interviewee gives an example related to this as;

"In an area development project, there was a need of a bigger pipe for carrying extra water as a climate adaptation solution. Instead of making the pipe bigger, as an alternative option, a green square with water features could be built within a neighborhood. The square could be kept lower to the ground to occupy the extra water. If both the choice has the same cost for the contractor, then it is wise and recommendable to go for the square as this would add a large amount of social value to the project and would satisfy end users". This solution is satisfying the end-user but also delivering a higher quality solution which would help in maintaining a good relationship with the client.

Thus, project value has different value drivers (performance criteria) other than cost, time and quality and wise use of them would bring more opportunity in the project. Contractors should always be open to all kind of possibilities for gaining more benefits. In the project, it could reach the point that it's difficult to handle more complexity but as one interviewee added, "*opportunity often comes with added complexity".*

d) Factors stimulating identification of opportunities

From the literature study, 22 factors are identified which would help in creating and identifying opportunities in large infrastructure projects. During the detailed interviews, interviewees are asked about their views based on their experience on top factors that would help this process of opportunity identification. Many factors suggested by them are already identified from the literature while 11 new factors are collected from nine interviewees out of ten interviews done during detail interview sessions, which are not in the initial factor list and can be seen in table 6 and an extended explanation is presented in appendix E. An importance level study of these 33 factors is presented in section 4.4 of this report.

Table 6: Factors stimulating creation and identification of opportunities in large infrastructure projects

S. N	Factors	Explanation
F23	Presence of opportunity identification process and its implementation	The opportunity identification process should be there especially during the tender process and should actually be used by the team members.

F24	Trust and open communication between the project team members	Improved communication between team member (it's not a one-man show to identify opportunities thus; the whole team needs to contribute towards it. This can be done by not keeping possible opportunities to ourselves but putting it on the table, so everyone could look up to and analyze better. For open communication, trust within each other is required.
F25	Flexible client	Flexible client to help and assist during the process of construction
F26	Experienced project team	Team members with enough experience regarding similar projects could identify more opportunities in projects.
F27	Change in culture of how we see and approach opportunity	Self-serving mentality of project members involved in the process should be changed where members generally don't want to raise their performance benchmark to lose their regular incentives through their sub-optimal effort.
F28	Flexible reimbursement scheme	Pricing scheme of projects from the client could be improved for exploring more opportunities.
F29	Interface management between different parties and discipline	Proper interface management between the parties and discipline involved in the project should be done effectively where each party should be up to date about the progress of the project.
F30	Coordination between review team and execution team	Proper coordination should be maintained between review team which is not generally involved in the daily execution works of the project and the execution team, so while discussing any possible ideas, it could be easily understood by everyone and approved for exploitation.
F31	Team members are proud and enjoy doing the project	Project team members being proud of what they are doing helps in making a positive atmosphere in the work environment thus, increased work efficiency.
F32	Awareness of possibilities for coupling of solutions	Thinking of extra possibilities – should be aware of other possibilities to combine it with a solution, like; energy, climate, health, etc. (Integrating specialization like integrating buildings with climate, health, energy and attract more investors and make your project more valuable)
F33	Able to handle increased complexity (chaos)	As a project member, one should be able to handle chaos while identifying opportunities, because it is easy to dive into every possible opportunity and try to fix them all but a structured approach by handling the chaos would help in making timely decisions, so the opportunity could actually be implemented in the project.

e) Improving the approach for identifying opportunities

To improve the current approach of contractors for identifying opportunities in large infrastructure projects, various suggestions are forwarded by the interviewees which are summarized below.

Increased focus towards opportunity management

Generally, the focus of project team is still towards managing the threats in projects, but opportunities should also be explored during the project for additional benefits. For this, it should be a regular part of the tender process and should be given enough space to invest time on exploring opportunities connected with a project. As risk management which focuses on the negative side, consists of various

activities like; risk workshops, brainstorming sessions, identifying risks online and so on, a similar approach could be used but with equal attention towards the positive sides as well. This attention should not be a one-time job but, should be a continuous process in every phase of the project. It is generally difficult to shift the focus for exploring opportunities due to nature of construction industry with high competition to win the bid, limited space in contract, and work pressure during execution but, this focus is needed to explore opportunities in projects.

Adjustments/approach in risk (threat & opportunity) management workshops for idea generation

Before conducting a risk workshop during the tender phase, contractor must assess the client's preference in the project. If the client is open to innovative ideas then, along with project team's idea, the team should also be aware of the ideas from the client because these ideas can come from many sides (shareholders, stakeholders, etc.). So, an open workshop is required with all relevant parties.

During the risk workshops, brainstorming sessions for identifying opportunities are conducted. As it is a crucial step in opportunity identification, several interviewees recommended various areas to be touched upon during such sessions which are discussed below:

a) While thinking of new ideas in the project, it should be both shallow and deep thinking. Shallow and out of the box sessions to get a wider perspective and deep and narrowing down of ideas to be focused on preparing a detail implementation plan.

b) Opportunities identified should be visible to everyone, so the team members should open up during such workshops. Team members' personal interest should be aligned with the company's interest so the motivation of producing better solution is required among the team members. As one interviewee from the contractor side explains;

"*Identifying opportunities also requires real thought process and being entrepreneurial. Being entrepreneurial comes at risk but it should be taken and also incentives could help in people being entrepreneurial because generally, people don't put extra effort for nothing".*

c) Ideas during the workshop should be developed which enhances project value. In the bids, project team should put such ideas with a multifunction solution which would make the bid stronger and the contracting party could be better than their competitors. If innovation is one of the requirements during tender, then such ideas are expected by the client.

d) Innovative ideas could be thought of during this process. If the client's requirement includes sustainability then ideas like using alternative materials (bamboo instead of aluminum for the road signboard, bio-based bitumen instead of fossil-based bitumen, etc.) or alternative techniques of construction (cathodic protection for sheet pile instead of normal sheet pile for preventing water leakage which would allow the pile being used to be smaller in width than the normal width, so less material used, thus less CO_2 emission) among others can be proposed.

e) Contractors who are also active in the exploitation phase could also take the role of an investor. So, during the brainstorming sessions, ideas such as; if the contractor has expertise in energy production sector then for road construction, ground pipes could be used for water carriage which could be used for energy production. So, two works are being done at the same time. While the contractor could do the main job of constructing the road but, also could get benefitted from energy production as an investor.

f) Ideas which seems threat driven could also be explored for its positive side. People are generally focused towards threats side, but the opportunity side is also important. One interviewee who works

as a value manager elaborates an approach which could be used if the client or other project decision-maker is reluctant about exploring opportunities and thinks it's a waste of time.

"Identify opportunities first, then frame it as not dealing with opportunities is a risk to the project or stakeholder management, then the client or decision-maker would be more attentive towards it".

g) Ideas could also be generated by looking into project surrounding and use of its surrounding in the best possible way. In one of the road projects, the contractors negotiated with the nearby residents with a bigger house to keep solar panels on their house so that the contractor could use produced energy for the road operation.

h) Exploiting new opportunities generally seek change in the initial plan. To realize such opportunities, the project team should know about the effect of change onto other activities and on overall project planning. The analysis of change should be done early in the process so that it is manageable. As one interviewee from the client-side explained;

"*Since projects are generally complex due to a lot of variations thus handling the change effectively is of utmost importance. If the team cannot handle change, then don't seek any new opportunities and stick to your initial plan. When a change comes to a project, there are always more than one scenario to choose, and scenario analysis needs to be done on cost and benefits properly for opting the right scenario for the project. He suggested, the decision on change (idea implementation) should be checked for its; consequence, ability to handle change, resources required, and benefits that it fetches".*

i) An approach as Buurbouw (Building with neighbors) could also be used by contractors. It won't be big opportunities for contractors directly in terms of money but, could have a big impact on the neighborhood and overall reputation of the project. It's a way to get smooth execution of the project. As an interviewee from the client-side explained;

"For instance, a big tunnel or road project is going on near a neighborhood. The nearby people generally demand small things like a small garden or green area within the project's vicinity. This can be solved by contractors by talking with them to sort things out, like what did we destroy from our project and where can I help you. At a large construction site, where activities go for 5 years or longer period, it's a continuous nuisance and visual pollution for residents nearby. Iron fences are generally kept which are ugly and unpleasant for the neighbor so instead, small changes could be made to the solutions like trees in a row can be planted as the fence which makes the view better and ensures the functionality as well. It's a small change in the work scope for the contractor but big for the surrounding. Another example could be, construction vehicles producing continuous sound (beeps) is annoying and irritating to the neighbors instead, white noise could be installed on those vehicles, which are much smoother to the ears and are also very much appreciated by the local people. So, it's not only about the technical solution but also about people." (End-user satisfaction/Company recognition)

j) Large contractors could also work with startups for generating new ideas which would be helpful for the contractors in developing effective solutions. As one interviewee from client-side explained;

"*For example, bamboo as a replacement of steel for highway safety rails might not be known to the big contractors which is better for low emission. If they don't believe its structural capability, or they don't have the certificate of using it, then they won't have an option to offer it to their client which could have made their bid stronger, so the startups could fill that knowledge gap. Finding each other, having meetings and building trust with each other could bring such solutions into the project. Proving the strength of wood through testing can make the things that you don't know (known unknowns) to*

(known knowns) while initially, it was (unknown unknown) when you didn't even knew that such solution existed".

One of the interviewees from the contractor side explains an approach that might be helpful during risk workshop during the tender phase. Suppose a risk workshop contains 30-40 ideas during the tender phase. For choosing the best ones to work further, he suggested a strategy as;

Strategy

- Focusing on the big rocks first (ideas which are more impactful and carries larger benefits) which is similar to the famous example of a jar with rock, pebbles, and sand as ideas so, the bigger ones have to be chosen first in order to get maximum benefit.
- Each participant votes on the idea and gives their opinion about its feasibility. This will help in filtering the ideas.
- A tradeoff matrix is then made for each selected idea where elements like design feasibility, risks associated with it and other important elements are prepared. Based on this tradeoff, most feasible ideas are selected.
- The philosophy recommended is;
    1. Focus on simple design but the design should be ecofriendly, technically and aesthetically sound
    2. Check the design with the client's requirement, if most of the requirements are being met by the design then good, go-ahead
    3. Now, try to find extra requirements which could be added on to the design and could be suggested to the client for gaining extra profit for the contractor.

These workshops could generate great ideas, but it is worthless if not committed to it and is followed until it has been realized/materialized in the project. Ideas with greater impact should be considered further in the process. Such ideas, if developed with enough confidence level could then be used for adjustments in the estimates (could be used similar to negative risk reserve), so the contractors could quote the price accordingly. For threats, if it doesn't occur then the effect is zero but if it does occur, the effect is negative to the contractor. While for opportunities, if it occurs then the effect is positive but if it doesn't occur the effect could be either neutral or even negative. As suggested by one of the interviewees from the contractor side, suppose an opportunity of excluding a bridge worth 200,000 euros is discovered in a large highway project during the tender phase. Two cases could be encountered; In the first scenario, contractor could have the opportunity to bid low and win the contract but also the threat of losing extra money. In second scenario, contractor have the opportunity to get extra benefit during execution.

i. Contractor didn't include the price of the bridge while submitting the bid then either,
    - Contractor plans not to build the bridge and doesn't get extra money for the client so no profit no loss, but he could win the bid due to a lower price quotation
    - Contractor plans not to build the bridge but have to build it with no extra money from the client then it's negative transaction for them

ii. Contractor includes the price of the bridge while submitting the bid then either,
    - Contractor doesn't build the bridge but gets paid by the client so positive
    - Contractor builds the bridge and gets paid for it so neutral

So, while deciding on such scenarios, the probability of opportunity occurring should be assessed properly. If the probability is really high, first scenario is better. If the probability is not that high, second scenario is preferred. This is particularly important after identifying all the opportunity and after preparing an opportunity list. A decision needs to be taken by the project team based on the

assessment on choosing the favorable option (at that time) between the two scenarios described in the example for each opportunity. The probability of occurrence for any opportunity could have a benchmark from the company to choose between two scenarios but should also be flexible enough based on project type as each project is different and it depends on the context of project and risk appetite of the contractor company. One interviewee explained:

"According to International Finance Reporting System (IFRS), in the forecast, the Percentage of completion (POC) should be of at least 75% certainty at the current time that you are able to do so, and the idea will be materialized. If the idea is having a lower probability of occurrence, then list the ideas or claims which could be possible opportunities for the project and provide a range of percentages, maybe 50% certain or more or less. Then decide on what could be the steps of turning that idea into an actual opportunity for the project".

If the idea is successful than extra benefits come to the project but if it is unsuccessful, an investigation needs to be done on finding the reasons for idea not being successful. This investigation could then be used for future projects, thus should be properly documented.

Activities to turn ideas into opportunities

To develop successful ideas and turn it into a real opportunity for the contractor, several key activities are suggested by the interviewees which are mentioned below.

a) Proper interface management should be done between different disciplines involved in the project team.

b) Team members should be very much aware of the project details where they could see a chance of materializing an opportunity. This focus of exploiting opportunities should be kept throughout the phases. Also, requirements from the client should be thoroughly reviewed and if some blocking point is presented in the contract then it should be discussed if it is really relevant to this project because sometimes the restrictions are kept based on client's past project experience.

c) Project teams should work in sub-teams to find the best solution for a common problem. In this phase, the sub-team members working for their individual solution could develop an attachment for their work and think it's the best, while chances are developed to overlook another team's solution which might be better than theirs. As one interviewee from the contractor side said, "*Do not get in love with your own design"* and this behavior could also be understood as a sunk cost fallacy.

d) While working on a project, five factors are important within the team members; open, trusted, predictable, proud, and pleasure. Team members should also be committed for bigger impact ideas at first and then smaller impact ideas should be followed.

e) Opportunities could be exploited in the projects, but it needs proper communication with the client. So, the challenge is an appropriate dialogue with the client. Right balance is needed when discussing with the client, not too abstract and not too detailed. An interviewee from the contractor side gave an example as;

"In the project requirement given by the client, it says one road should be blocked. If the contractor simply requests, we want to open that road for our convenience then the client will probably not agree to it. But, if it is reframed and asked about what the client is concerned about and why it is restricted, with further elaboration on the added value to the project provided by solution if the contractors are allowed to use the road then the client could be convinced in accepting the request. Convincing the client with SMART arguments where it is linked with reasons why certain thing is important and could benefit the project could be a useful strategy while negotiating".

f) Maintaining a healthy relation with client and stakeholder is also a major helping factor for finding good solutions. As one interviewee from contractor side explained:

"*There are design difficulties to get a solution together between involved parties because they don't want to play open card, open communication is lacking. Parties don't want to put everything on the table, which restricts to create a solution which would be beneficial to everyone and to create a win-win situation. Both client and contractors aren't always open about their costs and their views on the project".*

g) As a contractor company, specialization in various fields is needed to identify more opportunities in projects. As one interviewee who works a consultant explained;

"Understanding the specializations of different functions that could be added in your solution is important. When you build a neighborhood, then you must have the knowledge of different sectors like energy, health, water, and so on and there you could see possible combinations of solutions. It could be done from the obvious ones which are easy to start. Nowadays, healthy cities as blue zones where health is improved when living in this area are on the rise (blue zone features: places to move around, clean air, shops with healthy foods, etc.). As a contractor, knowing blue zones better than your competitor gives you the opportunity to propose better ideas to the client which gives a competitive edge in the market. So, knowing what specialization is out there, how it can be integrated and what they mean for one another is very important. The way cities are being developed at this moment, you must apply multifunctionality otherwise you are not a player in the field. If the specialization is not inhouse then, small architectural firms who know everything about one or two functionalities could be of help for gaining required information and winning the bid".

h) Involving stakeholders during the design phase is also important as they could have valuable inputs in the design of the project. As one interviewee from the contractor side explained;

"Contractors usually have this difficulty of involving others during the design phase, but it should not be the case. Stakeholder involvement could increase efficiency in your project, and it would be helpful for the contractors. End users could suggest what kind of design would be more useful for them which would ensure its usability afterward as well. This fits also in D&C contracts, after tender phase when the price is already fixed, and the project is in the design phase, use of end-users might create better ideas to deliver the same performance level of the product but cheaper in cost and less in time. Thus, increased efficiency and profit for the contractor".

Client-side improvements

Few activities could also be done from the client-side to realize opportunities in such large infrastructure projects.

- One interviewee from client-side explained the importance of client-contractor relationship during a project.
  "*When either client or contractor sees an opportunity in a project, then discussing together for potential benefits for each party is very important. If the idea is not that relevant for the contractor moneywise but is better for the client (because of project image or for political reasons) then the client should add extra money to realize that idea. Because contractors doing it without additional money could have financial consequences for them and could also deteriorate their relationship which is not good for the project and also for future projects. If the client sees the idea is a negative business case for one of them, then help each other by some means. The client doesn't always have to give extra money but could help contractors by other means like giving permission to use the road(space) for a longer time where the*

contractor could store materials and working on-site could be fast and easy. It might not be in the contract to give that additional space but could be done as a common understanding. This can only be done if you know each other's problem and opportunities, thus trust-building and enhanced communication is required. Contractor should make better use of such opportunity because if you try to overuse it, then you lose the trust, and next time client won't help the same way".

- Sometimes, there is inefficiency in reference design provided by the client which could be made better if they involve contractors in the early phase of the project (early contractor involvement). If adopted this solution, early contractor involvement should be done with a proper assessment of contractor's capability so that the design could be improved at the early phase itself due to contractor's knowledge and the client doesn't have to make a separate reference design.
- As one interviewee who works as a researcher explained, it is generally seen as opportunities are exploited more in projects which have enough funding from the starting. In other cases, capturing extra value in construction projects usually happens at the point when the project is experiencing problems like; not getting funded or getting a lot of obstruction for realizing it. The additional value provided by the project could then be discussed to get more funds and get the project approved for construction (e.g., A2 tunnel in Maastricht, The Netherlands).

4.3.4 Conclusion

This step of detailed interview with the experts have a large input for this study which also supports the information collected from the literature study in chapter 3. These discussions gave additional information to answer the first sub-question about explaining the concept of opportunity and project value in large infrastructure projects. Along with that, additional information is collected regarding sub question b and c as well. It was also helpful to collect information regarding improving the current approach towards opportunity management. Information regarding inclusion of various activities while doing the opportunity management workshops so that more opportunities could be explored in the project. Some of the suggestions made for improving the approach corresponds with the 33 factors identified as important for opportunity creation and identification.

4.4 Questionnaire Survey

After collecting 11 more factors from the detailed interview with various experts, now the list consists of 33 factors that would help in identifying opportunities. The initial 22 factors were not shown to the interviewees during the detailed interview so that they could provide extra factors based on their perception and not just repeat the same factors found in the literature. But, to know relative importance level of each factors specially for a D&C contracts from a contractor's perspective, this step of online response is needed to weigh each factor by the interviewees.

Questionnaire Survey is done after the detailed interviews with same and additional respondents so that unbiased views of all the respondents could be collected on all 33 factors at once. There are 18 respondents who were supplied with the questions and 11 of them submitted their response with a response rate of 61.11%. The detail of the respondents can be found in appendix F1. These respondents gave the importance level for each of the 33 factors out of scale 1 to 5. The full respondent scores can be seen in appendix F2. Also, project value drivers are scored as per there level of importance for a typical design and construct contract large infrastructure project from a contractor's perspective which is presented in appendix F4. The application regarding the findings on project value drivers is explained in chapter 6.

After the respondents provided with their scores on 33 factors as per their importance in opportunity identification in D&C contracted large infrastructure project from a contractor's perspective, table 7 summarizes the importance of each factor based on average scoring from the respondents.

Table 7: Importance level and Relative Important Index (RII) of stimulating factors for opportunity identification

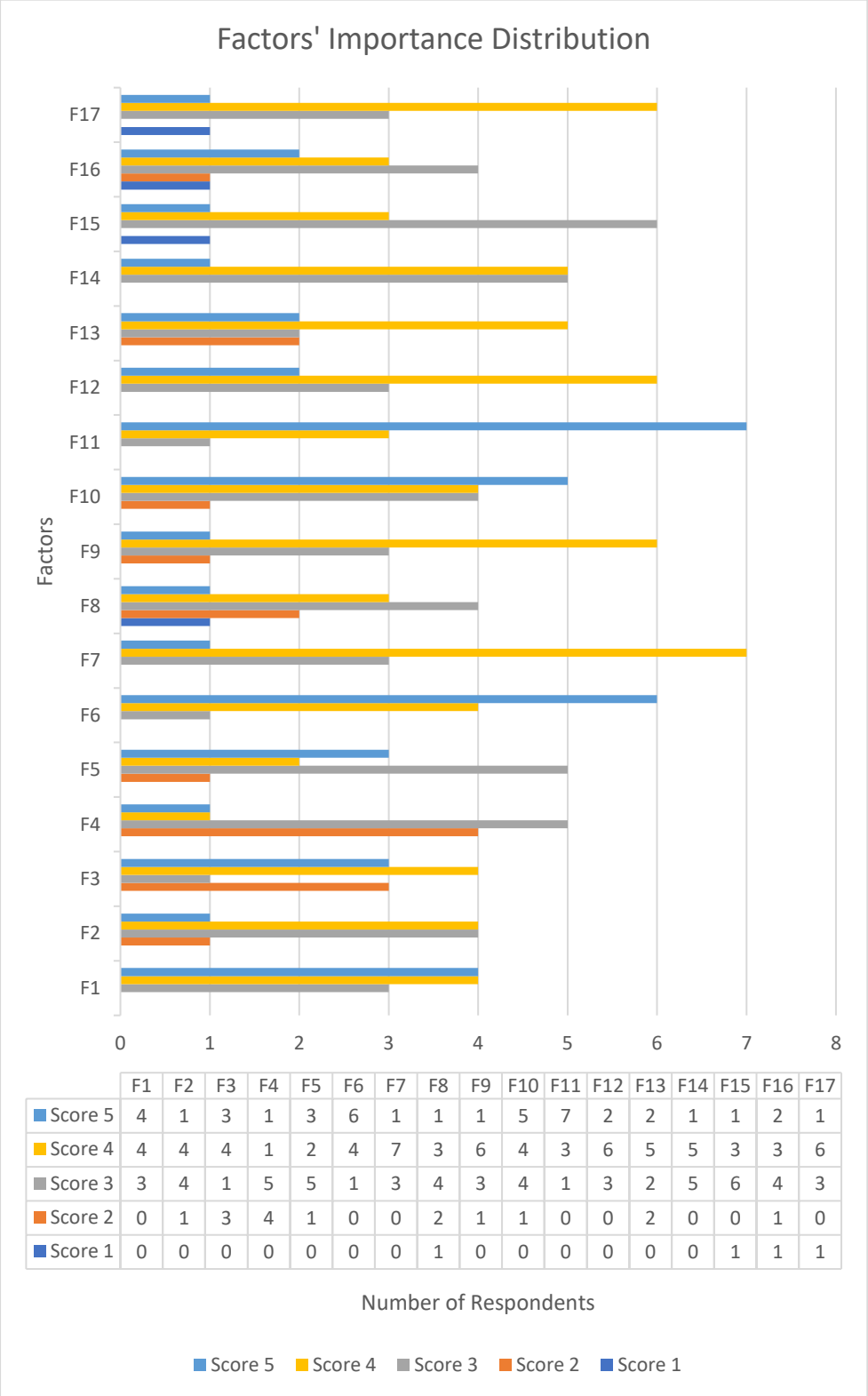
S.N	F.N.	Factors	Avg. Score	RII
1	F24	Trust and open communication between the project team members	4,64	0,93
2	F11	Ability to analyze the impact of change	4,55	0,91
3	F6	Formation of collaborative work culture	4,45	0,89
4	F26	Experienced project team	4,36	0,87
5	F25	Flexible client	4,27	0,85
6	F33	Able to handle increased complexity (chaos)	4,09	0,82
7	F1	Project manager with business-oriented mindset	4,09	0,82
8	F31	Team members are proud and enjoy doing the project	4,00	0,80
9	F12	Ability to communicate potential value of the opportunity	3,91	0,78
10	F19	Will and power to change the originally planned solutions and deliverables	3,91	0,78
11	F29	Interface management between different parties and discipline	3,82	0,76
12	F7	Open communication with client organization	3,82	0,76
13	F18	Acceptance of change in the project	3,73	0,75
14	F30	Coordination between review team and execution team	3,73	0,75
15	F23	Presence of opportunity identification process and its implementation	3,73	0,75
16	F2	Ability to capture stakeholders' view of value	3,64	0,73
17	F3	Ability of project manager to develop holistic view within the project	3,64	0,73
18	F5	Organizational support and interest	3,64	0,73
19	F9	Ability to balance between control and flexibility	3,64	0,73
20	F10	Demanding goals in project	3,64	0,73
21	F13	Taking the lead for opportunity exploitation	3,64	0,73
22	F14	Shared commitment among involved parties	3,64	0,73
23	F20	Learning and knowledge sharing	3,64	0,73
24	F17	Celebrating achievements of the projects	3,55	0,71
25	F21	Understanding human behavior	3,55	0,71
26	F16	Involvement of different categories of stakeholders	3,36	0,67
27	F32	Awareness of possibilities for coupling of solutions	3,36	0,67
28	F28	Flexible reimbursement scheme	3,36	0,67
29	F15	Stakeholders being proud of the project	3,27	0,65
30	F27	Change in culture of how we see and approach opportunity	3,18	0,64
31	F8	Individual and project-based incentives	3,09	0,62
32	F4	Ability to understand how other organization affects the project objectives	2,91	0,58
33	F22	Tight project budget	2,45	0,49

Here, average is calculated as = $\frac{sum\ of\ all\ given\ scores\ for\ a\ factor}{number\ of\ respondents}$, and

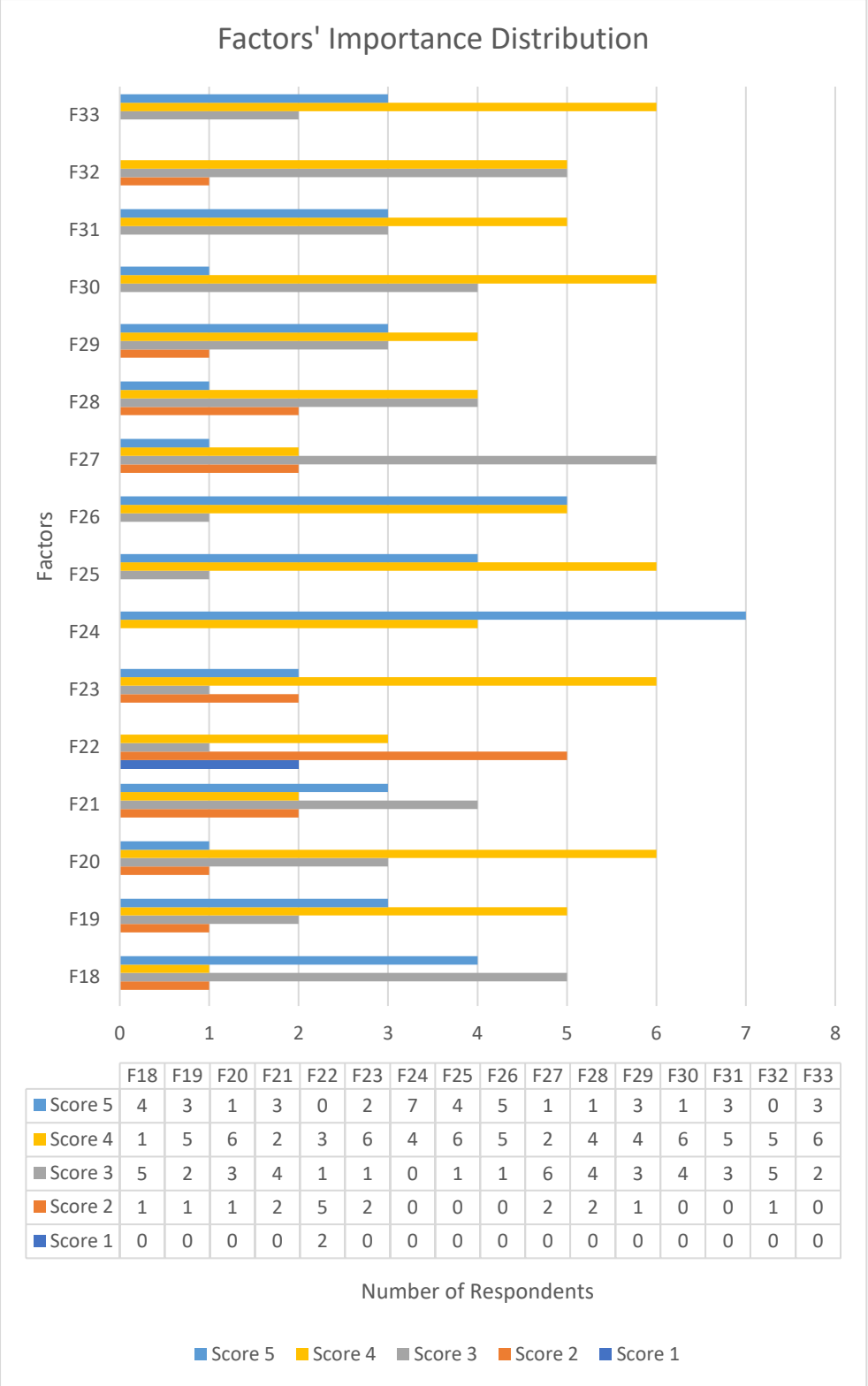
Relative Important Index (RII) is calculated as = $\frac{sum\ of\ all\ given\ scores\ for\ a\ factor}{number\ of\ respondents \times maximum\ possible\ score}$

(Source: Yucelgazi et. al., 2019)

These factors are scored by various practitioners and the score distribution can be seen in figure 16.



	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17
Score 5	4	1	3	1	3	6	1	1	1	5	7	2	2	1	1	2	1
Score 4	4	4	4	1	2	4	7	3	6	4	3	6	5	5	3	3	6
Score 3	3	4	1	5	5	1	3	4	3	4	1	3	2	5	6	4	3
Score 2	0	1	3	4	1	0	0	2	1	1	0	0	2	0	0	1	0
Score 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1



	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28	F29	F30	F31	F32	F33
Score 5	4	3	1	3	0	2	7	4	5	1	1	3	1	3	0	3
Score 4	1	5	6	2	3	6	4	6	5	2	4	4	6	5	5	6
Score 3	5	2	3	4	1	1	0	1	1	6	4	3	4	3	5	2
Score 2	1	1	1	2	5	2	0	0	0	2	2	1	0	0	1	0
Score 1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0

Figure 15: Factors points distribution by the respondents

From table 7, the importance level of each factor could be known. It can be observed that the differences in the importance level of each factors is marginal and only tight project budget (F22) is below the half mark line. Since the margin between the factors are low, the importance level for each of them are seen as relatively higher to lower while comparing it with one another. Thus, it could be argued that these factors are crucial and act as a positive a catalyst for opportunity identification in

such large projects, where tight project budget acts as a hindrance towards opportunity exploration process as supported by several interviewees and respondents.

For further clarification, these 33 factors are clustered into six groups based on their similarities in characters. These six groups are presented below. A full list of factors in each group can be seen in Appendix F3.

1) Competency
2) Company Policy
3) Collaboration
4) Client Related Decision
5) Self Reflection
6) Process Related

To know the weight distribution of each group in terms of crucial factors for opportunity identification, a chart can be seen in figure 16. The group weightage is calculated as below and a list of scores can also be seen in Appendix F3.

Group weightage = $\frac{Total\ factor\ score\ in\ each\ group}{Total\ factor\ score} \times 100$

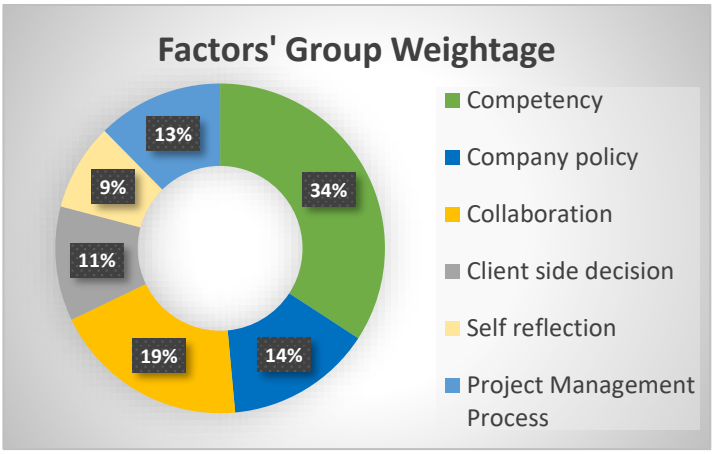


Figure 16: Factors' group weightage

Here, team competency has the highest weightage since it contains 11 of the 33 factors followed by collaboration with 6 factors, company policy with 5, Project Management process and client-side decision with 4, and self-reflection with 3 factors. These groups are related to each other and factors within one group is needed to enhance another group's performance. The relation between these factor groups can be seen in section 4.5 (sub-question b). Further, this clustering is also helpful to observe the required focus areas for opportunity identification while preparing for a project.

4.5 Conclusion

Information regarding sub-question a

Opportunity

Opportunity is an uncertain event or condition, factors, and variation that causes change within a project setting which will have increased positive effect than planned in at least one of the project's objectives and would increase project value. An idea or solution perceived as opportunity should benefit at least one of the stakeholders (contractors in this case) involved in the project to be considered as an opportunity. These benefits are in terms of added value for them in a project. To understand how an opportunity affects a project, value drivers should be understood well and fixed at the beginning of each project by the project manager.

Opportunities in large infrastructure project under D&C contracts can be seen as an opportunity during the tender phase to win the bid and opportunity during the execution phase to earn extra benefits. Opportunities discovered during both phases could either benefit the contractor and the client or to the contractor only. It is the choice of contractor how they want to approach a project but an important thing to remember is how they want to enjoy the benefits of the project. Opportunities for contractors in such projects could come in different forms but are not limited to these forms only, which can also be seen in appendix A.

a) Design and scope related solution
b) Technical solution
c) Contractual space
d) Work method optimization
e) Development of better organization form in the project
f) Better decision making
g) Initiating valuable activities, and so on.

An opportunity (Type 2) to specifically identify in the tender phase and be exploited only after the contract is awarded to the contractor is limited to explore because of several reasons:

1) Due to high competition in the market, during tender phase contractors generally focus towards winning the bid. Thus, the focus is towards identifying opportunities to help them win the bid (Type 1 opportunity).

2) Due to high work pressure and time constraints, the project team does not really focus towards Type 2 opportunities during tender preparation and is identified and explored later after contract award making them Type 3 opportunities. This constraint is also mentioned in the case study section 5.4.

3) More opportunities could be identified once the project team gets more familiar with the project (starts working with the design details/construction planning) which again results in Type 3 opportunities.

But this does not mean they are not present in such large projects. Although type 2 opportunities have bottlenecks for its full exploration, the identification process is still the same as type 1 opportunities which is explained in section 6.2. Since opportunity in concept is the same, and the process of identification is also the same during the tender phase, the only element making a difference here is, when to exploit an opportunity. An opportunity identified during the tender phase could be exploited at the same phase (Type 1) or after contract award (Type 2). Thus, a decision needs to be made after identification of opportunities during the tender phase based on the following criteria;

1) Its probability of occurrence and its impact on the project
2) Project scenarios like; market competition, availability time of the solution, project's requirements and so on.

Since each project is different in nature and characteristics, a decision should be made by the project team on if the identified opportunities would be exploited as a Type 1 opportunity or Type 2 opportunity. Based on the decision made, adjustments could be made accordingly to the project estimates. This is also explained in section 6.2.1, step 9.

As observed from various examples collected during this study, Type 2 opportunities are found on design and scope related solution, technical solution, contractual space, and work method optimization. They are also dependent on the negotiation done with the client to implement them in the project after the contract award. This is because these kinds of opportunities generally come with a change, except for the opportunities in the form of work method optimization, since during contract submission, these opportunities aren't disclosed to the client. Examples of type 2 opportunities can be seen in appendix A (entry 1,5,8,17,19,20,21,22,23,25,26,27,28,29,30). Another way is, an agreement could be made with the client in advance to share the benefits of opportunities if explored during the project, but this kind of agreement is generally initiated from the client-side (refer appendix A, entry 26). These examples are only limited to this study, while further opportunities could be discovered in such large projects.

All these opportunities that could occur in such projects are either an uncertain event or condition that occurred as the project progresses and the project team is more familiar with the character and behavior of the project and its related elements. Each of the opportunities, as a result, should have a positive effect on the project in terms of fulfilling its objective and enhancing its value.

Project Value

Project value in simple term is the benefits getting out of a project against the invested resources for gaining those benefits. Since project value is a multi-dimensional concept and subjective in nature these benefits could be in terms of one or any combination of nine project value drivers (performance criteria) which are represented in table 8. To enhance project value, it is important to know the priorities on project objectives and value drivers of a project reflecting the requirement of various parties and stakeholders involved. This should be done in advance by the project team by scrutinizing the expectation of client and major stakeholders involved in the project along with the company's expectation from the project and deciding the project value drivers accordingly. Opportunities in a project should increase project value and fixing the value drivers in advance would allow understanding how the company wishes to enjoy the benefits from a project when an opportunity is encountered. Also, the benefit of an opportunity is assessed in terms of these 9 value drivers and they are used for the assessment part of the proposed procedure for opportunity identification (figure 22) as well.

Below a table consisting of project value drivers is presented with findings from literature and experts from detailed interviews. Since, project value is a subjective concept and depends from project to project, for a typical large infrastructure project contracted under Design & Construct contract, the contractor could prioritize their value drivers among the ones presented below and could decide on their definition of the project value for each similar project. Table 8 gives an extension of project value drivers from just saved time, cost and enhanced quality to other tangible and intangible drivers that are also important in such large projects to identify and assess opportunity for its value addition.

Table 8: Project value drivers for large infrastructure projects under Design & Construct Contract

		Literature				Interviewees									
	Project Value drivers	Eskerod et. al., 2018	Lechler et. al., 2012	Vuorinen et. al., 2018	Martinsuo & Kellen, 2014	DI01	DI02	DI03	DI04	DI05	DI06	DI07	DI08	DI09	DI10
Tangible	Cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Time	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Quality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Safety						✓	✓				✓			
	Sustainability	✓		✓	✓	✓	✓			✓		✓	✓	✓	
Intangible	Company recognition/ reputation	✓				✓	✓		✓		✓				✓
	Relation with client/Trust building	✓	✓				✓			✓	✓	✓			✓
	Satisfaction within project team/people														✓
	End User satisfaction	✓	✓	✓	✓					✓				✓	✓

(Note: Tick mark represents the preference of each researcher and interviewee regarding what they see as project value drivers in large infrastructure projects)

Information regarding sub-question b

The important factors which could help in stimulating the creation and identification of opportunities in large infrastructure projects are presented in section 4.4, table 7. These 33 factors are clustered into 6 groups and their relation can be seen in figure 17. A detail description of each factor is also presented in Appendix E. These factors will create a strong foundation for opportunity creation, identification, and overall opportunity management in such projects. Also, these factors could reduce the constraint's effect for opportunity identification in such large project. A relation between constraints (found through case study in chapter 5) and the factors is presented in Appendix G.

For identifying opportunity, a company needs to have a well-supportive policy towards opportunity management. Opportunity management process should be given enough space and attention during tender preparation while maintaining an encouraging and positive environment in the project. Right policies would help in uplifting team competencies by investing in necessary skills, tools, and training needed for its employees. A competent team should also work collaboratively within themselves and with client organization since opportunity management needs an open and joint approach. For effective collaboration, initiatives from both contractor and client-side are required where the client could be flexible with their reimbursement scheme. Solving issues like tight project budget would provide enough room to explore more opportunities in a project while demanding goals in the project would challenge the project team to look for better ideas. A collaborative approach in the project would also help in learning and knowledge sharing, along with the smooth handling of changes during the project. On the other hand, such project management approach will further strengthen collaborative work culture within the project team and with the client organization.

It is very important to be proud of what one is doing and should enjoy the process. This would help in being more collaborative and developing an optimistic attitude while executing a project. Self-reflection and introspection are needed to change the culture of only focusing on the negative side of risk (threat) to a more optimistic side (opportunities), giving enough attention to both sides. Thus, all six groups are related to each individual factor contributing to the process of opportunity identification and its management in a project. These factors will provide the initial base needed to start an effective opportunity identification process in such large infrastructure projects.

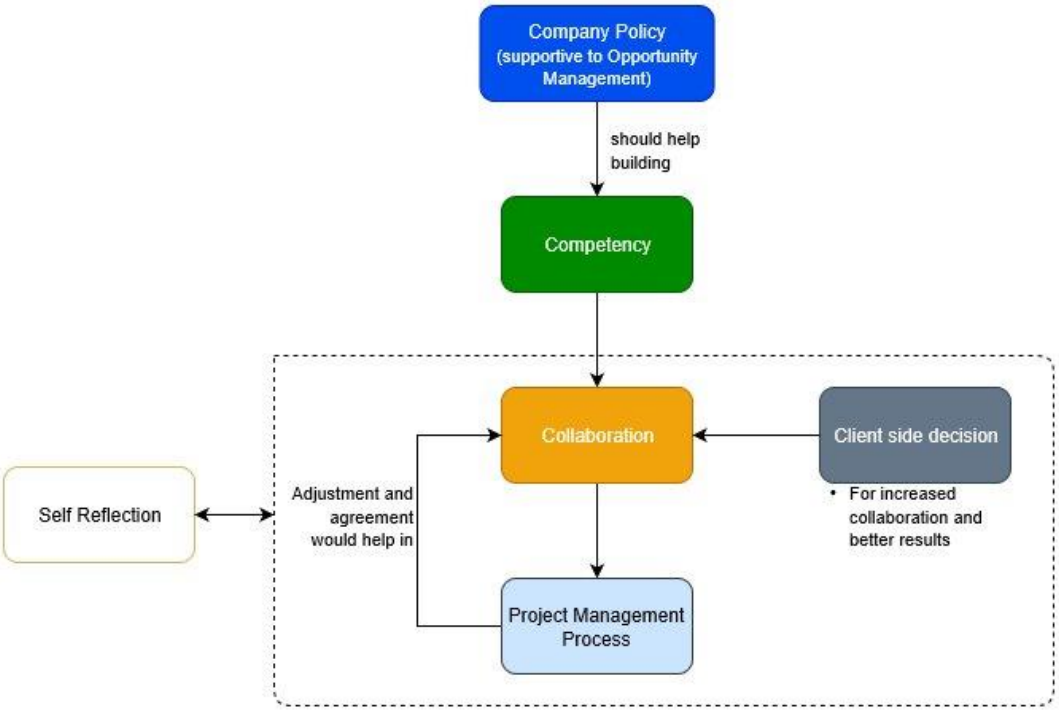


Figure 17: Factor's group relation (Source: Own illustration)

5. Case Study

As per further step in this research, case study of relevant infrastructure projects is done within the study scope. The case study is done completely from a contractor's perspective. For this, D&C contracted large infrastructure projects are taken as reference cases. This section examines on why opportunities are not being explored in such large projects and what could be adjusted for minimizing such hindrance, so more opportunities are explored in projects.

5.1 Criteria for selection of Cases

To find the relevant cases for this study, several criteria have been established to get to explore relevant project case. The criteria for the selection are as follow;

- The selected project should be a large infrastructure project. In terms of budget, there is no consistency to categorize a project as large infrastructure project. As explained by Warrack (1985), a project with $100 million budget could be termed as a large project but is not a fixed benchmark. Hillson & Simon (2012) also claims that while looking from a company's perspective, it varies as per the size of the company and the regular projects the company handles. Since, there is no exact benchmark in terms of budget to categorize an infrastructure project as a large infrastructure project, the projects with budget higher than 50 million euros which was suggested by an interviewee during the initial interviews is taken as a benchmark to be considered as a large infrastructure project for HOCHTIEF. This study is focused towards large infrastructure projects so, the selected cases should fulfill this criterion. Also, selected projects should have technical and contractual complexity while spanning for several years for its completion as stated as a character in section 3.1.1 (b).
- The project should be executed by HOCHTIEF or a consortium of several constructors including HOCHTIEF.
- The selected case should be Design & Construct contracted project because the main research question is focused on D&C Contracts.

Apart from the above four criteria, suggestions were given by the interviewees of the company during initial and detail interviews, when a question was asked, "*Could you suggest any project within HOCHTIEF where you were involved and where opportunities or unexpected benefits were realized*". Few interviewees suggested some projects while others could not suggest a project because of their unawareness or less tenure within the company.

The projects selected are;

1) Zuidasdok, Amsterdam
2) Confidential, Qatar

The name for the second project is kept confidential due to the condition put by the case interviewee as the project still has some clearance issue with the client. However, relevant information for this study has been provided by the interviewee.

Both are large infrastructure projects and fulfills other criteria mentioned above, thus appropriate for the case study. The main aim of this case study is to find the constraints regarding opportunity exploration that generally prevails in such large infrastructure projects and finding solutions for the identified constraints, if possible, to improve the overall approach towards opportunity identification. The secondary aim is also to check with the overall risk management process in respective cases.

5.2 Case 1: Zuidasdok, Amsterdam

5.2.1 Introduction

ZuidPlus started the tender phase in October 2015. The tender was provisionally awarded to ZuidPlus (a consortium between three construction companies: Fluor, HOCHTIEF, and Heijmans for Zuidasdok project) on January 19, 2017. The final award and signature of the contract took place a month later. This project is under a lumpsum contract where the client and contracting company agreed for a fixed amount to deliver the design and construction of this project. Zuidasdok is a large project with the contract estimate of around 990 million euros and the project is in collaboration between Rijkswaterstaat, ProRail, and Municipality of Amsterdam. Through this project, it is intended to improve the accessibility of Zuidas (South of Amsterdam) and the northern Randstad, both by road and by public transport since the number of travelers in this area will increase sharply in the coming years because of growing residential and commercial development in the area. Zuidasdok mainly takes place in the heart of the Amsterdam Zuidas, but also crosses the East and West districts.

The project includes:

- The widening of A10 from 4 to 6 lanes and bringing A10 South highway underground in the Zuidas area
- The redesign of the Amstel and De Nieuwe Meer traffic junctions
- Expanding and renewing the Amsterdam Zuid station
- The redesign of the station area.

The renewed Zuid station will also have more green space and would become a hub for various means of transport like trains, trams, buses, taxis, and bicycles.

The preparatory work for Zuidasdok started in 2018, the actual construction has started in 2019 and the project is supposed to be completed by 2028 (https://zuidplus.amsterdam/).

The timeline of the project can be seen in figure 18 where current and future stream of events is presented. The project is now in the early design phase while parallel construction is also being done on some parts.

5.2.2 Case Interview

An interview is conducted with the Risk Manager for this project about the approach being taken to identify opportunities in this project. The interview is focused on the current approach of opportunity management in newer projects because many researchers have already suggested that threat management is still mainstream in the construction industry which is also described in chapter 3 of this report. Questionnaire for the interview can be found in Appendix D and the description of the interview is stated below;

S.N.	Interviewee Code	Role	Organization	Type of Organization	Experience (years)	Duration (minutes)
1	CS01	Risk Manager	ZuidPlus	Contractor	6	105

Interview findings

The process adopted for risk management in this project is explained below.

In the tender phase, the process starts with the scope of work where it is discussed what is needed to be built, what are the requirements and from that time schedules are made. The estimates of cost are then made for the total project. This acts as a baseline of scope, time and cost, and now the process of risk management starts with the identification of both threats and opportunities as per the

prepared project plan. The focus here is thinking of events or conditions that could go wrong in the project as per the plan but also what could be better by finding better solutions which could enhance the requirements. The opportunities are generally identified, registered, but not actively followed up.

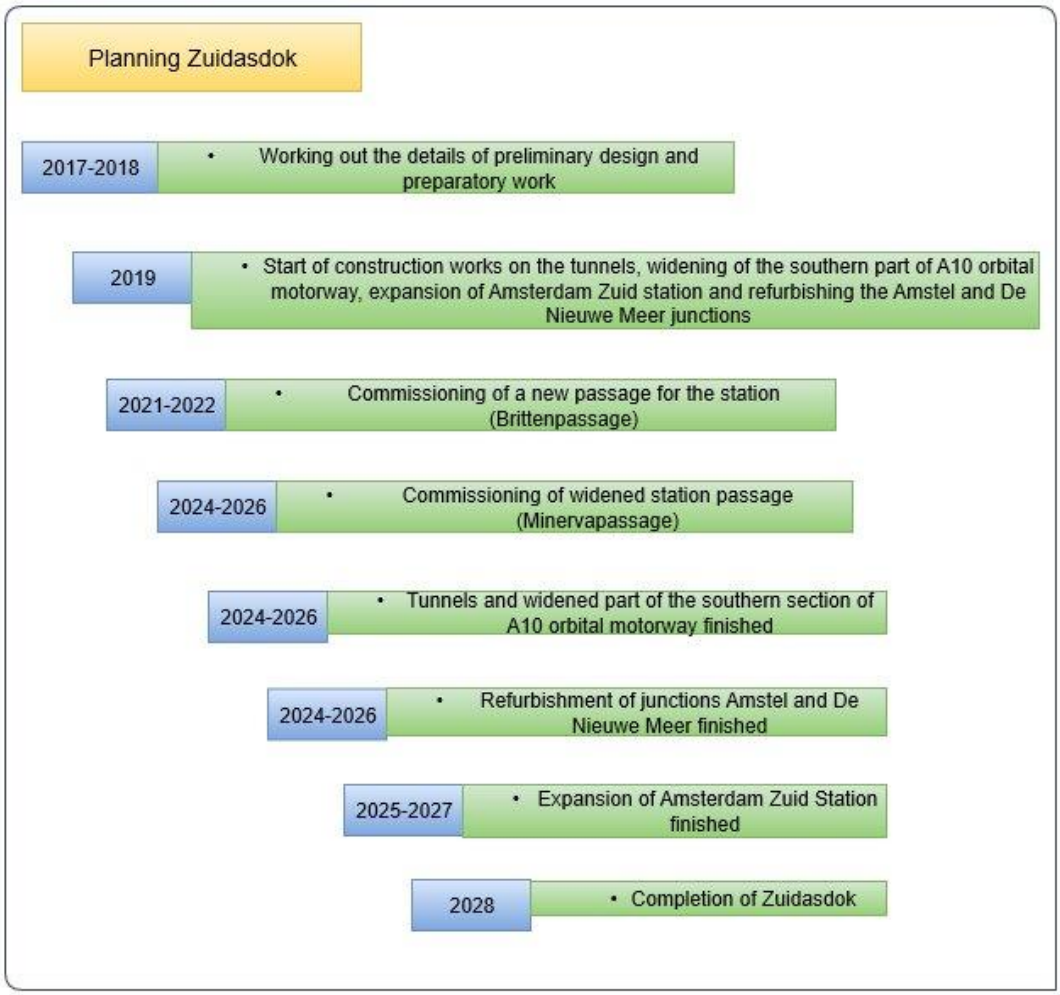


Figure 18: Timeline of events for project Zuidasdok (Source: Own illustration based on https://zuidas.nl/zuidasdok/)

The reason/constraints for not actively managing opportunities found in this project are explained below;

1) High work pressure

It is one of the main reasons why opportunities are not being followed properly in the project. High work pressure doesn't allow adequate time to work and explore towards the opportunity side. This project had identified few opportunities in the tender phase, but now as the project is in the design phase, the focus is shifted towards managing the threats only.

2) Low-profit margin

In D&C contracts, opportunities are not followed well because the profit margins are too low, so generally, there is no time and resource to follow up. To apply a low bid, contractors even quote less than what their risk reserve comes out to be, so the risk management part is often not taken fully in the bids and this creates increased pressure of fewer profits from the project. Being too optimistic during the tender phase also leads in submitting lower bids which might turn the profit levels down after the real-world start showing its character during the execution phase.

3) Scope change

In this project, few opportunities are identified during the tender phase but, over the time new changes have been applied to the project's scope from both the client and contractor's side and now the scope of work is different. Hence, the identified opportunities during the tender phase are not valid anymore.

4) Perception of people

Often in projects, threats are set at P85 but opportunities are set at P15. So, a threat amount is considered at P85 which gives a higher forecast amount but for opportunities, the event or idea should occur in very low forecast amount at P15 which is one of the reasons for lower opportunities in projects. The focus is more on threats because most of the people are risk-averse (threat averse) so the threats are attempted to be controlled first and then thought of opportunities in projects.

For the risk management process, the procedure adopted is similar to the ATOM framework presented in chapter 3 (figure 10) but, checklists are not being prepared in the project nor in past projects for recording the occurred opportunities. SWOT analysis is also done initially at higher management level for identifying business cases but not in the risk identification process.

An online tool is prepared to register all the threats and opportunities in the project so that it is easily accessible to everyone. After the team identifies threats and opportunities together, discussion is done on what is needed to take the opportunity. Each threat and opportunity are allocated with its owner and chaser who needs to follow it up. Often in these meetings opportunities are talked through but they are not registered in the risk register so the administration part is also being missed.

The project generally focuses on technical risks, but the organizational risks were not given equal priority which is also very important in large infrastructure projects. The consortium company has around 500 people working for the company but occasionally some of them are leaving, and some new employees are joining, which causes changes in organization and could result in increased threats to the project.

To identify if the opportunity would create value to the project or not team discussion is being done in the project. While explaining the possible opportunities, the benefits coming through each opportunity is explained that could be in terms of saved time, making the design more robust, saved cost, or safety enhancement, and so on. To set the benchmark for these project value drivers initially discussion is done between project members where a common benchmark is agreed upon. But often it is just design optimization that is being observed as to how the design could be better so that additional benefits could be grabbed by the project.

With the approach explained above, two types of opportunities were generally identified during the tender phase of this project.

- Additional scope of work that the client has not foreseen
- Optimization of works in design and construction methods, so doing less with the same results. For this, finding a better technical solution or using alternative materials which are cheaper in price but with desired quality.

However, not much has been done with these identified opportunities due to the change in requirements from the client.

In order to minimize or reduce the constraints for exploring more opportunity in such project, several suggestions were made during the interview which are as following:

- More focus should be given towards opportunity management process by both project team and higher management of the company and continuous monitoring and follow up of the identified opportunities is required in every phase of the project because requirements of the project could change which creates new threats and opportunities in the project.
- Change management and Risk management team/managers should work closely in a project because change in the contract also changes project threats and opportunities.
- It is important to set an environment in the project where team members could think of opportunities instead of threats only. Organizational culture should encourage and uplift the thinking of team members from the threat side to both opportunity and threats occurring in the project. It also depends on the psychological aspect and mindset of team members to broaden their focus on both, so the organizational culture could help in shift an extreme risk-averse person towards risk taker so that more opportunities could be explored.
- Organizational improvement should be done in such large projects. Same key employees/managers which were in tender phase should be there in initial execution phase (design phase) of the project if not for the entire project phases, so that maximum knowledge and focus could be transferred from tender phase to realization phase.
- Standard infrastructural themes or areas where more opportunities could be identified and maintained in such large projects. Areas like design tolerances, cables and ducts, materials, etc. could be in the checklist as focus points where more thinking could be done towards these crucial areas.
- To have adequate profit margins for the contractors, the contract being proposed by the company should be flexible and should give space between cost and profit so that adequate resources could be invested in identifying more opportunities in the project. The client could also design their contracts under best value procurement scheme, where the lowest price is not the only criteria for selection of contractors but several other aspects like quality, technical capability, sustainability and so on are also considered during selection.

The interviewee adds, "*Technical experience of the team, culture in a project, and psychological aspect of the team members is key for a good opportunity management process*".

5.2.3 Conclusion

The case of Zuidasdok has provided with several inputs which are summarized below;

- The risk management procedure adopted is similar to the ATOM framework explained in section 3.2.2 except in some parts like; not maintaining a checklist for opportunities and using tools for online registration of risks.
- The type of opportunity identified during the tender phase is mainly an additional scope of work and optimization of design and construction methods. The additional scope identified could be categorized as a discrete risk event in the project and finding an optimum solution as cheaper materials could be categorized as variability in the market due to change in material price. Thus, the sources of uncertainty play an important role in the occurrence of opportunity in such projects which is also explained in section 3.1.2.
- The project is experiencing several constraints like; high work pressure, low-profit margins, scope change, and perception of people to allot their time and resources towards opportunity exploration in the project.
- Some suggestions are forwarded to make a shift in current working approach and focus towards opportunity exploitation in such large projects.

5.3 Case 2: (Confidential, Location: Doha, Qatar)

5.3.1 Introduction

This project is executed by HOCHTIEF in collaboration with local companies of Qatar. The main scope of the project is to build an 8 km long residential city district in a completely barren land. The city district consists of residential units, shopping malls, and recreational and landscape facilities. The construction of the project started in 2006 and was completed in 2010 with a project budget of approximately 1 billion euros. This project was contracted as a cost-plus percentage payment scheme to the contractor where the client paid for all the cost during design and construction and an extra percentage based on the total cost of the project. The size of the project was enormous which created logistical challenge during its execution but, the project was delivered on schedule.

5.3.2 Case Interview

An interview is conducted with the Financial Director for this project about the approach being taken to identify opportunities in this project. The interview focused on knowing what kind of opportunity was discovered by the contractor while executing the project. This interview also gave the chance to look into the constraints for exploring opportunities in such projects and what could have been done to improve the approach towards opportunity identification and exploitation. Questionnaire for the interview can be found in Appendix D and the description of the interviewee is stated below;

S.N.	Interviewee Code	Role	Organization	Type of Organization	Experience (years)	Duration (minutes)
1	CS02	Financial Director	HOCHTIEF	Contractor	25	60

Interview findings

The process adopted for risk management in this project is similar to the one explained in case one and this is also a standard procedure in general for executing any project. The opportunities identified during the process are very few in numbers and are not actively followed in the execution phase of the project. The reason/constraints for not actively managing opportunities in this project is found to be;

1) Contractual restriction

The contractual clauses of the project are made such that any additional scope of work perceived as opportunity creating benefits to the project are generally reviewed by the client organization and the profit was mainly for the client-side only. So, this demoralized the project team in exploring any opportunities.

2) Time pressure

The time pressure is another main reason for not working actively towards exploiting opportunities. Initially, the project team identified few opportunities during the tender phase but, during the design phase the execution of project slowed down which created time pressure to finish the project within deadline. Thus, the focus of the project team was only on the regular works and extra opportunities weren't actively chased.

The opportunity of creating extra profit due to the cost-plus percentage reimbursement scheme is there, where making the project more costly resulted in more total amount from an additional percentage. Also, claims and variations are accepted by the contractor which again raise the cost of the project. However, this should be done carefully, and one should not overdo it because it could hamper the relationship between client and contractor which the interviewee mentioned is very important especially in this project. He added, "*Just to trust each other, the client took almost a year*

with regular meetings to build a reliable and trustworthy relation so that there would be transparency during project execution".

Another opportunity for the main contractor is that they are able to transfer threats to the sub-contractors so less money is kept in the risk reserve which allowed for lower bidding amount.

To minimize or reduce the constraints for exploring more opportunity in such projects, several suggestions are made during the interview which can be seen below;

- Involvement of all project team members from the tender phase to the execution phase so that while executing the project, the team is familiar with the project details and the identified opportunities could be chased better.
- Understanding the scenario in which the project is placed is very important. In this project, not overexploiting the space given due to the reimbursement scheme is important. It also depends on where the project is being taken place and what level of expertise the client has. But, overall trust and faith in each other is important.
- As there is always lack of time to look towards opportunity in such large and complex projects, a separate dedicated employee is needed to deal with identifying opportunity and creating value out of it. This employee would then initiate and form a dedicated team to involve in opportunity identification process during the tender phase and make sure all identified impactful opportunities are actively chased during the execution phase of the project.
- Value Engineering is also a crucial step that should be taken during the tender phase but also during the initial design phase to reconsider the solutions in detail for identifying design-related opportunities for benefit maximization after contract award.
- Market rates of different construction materials could vary during execution which might create an opportunity to change the scope of work and exploit more benefits. So, negotiation skill is needed to convince client on acceptance of scope change during execution. This should be done as per the contractual clause and space on scope change as the client is always alert towards opportunistic behavior of the contractor.

5.3.3 Conclusion

This case has provided with several inputs which are summarized below;

- The process of risk management is found to be similar to case one and the identification of opportunities are very less compared to threats in the project.
- The type of opportunity identified during the tender phase is mainly additional scope of work and alternate materials with the same quality standards. The additional scope identified could be categorized as a discrete risk event in the project and finding an optimum solution as cheaper materials could be categorized as variability in the market due to change in material price.
- One of the most important factors found is trust between client and contractor which is very crucial for this project and has helped in getting the project in the first place, but also to get small benefits during execution.
- The project had experienced constraints like contractual restriction and time pressure of the project execution so that the project team could focus on opportunity exploration in the project.
- Some suggestions are forwarded that could be done to improve the working approach and focus on opportunity exploitation in such large projects.

5.4 Case Study Conclusion

Based on the above two case studies, several findings and commonalities could be observed towards how opportunity identification and exploitation is currently done by the contractors in large infrastructure projects. The constraints found in the above two cases for opportunity exploration is presented in table 9. The suggestions on reducing the constraint's effect through case study and relation of 33 factors identified in chapter 4 can be seen in Appendix G.

Table 9: Constraints for opportunity exploration in two cases

S.N.	Constraints	Case 1	Case 2
1	High work pressure/Time pressure	Restricts to focus towards opportunities in the execution phase	Restricts to focus towards opportunities due to slowing down of process after contract award
2	Low-profit margin	Low bid creates less profit margin which makes opportunity exploration process difficult to execute	
3	Scope change	Changes applied from client-side leads to previously identified opportunities not valid anymore	
4	Perception of people	People being negative risk-averse and focuses only towards threats prevention is acted as a major constraint	
5	Contractual restriction		The contractual clause of profit and benefit-sharing/owner for an opportunity could restrict opportunity identification by the contractor (who should enjoy the benefit?)

These constraints create a domino effect of which all similar projects are being affected with, which can be seen in figure 19. First, due to high competition, the contractor generally bid low to win the contract. This creates a low-profit margin for the contractors thus very limited resources and time to invest outside their regular scope of work and thus the focus is only towards threats. Because of this, opportunities are never really explored properly in such projects and hasn't given enough space and attention during the project execution. This finally leads to missed opportunities in such projects which could have maintained the profit margin and additional non-financial benefits to the project.

Figure 19: Domino effect of constraints on opportunity exploration (Source: Own illustration)

Apart from these constraints, suggestions and recommendation are also made in each case scenario to improve the approach of opportunity identification and exploitation and reduction of constraints effect in similar projects which is summarized in table 10.

Table 10: Comparison between cases on suggestions for constraints' effect reduction

S. N	Suggestions	Case 1	Case 2	Reducing constraint effect
1	Increased focus towards opportunity management	More focus should be given towards opportunity management by both project team and higher management of the company		
2	Close work between change and risk management team	Since change in contract leads to change in opportunities and threats		Scope change
3	Encouraging organizational culture	Setting environment within the company where both threats and opportunities are equally treated		Perception of people
4	Retaining key employee in the project	Same key employee should continue working in tender and execution phase of the project for transferring complete knowledge and focus in all phases	Involvement of all team members from the tender phase to the execution phase	High work pressure/Time pressure
5	Creating a database for commonly occurring opportunities	Areas like design tolerances, cables and ducts, materials, etc. could be in a checklist as focus points for exploring opportunities		High work pressure/Time pressure
6	Flexible contract	The contract should provide space between cost and profit so that opportunity exploration could be done better		1) Contractual restriction 2) Low-profit margin
7	Good understanding of project scenario		Not overexploiting the space given by the client while maintaining a good trust level in the project	Scope change
8	Separate dedicated employee		Separate employee for ensuring the process of opportunity management could be designated	High work pressure/Time pressure
9	Value Engineering at key project steps		Value Engineering of solutions during the tender phase and initial design phase	
10	Negotiation skills for acceptance of scope change		Negotiation skills is needed to approve change so that benefits could be exploited from project variability like market rates	Scope change

From the above suggestions, we can observe that half of them are related to the literature review section and data collected through detailed interview in chapter 4. The same repetition of constraints and similar suggestions from the interviewees from each case shows that these suggestions are important for exploring opportunities in such large projects. These suggestions also related to the 33 important factors for opportunity stimulation in large infrastructure project shown in section 4.4. Knowing the constraints, suggestions and opportunity management approach would help in preparing the opportunity management roadmap which is discussed in chapter 6.

6. Roadmap for Opportunity Identification

This chapter provides information regarding opportunity identification method in large infrastructure projects. This is done with the help of findings collected from the literature study, interviews, questionnaire survey, and case study.

Information regarding sub-question c and d are presented in this chapter

6.1 Goal

The goal of this chapter is to find the right approach on opportunity identification process by assessing the current approach of opportunity identification in practice by a contractor company and incorporating the data collected through literature survey and empirical study to improve the current approach. The recommended roadmap is to help in bridging the gap between what is recommended and what is being done for opportunity identification in large infrastructure projects by the contractors. This improvement of approach towards opportunity identification and exploitation is believed to increase the chances of identifying opportunities in such projects which would ultimately help in increasing the profit margin for the contractors. This would also help in maintaining a healthy relation with the client and being competitive in the market due to well-maintained company reputation, as exploiting opportunities helps in increasing project value. The proposed roadmap cannot be practically proven for its effectiveness until it has been tested in real projects, thus continuous improvement through feedback is needed to fully mature the suggested approach.

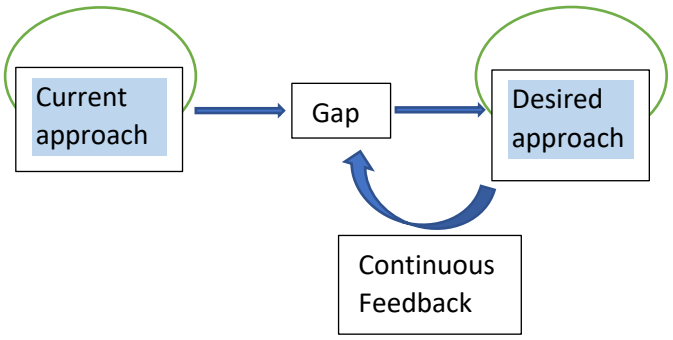


Figure 20: Approach for increasing opportunity identification

6.2 Description of roadmap

The roadmap presented in this section for opportunity identification is a combination of inputs from all previous steps done in this study. The roadmap consists of 6 elements that acts as requirements while each of them has its own importance for a successful opportunity exploration approach. Thus, the suggested requirements should be fulfilled by the contracting company in order to make the opportunity identification process more effective. Below, an explanation on the requirements are presented along with various elements and activities associated with it. In figure 21, the elements and their relation are presented and in figure 22, an overview of information related with each requirement of the roadmap is shown.

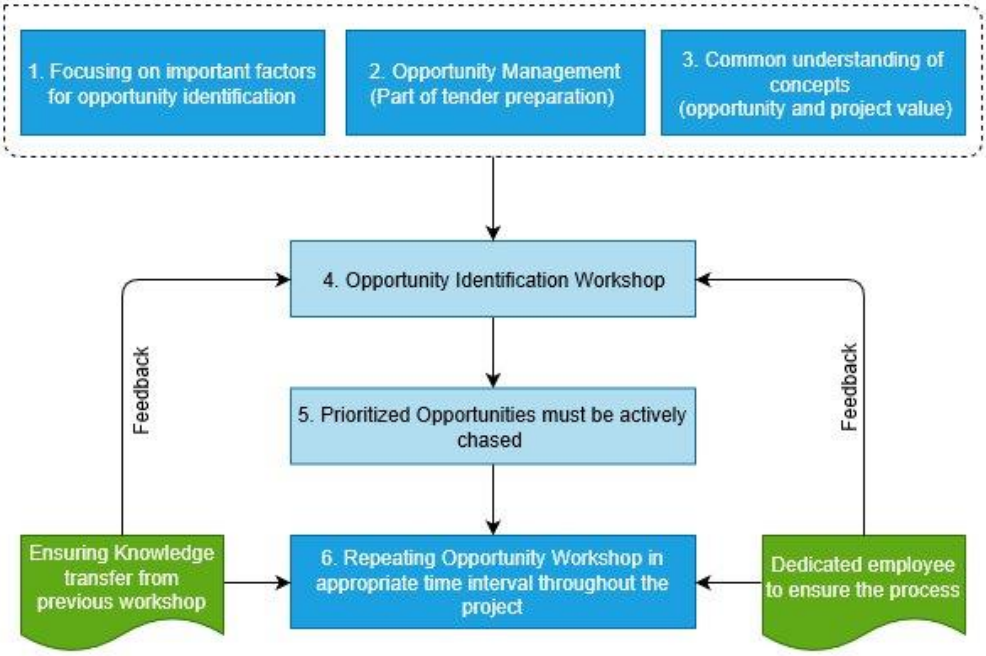


Figure 21: Roadmap for opportunity identification (source: own illustration)

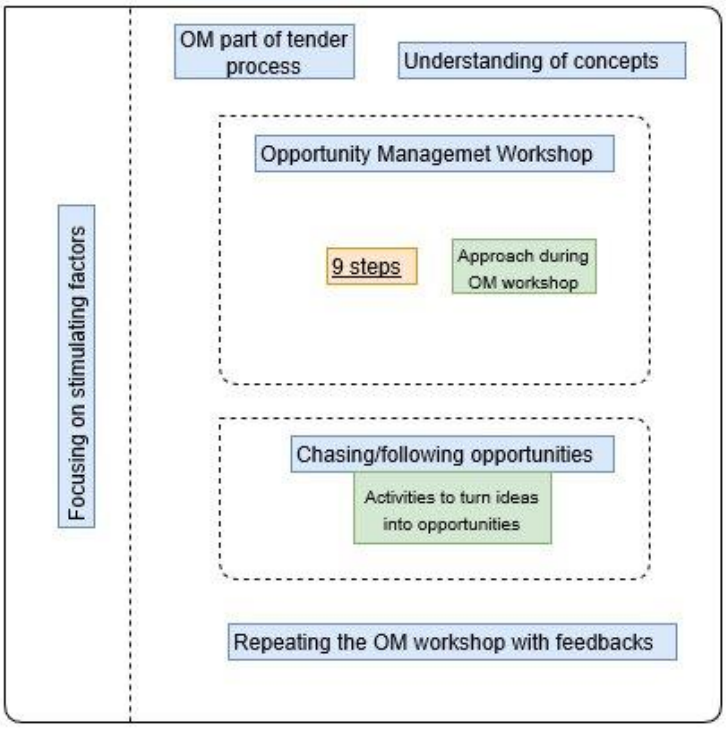


Figure 22: Overview of information sections and components related to the roadmap

1) Focusing on stimulating factors for opportunity identification

As explained in section 4.4, it was found from the literature study, interviews and questionnaire survey that these 33 stimulating factors are crucial to stimulate opportunity identification as they provide a strong foundation as a prerequisite to establish a better project environment for opportunity exploration. Also, these factors could help in reducing the constraint's effect for opportunity

identification in such large projects and the relation can be seen in Appendix J. These factors are clustered in six groups and the groups depend on each other to be fully effective as explained in section 4.5. These factors should be in focus and well ensured by the company and project team before starting the opportunity identification process. The factors are divided into four level: organization, project manager, project team member, and client to ensure the focus and ease on its applicability which can be seen in table 11. Client level factors could be used as proposal or suggestion by the contractor to the client. Some of the factors are applicable to more than one level and should be dealt accordingly. A detail description each factor is presented in Appendix E.

Table 11: Focus Levels of stimulating factors for opportunity identification

Level☞	Organization (Contractor)	Project Manager (Contractor)	Project Team members (Contractor)	Client
Factors' Group☞	Stimulating factors for opportunity identification			
Competency	F9, F26	F1, F2, F3, F4, F9, F11, F12, F13, F32	F9, F11, F32, F33	
Company Policy	F5, F8, F17, F21, F23	F17	F17	
Collaboration	F6	F6, F7, F14, F16, F30	F6, 14, F24, F30	F6, F14, F16
Client-Side Decision	F22	F25		F10, F22, F25, F28
Self Reflection	F27	F15, F27, F31	F27, F31	F15, F27
Project Management Process	F20	F18, F19, F29	F19	F18, F19

a) Competency

The company, project manager and project team member, all should focus on the factors which are directly related to them regarding building competency for opportunity exploration. These employees at different level should try to incorporate such competencies with their team through relevant activities/adjustments so that the team has more chances of identifying opportunities in their project during and after the tender phase. These abilities within project team would also help in exploring opportunities from discrete risks events like; technological improvements, stakeholders' agreements, etc. and through variabilities like improved market rates for materials. It would also ensure that the team could handle any changes occurring due to the implication of an opportunity or would take only those opportunities whose change effect could be handled by the team.

F.N	Competency
F1	Project manager with business-oriented mindset
F2	Ability to capture stakeholders' view of value
F3	Ability of project manager to develop holistic view within the project
F4	Ability to understand how other organization affects the project objectives
F9	Ability to balance between control and flexibility
F11	Ability to analyze the impact of change
F12	Ability to communicate potential value of the opportunity
F13	Taking the lead for opportunity exploitation
F26	Experienced project team
F32	Awareness of possibilities
F33	Able to handle increased complexity (chaos)

b) Company Policy

F.N	Company Policy
F5	Organizational support and interest
F8	Individual and project based incentives
F17	Celebrating achievements of the projects
F21	Understanding human behaviour
F23	Presence of opportunity identification process and its implementation

The policy of a company should be in favor of the process for making the opportunity identification task convenient to the project team. Opportunity management should be an integral part of a tender preparation for any large project and should not just remain an optional step. It should also be supported by higher management in terms of resource allocation. Also, investment in training and skill development is needed for employees by the company for better results. A company culture should maximize the play (employee enjoys working), purpose (employee values the work's impact and outcome), and potential (employee works for enhancing his/her potential) and should minimize the emotional pressure (employee works because of fear, peer pressure, and shame), economic pressure (employee works to gain a reward or avoid punishment), and inertia (employee's work just becomes a habit and one does not realize the motive behind it) felt by its employees for motivating its employees and increasing the work performance (McGregor & Doshi, 2015).

c) Collaboration

F.N	Collaboration
F6	Formation of collaborative work culture
F7	Open communication with client organization
F14	Shared commitment among involved parties
F16	Involvement of different categories of stakeholders
F24	Trust and open communication within the project team members
F30	Coordination between review team and execution team

Collaboration in work is needed between all levels for exploring more opportunities in projects. Opportunity identification through open and honest communication helps in creating transparency among both the project team members along with the client about possible options, that could bring benefits to the project. This transparency of information creates chances of better decision making regarding the project (Willumsen et. al, 2019).

Also, trust and open communication within the team members allow to buildup in one another's idea. As suggested in the case study, close work should be done between change and risk management team (refer table 10). Thus, a non-feasible idea from one perspective could turn into a feasible idea while looked from another perspective (shared mental model).

d) Client Related Decision

F.N	Client Related Decision
F10	Demanding goals in project
F22	Tight project budget
F25	Flexible client
F28	Flexible reimbursement scheme

While the contractor side cannot directly influence this category but, could be used as a proposal/suggestion for client if opportunities are to be explored in the project. If there is trust and open communication between client and contractor then, sometimes the client could be flexible towards the restrictions implied during the construction phase of the project. An example can be seen in Appendix A, entry 15.

e) Self Reflection

F.N	Self Reflection
F15	Stakeholders being proud of the project
F27	Change in culture of how we see and approach opportunity
F31	Team members are proud and enjoy doing the project

Project members being proud of what they are involved with would make the work more enjoyable and encourage them to do well, creating a positive atmosphere in the workplace. Ensuring such a scenario in projects takes good leadership and a lot of motivation among the team members.

f) Project Management Process

Project's execution process should support these factors where any new idea bringing extra benefits to the project should be accepted. This could bring change in the project's planning but should be accepted based on the impact of benefits and required resources to achieve it. Also, the project should have a system of knowledge transfer and lesson learned from past projects or from the previous phase of same project. This can be done through maintaining opportunity database and project analysis reports.

F.N	Project Management Process
F18	Acceptance of change in the project
F19	Will and power to change the originally planned solution and deliverables
F20	Learning and knowledge sharing
F29	Interface management between different parties and discipline

2) Opportunity Management Process (part of tender preparation)

Opportunities cannot be identified properly in a project until it is not taken seriously and invested enough time on its exploration. As it was observed during the interviews and case studies that it hasn't been given enough attention due to several constraints (section 5.4). Opportunity management should be a fixed part of tender preparation where for each project, opportunity exploration must be done in this phase. The project team should look for opportunities along with threats during the initial workshops for preparing the solutions and bidding amount. Thus, enough space should be given towards opportunity exploration and should be done before exploring the threats of the project, if possible, as this would allow more focus towards exploring the possible opportunities, thus more opportunities could be identified (Johansen, 2015, pg. 160). Since opportunity identification needs more open-minded attitude from the team members and an optimistic view of the project, it should be treated differently than threats while identifying and exploiting it (NETLIPSE, 2016).

3) Common understanding of concepts

It is very important that all the project team member involved in the opportunity identification process have the same understanding of what is meant by an opportunity for a project. The need for common understanding of the concept is also made clear in section 4.2.3 during the initial interviews. It is important to understand the concept first before approaching for identification. This would help in identifying real opportunities for the project with similar entries in the opportunity database. The entries then would also be easy to follow up for its impact analysis and further monitoring. Further, this would prevent from considering ideas that do not impact on project's objective or either increases project value. Thus, to clarify this, the objective of the project should be understood well, and the project value drivers should be decided in advance before exploring opportunities. The concepts are explained in chapter 3 and a conclusion is given in section 4.5.

4) Opportunity Management Workshop

This is crucial requirement for opportunity identification and its exploitation and should be done once the company has established above three requirements. To identify opportunities, a method is required and a workshop with the relevant participant is suggested as the most appropriate way to discuss possible opportunities (Hillson & Simon, 2012). Opportunity identification based on a dialogue-based communication like a workshop creates consensus on decision making (Willumsen et. al., 2019) which further helps in value creation due to better decision making and cooperation among the team members.

Opportunity management workshop should be done during the tender phase and should be repeated in later phases as well to identify new opportunities that might occur due to changing project dynamics or due to increased knowledge of the project. The aim of this workshop is to identify potential opportunities that could add value to the project and to prioritize them based on the benefit

assessment so that further follow up is easy and doable. These opportunities are identified through sources of uncertainties that are associated with the project. This step is further explained in detail in section 6.2.1.

5) Follow up of selected opportunities

The identified opportunities must be prioritized based on their consequence (benefit) on the project. Actively following the prioritized opportunities is necessary because an opportunity will not bring any benefit to a project until it has been actively chased to be realized in the project. It was found through the interviews that opportunities are being explored in some cases at the beginning of the project but are not followed afterward. For chasing opportunities for its exploitation, various suggestions are provided in section 4.3.3e (activities to turn ideas into opportunities) of which some are related to the stimulating factors discussed as requirement 1.

6) Repeating step 4 and 5 with feedbacks

The opportunity identification process is not a one-time task and should be done repeatedly throughout the project at a certain time interval. Johansen (2015) suggests this interval of opportunity workshop to be once or twice a year for a large project spanning more than three years. This would help in exploring new opportunities as the project develops. Apart from conducting a full workshop twice a year, regular checking and follow up is required more often as described in step 5.

Feedback system

Feedback is needed for a newly proposed approach to be effective in their desired work. This opportunity roadmap would also need feedback from its involved team members (DI01). A dedicated member for such large projects could focus on executing and coordinating the whole process and improving it from the collected feedback. Also, the member should be responsible for knowledge transfer from the past workshop through maintained database so that the context of opportunity is quickly reviewed, and more benefits exploration can be done further.

6.2.1 Workshop for opportunity identification

Opportunity identification is done after understanding the concept of opportunity and deciding on the objectives and project value drivers because opportunity cannot be identified if the project hasn't set up its objectives and fixed the project value drivers. After defining the project objectives and value drivers, and establishing a common concept of opportunity, identification of opportunities is possible.

The nature of opportunity identification workshop should be different from threat workshop because it needs more open and out of the box approach. People should be more open, free, creative and joyful during brainstorming such ideas (Johansen, 2015; NETLIPSE, 2016). This argument is also supported by two of the interviewees from the contractor side and consultancy side.

In this section, a stepwise procedure is explained on how opportunity identification workshop process should be executed based on literature, detail interviews, and case study findings. A flowchart of the process can be seen in figure 22. This flowchart has a base from the ATOM framework designed by Hillson & Simon (2012) presented in section 3.2.2, figure 10 but also contains other elements based on this study. One of the key distinctions is in step three where the project value drivers need to be fixed as a focus area for opportunity exploration. For brainstorming of ideas, the framework of RBS has been adjusted as per the scope of this study. Also, the use of opportunity log review is suggested as this would allow finding further opportunities that might have occurred in similar previous projects. The assessment section has been adjusted as well based on this study with a new inclusion of importance level for project value drivers as this would allow to approximately convert the various

value driver dimensions into a single composite unit for easy impact assessment. Step 8 and 9 are new as per the requirement of this study.

Validation of proposed procedure for opportunity identification

The proposed procedure is validated in two steps i.e., opportunity workshop and feedback session which was conducted with six experts. A detailed description of validation session can be found in Appendix M. For the opportunity workshop, a reference project of constructing a bridge near Schiphol airport was taken which is to be built over a highway and train tunnel. Initially, the case description was done to the participants and the objective of the project was clarified. Then as per the roadmap, definition of opportunity was introduced so that the participant could focus on what exactly to search for. After explaining the concept, the workshop was conducted based on the steps explained in figure 22. For step 3, hundred points were distributed among the project value drivers based on their level of importance as per the project's characteristics. After allocating the points, brainstorming for opportunities was done based on the Risk Breakdown Structure presented in Appendix H (without preferred RBS level) to identify opportunity from possible categories. Step 5 and 6 of the process could not be executed since the project taken was a fictitious so contractual constraints weren't available. Also, since the company doesn't have the practice of maintaining an opportunity log, it was not possible to execute step 6 either.

Table 12: *Example assessment of an opportunity for tangible benefits before validation*

Required Resource					**Benefits**				
	Influence	**Effect (in terms of cost)**	**Importance level**	**Total effect**		**Influence**	**Effect (in terms of monetary benefit)**	**Importance level**	**Total effect**
Cost	Yes	5000	27	1350	Cost	Decrease	15000	27	4050
Time	Yes	3000	21,5	645	Time	None	0	21,5	0
Quality	None	0	18,5	0	Quality	None	0	18,5	0
Safety	None	0	20	0	Safety	None	0	20	0
Sustainability	None	0	13	0	Sustainability	Increase	15000	13	1950
	Total	**8000**	**100**	**1995**		**Total**	**30000**	**100**	**6000**
							Probability	Very high (0,75)	6000*0,75
									4500

As step 7, the assessment of selected opportunities was done based on the example presented in the table 12 for an alternative material discovered during tender phase while the importance level was adjusted based on the point allocation for value drivers decided in step 3. For the assessment, both required resources and benefit side has five value drivers and the importance level for each of them was taken as per the prioritization done in step 3, finally giving a composite impact level on both sides. The opportunity workshop was concluded at this step due to the difficulty in assessment.

Several suggestions were given by the experts especially for the assessment part. Table 13 summarizes the adjustments that were made on the proposed procedure based on experts' suggestions and observation during the validation session.

Table 13: *Adjustment on proposed procedure for opportunity workshop*

S.N.	Before validation session	After validation session	Comment
1.	The prioritization of project value drivers was to be done among the project members.	The prioritization of project value driver is to be done by the project manager alone.	Project Manager has the widest view of the project and the allocation of points could be done without any disagreement.
2.	Value drivers for the project should be looked from a contractor's eye.	Value drivers for the project should be looked from a client's eye.	It would be a better approach for allocating points to them because contractors then could assess what is more or less preferable value drivers for the project and could add more ideas towards preferred areas to be in a position to ask for additional benefits for themselves.
3.	The opportunities are to be brainstormed at RBS level 2. (Appendix H)	The opportunities are to be brainstormed at preferred RBS level. (Appendix H)	RBS level 2 has 38 categories to be looked for which was too much for such short brainstorming session. As a recommendation, only highly relevant categories as per the scope of this study was kept consisting of 22 categories to be investigated.
4.	All five value drivers were assessed for investment side.	Only cost and time is assessed as an investment for exploiting an opportunity.	Other three could only affect the project planning but is not an investment. For example, if you change a design in your project then it could influence the quality but, it's not an investment because the project team again must work towards fixing the quality if that idea is to be taken in the project. So, the investment is again in terms of time and cost.
5.	For investment side, each value drivers were prioritized where for impact calculation, fractions (importance level) of each driver were multiplied with.	Only cost and time are kept as an investment with 100% importance level for both.	If an investment of 50k is to be made for an opportunity, and it has been decided that cost is 25% important as a value driver, then only 25% of 50k is being taken as effect on investment towards that value driver while the actual investment is 50k.
6.	On benefit side, all five value drivers were allocated over 100 points for its prioritization.	Cost is separately allocated 100 points while another 100 points is divided among other four value drivers as per the prioritization.	Cost is a consequence of the other four value drivers towards the return side and it is difficult to quantify all other value drivers in terms of cost due to its complexity in calculation and less time availability during tender phase.
7.	No step for opportunity sorting based on feasibility of implementation and threats involved	Assessing an opportunity has a pre-step for its sorting based on feasibility of implementation and threats involved	To cope with high time pressure during tender phase and to ease the process of opportunity exploitation by selecting highly feasible opportunities and low change impact (threats carrying) opportunities for further assessment.

Based on the suggestions forwarded by the experts, a corrected version of the procedure for opportunity workshop has been prepared which is presented below. This procedure consists of 9 steps with inputs required for some steps and outputs expected from each step.

Step 1: Pre-workshop Preparation

Input

Here, all the members should be fixed that will be participating in the workshop. This should include important project team members within the company. A stakeholder analysis should be done here to find out important actors who can influence the project. The workshop could have stakeholders like; sub-contracting company with whom the company can work together during the project's execution for exploiting benefits from identified opportunities. However, this depends on the company's decision on whether they want to share the benefits or not. If the company wishes to exploit the benefits only for themselves, then only the project team will be participating in the workshop, which could possibly have the chance of identifying fewer opportunities than the previous case.

Output

In this step, all the inputs for further steps must be ready like Risk Breakdown Structure (RBS) of the project (see appendix H for example) for finding possible sources of uncertainty for the project, list of potential project assumptions and requirement or pre-contractual constraints, and opportunity log maintained from previous similar projects. Also, the list of participants must be ready to be involved in further steps.

Step 2: Confirm Scope and Objectives

Project definition is generally forwarded by the client as what are the requirements in the project and what is expected from the project (Ridder et. al., 2009). Based on the client's requirement, project team must confirm project scope and objectives here because this will help in removing any ambiguity among the participant on what their focus should be while identifying opportunities. This would also help in identifying only relevant opportunities that would help in achieving project's goal rather than spending time on something that is not relevant to the project.

Output: As an outcome, project scope and objectives should be fixed at this step, as per the project's requirement.

Step 3: Prioritize project value drivers

There are 9 project value drivers identified in this study which are important for large infrastructure projects from a contractor's perspective. A list of project value drivers is presented in appendix F4.

Project value drivers seen from the eyes of client would be a better approach for allocating points to them (source: Appendix E, F19, QR02; validation session) as one of the benefits is that the contractor could maintain a healthy relationship with the client which is one of the important intangible value drivers identified in this study. Contractors then could ask what the client wants from the project and assess what is the preferable value drivers for the project. Let us see it through a few examples, for constructing an Olympic stadium, time would be the most important value driver for the client. Similarly, for a nuclear power plant, safety and quality would be the most important value drivers. After knowing the preferred value driver for the project, contractor could then develop better ideas towards those areas, to be able to ask for additional benefits for them. In such situations, the client would be willing to add extra money to the project for better results (refer pg. 45, client-side improvement). However, the preference should be understood by the project manager through initial discussion with the client for aligning the focus accordingly and preventing further added complexity if done at a later stage, that could disrupt the partially planned project (Source: QR02).

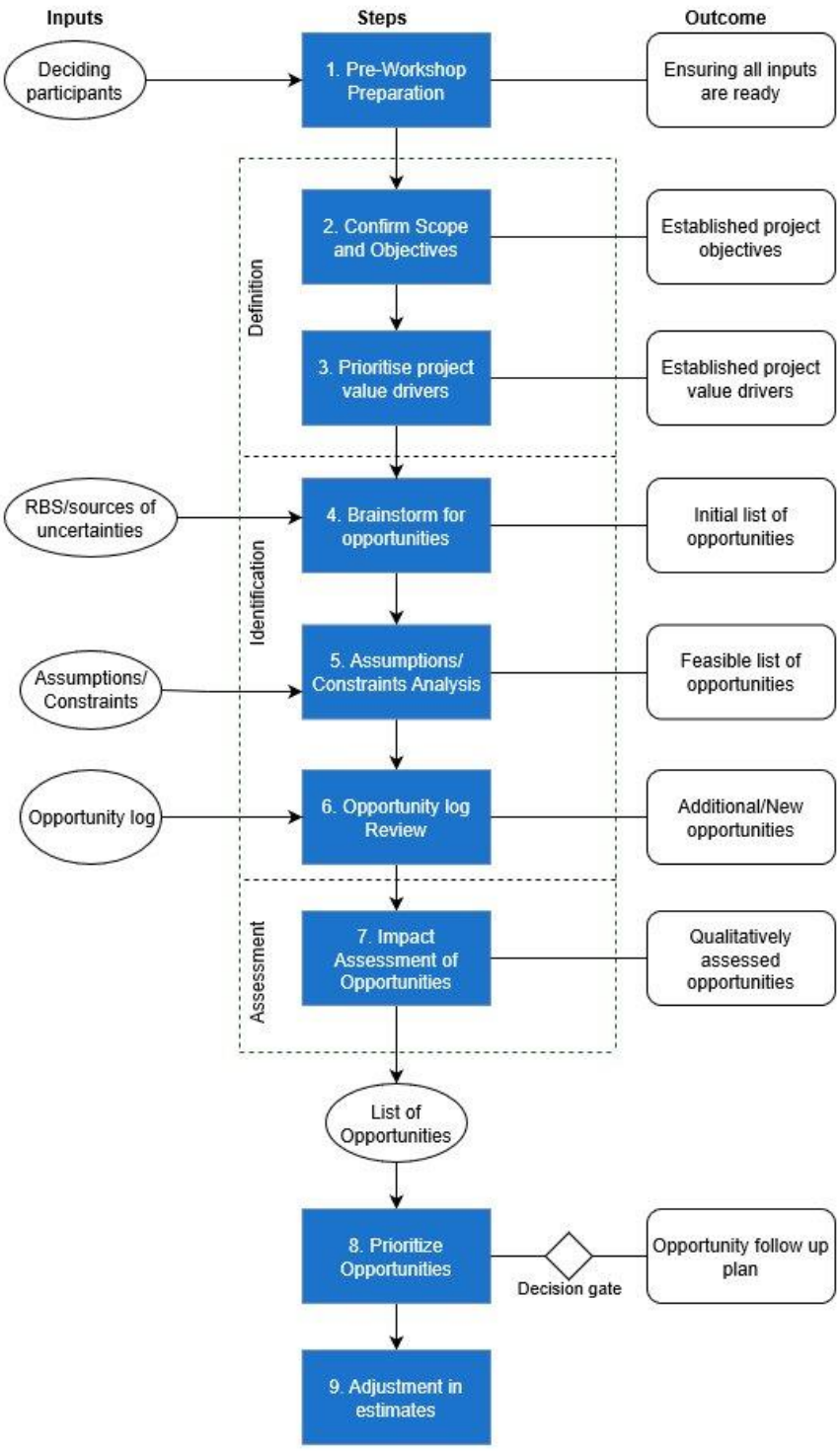


Figure 22: Procedure for identifying opportunities during tender phase (source: own illustration)

Opportunities identified based on the value drivers could then be used by the contractor to get benefits after contract award. For example, if time is ranked high as a value driver then the client needs the project to be well in time. Here, the contractor could negotiate for added money after contract award on time enhancing opportunities like; prefabrication. Also, Project Manager should be the one to allocate points for the value drivers based on client's requirement and expectations from the project. This is because, a Project manager has the widest overview of the project and could see for the majority of opportunities related to the project (Hillson, 2004; Lechler et. al., 2012).

Step 4: Brainstorm for opportunities

This is one of the crucial steps because here all the participants need to think of possible opportunities that would benefit the project in a way they have decided earlier. During such brainstorming sessions, participants tend to identify opportunities based on their experiences and focus areas, so an RBS with several categories will act as a framework to ensure completeness for category exploration (Hillson & Simon, 2012). An RBS with a preferred level of categories can be seen in appendix H. Since, the study is focused towards opportunity based on D&C contract, the opportunities explored would be both related to design and construction phase of the project unlike Design Bid Build contract, where a contractor is only involved for construction phase. Other integrated contract like DBM, DBFM, DBFMO could bring further opportunities related to operation and maintenance phase or financial aspect of the project, but the proposed RBS framework for brainstorming, excludes such categories of opportunities. Thus, the opportunities are explored during tender phase that are possible to be exploited only till design and construction phase of the project.

Input

Brainstorming opportunities would need inputs like an understanding of uncertainties (explained in section 3.1.2) where the sources of uncertainties is checked through a Risk Breakdown Structure (RBS) so that each potential area could be focused to explore possible opportunities. While exploiting opportunity from one category of uncertainty, another category of uncertainty might be affected due to exploitation of that opportunity. For example, an opportunity of changing a material for a higher quality final product which is one category of uncertainty might bring threat regarding unavailability of that material with regular supplier which is another category of uncertainty. Thus, the effect of incorporating an opportunity in the project should be noted for adjustment in the required resources while assessing an opportunity for its benefits.

The brainstorming session should adopt a philosophy of no criticism while generating and building on each other's idea. It should also be focused on ideas of larger impacts for the project (Hillson & Simon, 2012; NETLIPSE, 2016).

Various elements need to be kept in mind while doing such brainstorming sessions that are explained in detail in section 4.3.3e (adjustment/approach in risk management workshops for idea generation) and are listed briefly below.

a) Shallow and deep thinking of ideas
b) Team members communicating openly without any criticism
c) Exploring innovative ideas related to the theme of the client's requirements
d) Ideas based on the company's capability, strength and areas of expertise
e) Ideas with larger impact should be focused more
f) Reframing threats towards opportunities
g) Ideas based on the project's surrounding features
h) Could involve relevant startups' representative to explore new ideas

Output

As an output, this step should produce a list of possible opportunities from all the members that could be worked further for sorting of feasible opportunities for the project.

Step 5: Assumption/Constraints analysis

Input

Here, assumptions related to the project and constraints generally implied by the client is reviewed and analyzed for its validity. This would help to identify real constraints and could exclude some constraints that could be proven false later in the project. Hillson and Simon (2012) clarify it by an example as *"Outsourcing is not permitted, and all project work must be done in-house," an opportunity can be derived: "Outsourcing may be permitted for some project work".*

Output

This step should produce further sorted list of opportunities after comparing it with the contractual constraints provided in the bid document but could also discover possible loopholes where the constraints aren't valid and new solution could be discovered as an opportunity to the contractor.

Step 6: Opportunity log review

This is a nice approach to identify potential opportunities in a project by referring to the maintained opportunity database where similar category projects were executed.

Input

As an input, this step needs an opportunity database to see various kinds of opportunities that might be relevant for the current project. This database could also help the project to know frequently occurring opportunity types in similar projects and where the project team should focus more. An example of an opportunity log can be seen in appendix A. This database could be maintained with further classification as: type of contract, size of the project, type of infrastructure and so on.

Output

As an outcome, this step could produce further relevant opportunities for the project and could also refer to the source of opportunity and kind of benefits that it could bring if applied in the current project.

Step 7: Impact assessment of opportunities

Not all identified opportunities could be chased actively due to limited time and resources. Thus, first a quick assessment on its feasibility of implementation in the project and the threats involved along with each opportunity (effect of change on the project) should be assessed qualitatively with the help of the graph shown in figure 23.

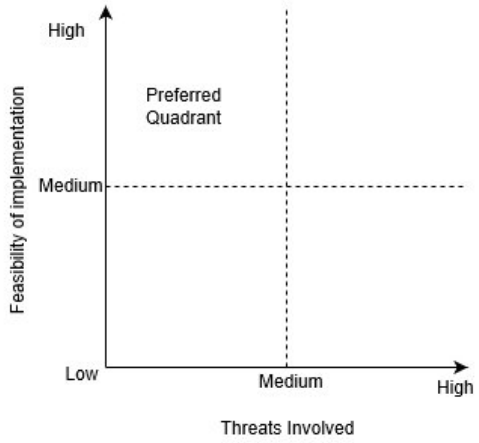


Figure 23: Opportunity sorting based on feasibility of implementation and threats involved (Source: own illustration)

This step is needed to prevent time and to focus only on relevant and practical opportunities for the project, based on contractor's strength and resource availability (refer section 4.3.3e, pg. 43, a strategy suggested by an interviewee; Hillson & Simon, 2012).

After sorting the opportunities from this step, further benefit assessment of opportunities should be done based on their influenceable value drivers. The impact is generally in terms of saved cost. However, other 8 value drivers are also important as discussed in step 3. Based on the project priorities, other value drivers could be used to measure consequence (benefit) of an opportunity. This step is explained further in section 6.2.2.

Output

This step will produce a final list of opportunities which can be used further for prioritization of opportunities based on its impact level and resources/competencies with the available project team to chase those opportunities.

Step 8: Prioritize opportunities

After assessing the impact of each opportunity, it could be prioritized by the team members based on its benefits on various value drivers and resources required. This step has similarities to a strategy suggested by one interviewee in section 4.3.3e (adjustments in risk management workshops, pg. 43).

Output

As an output, this step should produce a list of final opportunities which will be actively chased in the project. Here, a decision should be made on each finalized opportunity on when to use it based on the probability and impact of that opportunity and the project scenario like market condition, available time for proposed solution, competitive edge on the market and so on. Type 2 opportunities should be finalized so that it could be chased properly after contract award. Each opportunity should be allocated to a project member for its follow up and realization. Also, strategy for opportunity response planning should be decided here on whether to exploit, share or enhance each opportunity after contract award. For those opportunities which cannot be exploited without sharing with client (needs approval from client) or other stakeholders (sub-contractors that would act as a major source for exploiting the opportunity), benefit sharing mechanism could be made in agreement with relevant party. For all three strategies for opportunity exploitation, benefits for the contractors should be more than the resources to be invested.

Step 9: Adjustment in estimates

After finalizing the list of opportunities and its consequences, estimates could be adjusted similar to the negative risk reserve where contingency budget is separated in case of threat occurrence. The difference here is that the estimates could actually be lower because of opportunity reserve i.e., reduced bidding amount. This can be done to win the contract. An adjustment scheme can also be seen in Appendix I.

Further, for exploiting the opportunities during execution phase (type 2 opportunity), the contract prepared by the contracting party should be flexible enough to absorb the change effect of the finalized opportunities during tender phase. For example, to apply the opportunity of an alternative material found during tender phase, the contract should have that flexibility in terms of time and budget availability which would be needed to exploit that opportunity during execution phase. Thus, based on each opportunity finalized, the proposed contract should be adjusted as well. Also, extra space could be given in the contract for adopting type 3 opportunities as an additional benefit during execution phase.

Further, for type 2 opportunities, the adjustments in estimates could be done internally while the quotation price would still be higher than the adjusted price. For example, if a project budget estimation is 100 million euros and after identifying type 1 opportunities, the budget could go down to 90 million euros. So, the bidding price now is 90 million euros but, if further opportunities worth 5 million euros are identified during tender phase that could be used after contract award (type 2 opportunities), the project team could decide on how much should the bidding price be between 85-90 million and how much should be kept as a profit for the contractor after reducing the investment required to exploit them. This is, to win the contract with lower bid and to gain extra benefits during the execution phase.

Output

Adjusted estimates based on contractor's strategy to exploit benefits out of identified opportunities should be calculated keeping in mind the resources needed for exploiting each finalized opportunity and the benefit it gives. Since, the benefits would be more than the resources required, the final reserve for overall risk (threats and opportunities) could be lower due to incorporation of finalized opportunities.

To properly exploit the identified opportunities, several suggestions are made on section 4.3.3e (Activities to turn ideas into opportunities) along with 33 factors which also correlate with most of the suggestions provided by the interviewees. Also, an investigation needs to be done if an opportunity fails to be exploited by the project team during the execution phase so that it could be used for future reference as lessons learned. This is also explained briefly in two of the case studies as a suggestion for opportunities exploitation in section 5.4.

6.2.2 Value Creating Opportunities

Opportunities identified must create value to the project if exploited within the project duration. There are 9 project value drivers identified in this study that are also explained in section 4.3.3c. From the definition of opportunity, it is clear that an opportunity for a project must enhance project value and project value for this study is expressed and measured in terms of these 9 value drivers. Thus, an opportunity would create value to a project if it adds benefit in any combination of these 9 value drivers. Also, as discussed in section 3.2.2 d, the value-creating opportunity should give more benefit than the invested resources required to exploit that opportunity.

These 9 value drivers must be prioritized by the project manager to explore possible opportunities accordingly. Through a survey, importance level for each of the value drivers is found which can be seen here and in Appendix F4. Project manager could decide at the start on the importance level (step 3 of figure 22) of each value drivers based on the characteristics of the project. This would help in three ways:

1) It will help to focus on what kind of opportunities are to be explored in the project.

2) If an idea comes up to the team, it would help in deciding whether the idea will be an opportunity for the project based on the benefits it gives in terms value drivers of higher importance level for that project. For example, if the manager decides that time, safety and relation with the client are important for the current project, then any explored idea must benefit in those areas to be considered as an opportunity.

	Project Value drivers
Tangible	Cost
	Time
	Quality
	Safety
	Sustainability
Intangible	Company recognition/reputation
	Relation with client/Trust building
	Satisfaction within project team/people centric activities
	End User satisfaction

3) This would also allow the project team to focus on higher impact/benefit opportunities that could occur in the project utilizing the limited time during tender effectively.

An equation can be made for determining value-creating opportunities in the project.

Required resources < (total impact in terms of value drivers × probability range of occurrence)

Here,

- Required resources mean the time and money required to exploit the opportunity and covering up of any change effect, if occurred by that opportunity in the project.
- Impact on value drivers means opportunity benefitting in terms of relevant value drivers.
- Probability range means the chance of occurrence of an opportunity where a range like 75 and above as high and 50-75 as medium could be stated in advance for opportunity consequence (benefit) assessment.

A project could save cost in terms of saved time, delivering the same quality and safety level with lower cost, and maintaining the same sustainability level with lower cost. The impact here for an opportunity benefiting in terms of time, quality, safety and sustainability could theoretically be deduced to cost where it could have been compared with required resources for realizing it. However, after conducting the opportunity workshop, it was observed and recommended that it is difficult to convert the effect of each value drivers to cost and is not feasible due to time restriction during the tender phase and makes the calculation more complex. Thus, for the assessment of opportunities, its effect should be assessed at a higher level which is explained through an example below. If the opportunities benefitting in terms of these tangible value drivers are chased properly then the project could also achieve benefits in the form of intangible value drivers in most of the cases.

An example of assessing an opportunity during the tender phase is presented below.

Example

Let us take an example of an alternative material that has a high chance/likelyhood (75%) of availability during construction phase and could be used for the road project which is discovered by the project team during the tender phase.

The project has its tangible value drivers' importance level set as time-15, quality-30, safety-15, and sustainability-45 since the client is more concerned about the road being sustainable and higher in quality. Cost is always kept at 100 because it is the effect of all other value drivers (source: validation session).

First, the feasibility of implementation and threats involved while adopting this solution should be checked. If the solution is feasible enough as per the company's strength and has a low threat regarding further change effect on the project due to its incorporation, then the solution could be further assessed for its investment (required resources) and benefits.

Required resources for applying the alternative material is the cost and time that will take to adjust the planning if it has been already done and finding the source (vendor/company) of alternate material. There might also be other types of investment needed in terms of cost and time based on each opportunity character which should be considered.

Table 14: Example for required resources assessment

Investment		
Required Resources	Influence (Yes/No)	Impact (I)
Cost	Yes	1
Time	Yes	2
	Total	3

Suppose, the material could save cost and is more sustainable than the regularly used material and the material could give a higher quality to the road. Also, the material has a very high chance of soon be going for production and has a high chance to be commercially available during the construction phase of the project.

Table 15: Example for tangible and intangible benefits assessment

Return					
Benefits					
Tangible	Influence (Yes/No)	Impact (I)	Importance Level (IL)	Effect= (I*IL)/100	Description on Impacts
Cost	Yes	4	100	4	
Time	No	0	15	0	
Quality	Yes	2	30	0,6	
Safety	No	0	15	0	
Sustainability	Yes	8	40	3,2	
			Total	7,80	
			Total incl. likelyhood	5,85	

Intangible	Influence (Yes/No)	Impact (Increase, decrease, none)	Description on Impacts
Company Reputation	Yes	Increase	
Relationship with client	Yes	Increase	
Project team satisfaction	No	None	
End User Satisfaction	No	None	

Table 16: Example as required resource and benefit comparison

		Required Resources	**Benefits**	
S.N.	**Opportunity**		**Tangible**	**Intangible**
1	Use of alternative material for road construction	3	5,85	Helps building company reputation in the market Relation with client could be stronger

It can be seen from table 16 that this opportunity could indeed create value for this project. Thus, the project team could compare this opportunity with other opportunities for its prioritization (step 8 of figure 22).

For the impact level categorization, it is recommended that the company should decide it prior to the assessment (Hillson, 2004; Hillson & Simon, 2012) as it depends on the type and scale of a project. The decided impact level should be approximately comparable between the tangible value drivers so the assessment would be fair and logical. Below, some examples of impact categorization are presented.

Probability label	Indicative Probability
Very high	90%
High	75%
Medium	50%
Low	25%
Very low	5%

(Hillson, 2004)

Quality		Hillson, 2012
Scale	Impact	In Functionality
Very High	16	Very significant improvement on overall functionality
High	8	Significant improvement on overall functionality
Medium	4	Some improvement on key functional areas
Low	2	Minor improvement on overall functionality
Very low	1	Minor improvement on secondary functions
None	0	No change in functionality

Cost	Hillson, 2012	Hillson, 2012	Nicholas & Steyn, 2012
Scale	Impact	In euros	In project cost
Very High	16	>200K	> 50% cost
High	8	100K-200K	25-50% cost
Medium	4	51K-100K	10-25% cost
Low	2	10K-50K	1-10% cost
Very low	1	<10K	<1% cost
None	0	0	

Time		Hillson, 2012
Scale	Impact	In days
Very High	16	>20 days
High	8	11-20 days
Medium	4	4-10 days
Low	2	1-3 days
Very low	1	<1 day
None	0	0

Impression on the procedure

To successfully exploit such opportunity, it is wise to identify these opportunities during the tender phase where a qualitative estimation is made during the opportunity workshop that the finalized list would probably be an opportunity for the project. However, the required resources in terms of cost and time are recommended to invest for type 2 opportunities only after the contractor wins the tender. This is to prevent the resources of the company to be invested in low probable opportunities, since winning a tender itself has a likelihood of around 20% (source; validation session) which reduces the likelihood of any opportunity by approximately 5 times. Thus, it is not wise to invest resources during the tender phase for a type 2 opportunity, which might end up for nothing. However, it is recommended to use the resources for type 1 opportunities to win the contract.

Opportunity either enhancing the required performance level or achieving the same performance level in lower cost, needs approval from the client to imply it in the project, if it is beyond the proposed offer (solution space) made to the client while submitting the bid. Two scenarios could occur:

a) Either the contractor negotiates for the change implication and takes (exploit) the profit for themselves. This might face challenges like a client being concerned about if the change is an opportunistic behavior from the contractor (Source: DI02) and the client might deny approving anything extra to the project. This could further raise the trust issue and could affect client-contractor relationship which is one of the intangible value drivers for such projects. This option could be taken only if the client doesn't want to get bothered with additional benefits for them but should be done carefully without hampering the relationship.

b) Or, the contractor could share the benefit with the client in an agreement between two parties, but first, the contractor should consult with the client that if they want to explore opportunities in the project or is happy with the regular scope of work (Source: QR02). A client wishing for additional benefits would accept opportunities, and change would be easily approved (Source: DI10). This scenario is preferable but should be done with proper study regarding how to bring various parties together for managing opportunities and sharing the benefits. This is because client often doesn't exactly know what they want during the project (along with the political and budgetary problems as an extra burden) leaving the contractor to struggle with the stakeholders' complexity (Source: DI06,

QR02, CS02). Thus, a solid mechanism for benefit sharing among the involved parties is required. However, this mechanism would be different for different projects and should be designed accordingly since each project is unique and exhibits characteristics like; varying contract type, different stakeholders involved and varying technical, organizational and external complexities.

For both the cases, a strategy as forwarded by one interviewee who works as a value manager could be followed for negotiation, if the client or other project decision-maker is reluctant about exploring opportunities and thinks it is a waste of time.
"Identify opportunities first, then frame it as not dealing with opportunities is a threat to the project or stakeholder management, then the client or decision-maker would be more attentive towards it".

If the contractor wants to exploit the benefits for themselves, it is recommended to explore opportunities within the offered solution space by the contractor which would not need a change approval from the client. This is possible when a project has enough space to look for opportunities (like specifications mentioned on a higher-level while submitting the bid) while the opportunities that could be explored in this case would generally be minor where no change approval is required from the client like using cheaper brand solutions (materials, equipment, supplies, etc.) with the same level of quality as mentioned while submitting the bid. Such opportunities will have minor changes in design and used material type. However, to exploit bigger opportunities which are visible to the client like major design changes, changed technical solutions, etc. which are beyond the solution space provided during the bid, change approval is required from the client-side (EI01, DI02). Therefore, if it is difficult to identify opportunities only within the solution space provided by the contractor due to less exploration area and needs to change the initially proposed plan to identify more opportunities which is often the case (Johansen, 2015; DI02), then the above two scenarios apply where it is wise to choose the second scenario.

7. Conclusion, Limitation, and Recommendation

7.1 Conclusion

This research has focused on understanding the concept of opportunities in large infrastructure projects with the aim of developing an effective procedure to identify opportunities in such projects. Different concepts related to opportunity have been reviewed along with important factors that would enhance the identification approach if followed properly. To develop a procedure for opportunity identification, several research methodologies are adopted along with information collected through empirical study and finally a roadmap has been proposed which could be used by a construction company to better identify and manage opportunities in their respective projects. A research question presented below was formulated at the beginning in order to achieve the research objective, which acted as a focus area for this study.

"*How can opportunities in large infrastructure project under Design & Construct contract be identified during the tender phase for enhancing project value for the contractor after contract award?*"

In order to answer the above research question, four sub-questions were developed for which stepwise information was collected during this study. Here, answer to these sub-questions are provided first and based on the collective answer to all four sub-questions, the main research question is answered.

Sub-Question a: What is an opportunity and project value for a large infrastructure project under Design & Construct contracts?

Opportunity is an uncertain event or condition, factors, and variation that causes change within a project setting which will have increased positive effect than planned in at least one of the project's objectives and would increase project value. An idea or solution perceived as opportunity should benefit at least one of the stakeholders (contractors in this case) involved in the project to be considered as an opportunity. These benefits are in terms of added value for them in a project. Opportunities could be of three types based on the scope of this study and they are;

Type 1: Opportunity identified during the tender phase to win the bid
Type 2: Opportunity identified during the tender phase to exploit the benefits after contract award
Type 3: Opportunities identified during the execution phase of the project i.e., design and construction phase

Project value is the benefits getting out of a project against the invested resources for gaining those benefits. The benefits are seen in terms of one or any combination of nine project value drivers (performance criteria) which are divided into tangible (cost, time, quality, safety, and sustainability) and intangible (company recognition, relation with client, satisfaction of project team and, end-user satisfaction) groups. To enhance project value, it is important to know the priorities on project value drivers reflecting the requirement of the client with crucial stakeholders involved along with the company's expectation from the project and deciding the prioritization of project value drivers accordingly. Opportunities in a project should increase project value and fixing the value drivers in advance would allow to understand how the company wishes to enjoy the benefits from a project when an opportunity is encountered. This would also allow the project team to focus on higher impact opportunities that could occur through uncertain sources in the project while utilizing the limited time during the tender phase effectively.

Sub-Question b: What are the important factors which could stimulate creating and identifying project opportunities?

In this study, 33 factors are found from the literature review and detail interview with the practitioners which could stimulate creation and identification of project opportunities. Also, the factors are weighted for their importance level through a questionnaire survey. The differences on importance level for each of them is marginal while majority of factors are scored high. Thus, it acts as an evidence that these factors are crucial towards an effective approach for opportunity identification. These factors are clustered into six groups and are related to each other for enhancing the effectiveness of opportunity identification. The groups along with their group weightage can be seen below. A full list of factors can be seen in Appendix F3, and the description of each factor can be seen in appendix E.

1) Factors related to Competency (34%)
2) Factors related to Collaboration (19%)
3) Factors related to Company policy (14%)
4) Factors related to Project Management Process (13%)
5) Factors related to Client-side decisions (11%)
6) Factors related to Self-reflection (9%)

The benefit of focusing on these factors is twofold. First, the factors will create a strong foundation for opportunity creation, identification, and overall opportunity management in large infrastructure projects. On the other hand, these factors could also help in reducing the constraint's effect for opportunity identification in such large projects, and the relation can be seen in Appendix G. These factors have implications at different levels like: organization, project manager, project team members and client. Thus, they should be focused on different levels and properly ensured for its implication while executing such large projects.

Sub-Question c: What could be a procedure for identifying opportunities by a contractor during the tender phase of large infrastructure projects?

A procedure is suggested in this study for opportunity identification by contractors during the tender phase of large infrastructure projects which is adopted from the ATOM framework suggested by Hillson and Simon (2012). The nature of opportunity identification workshop should be different from threat workshop because it needs more open and out of the box approach. Some distinctions are made from the ATOM framework, the first one being at step three where project value drivers must be decided as a focus area for opportunity exploration. For brainstorming of ideas, the framework of RBS is adjusted so that it would take less time to go through all the categories. Also, reviewing the opportunity log is suggested as this would allow finding further opportunities that might have occurred in similar previous projects.

The assessment section has also been adjusted based on this study with a new inclusion of importance level for project value drivers as this would allow to approximately convert the various project value dimensions into a single unit for easy impact assessment. Step 8 and 9 are new as per the requirement of this study.

The process consists of 9 steps with inputs required for some steps and outputs expected from each step.

1) Pre-workshop Preparation
2) Confirm Scope and Objectives
3) Prioritize project value drivers
4) Brainstorm for opportunities
5) Assumption/Constraints analysis

6) Opportunity log review
7) Impact assessment of opportunities
8) Prioritize opportunities
9) Adjustment in estimates

For identifying opportunities during such workshops, there should be open communication between team members, and this is possible when they trust each other. These sessions should be free of judgmental comments and pressure of being the opportunity owner for its exploitation, if proposed by a team member. This could be put effect if the members are highly motivated, open minded and optimistic about possibilities for incorporating creativity and building new ideas.

To successfully exploit such opportunity, it is wise to identify these opportunities during the tender phase where a qualitative estimation is made during the opportunity workshop and the finalized list will have the probable opportunities for the project. However, for type 2 opportunities, the required resources in terms of cost and time for its exploitation is recommended to be invested only if the contractor gets the contract. This is to prevent the resources of the company, since winning a tender itself has a likelihood of around 20% (source; validation session) which reduces the likelihood of any opportunity by approximately 5 times if the resources are invested in the tender phase since type 2 opportunities are only valid if a company wins the contract. Thus, it is advisable to identify such opportunities during tender phase and adjust the estimates accordingly. The estimates could be adjusted by adding some fraction of benefit in the actual estimates to lower the bidding amount and other fraction to the contractor themselves to get extra benefit. If the contractor wins the contract, those opportunities would add extra profit margin for them. But the contract made should be flexible enough such that, if they win the bid then all finalized type 2 opportunities could be incorporated in the project within the allocated time and budget.

Sub-Question d: How can it be known that the identified opportunity creates value to the project?

To know if an opportunity creates value to the project, assessment of that opportunity needs to be done in terms of benefit gaining from that opportunity against the resources required for that opportunity to be realized in the project. The benefits gained should be more than the resources invested to call it as a value-creating opportunity. Project value is a multidimensional concept and is not only limited to financial value. Thus, the value drivers from the contractor's perspective contains other eight drivers as well, apart from cost. For conducting the assessment, the company must decide on each level of impact for five tangible value drivers seeing from a client's perspective. Client's preference is important to offer solutions and opportunities towards the focus areas of the project to enhance the value proposition. The impact level for these five tangible value drivers should be comparable to each other, so that the assessment of each opportunity during various projects is logical. The intangible value drivers could be observed as an increment or decrement effect on those value drivers caused by an opportunity.

After investigating the results related to four sub-questions, the main research question of this study can be answered.

Research Question:

How can opportunities in infrastructure project under Design & Construct contract be identified during the tender phase for enhancing project value for the contractor after contract award?

Identification of opportunities in large infrastructure projects could be made more effective if several requirements are followed by the company, project manager, and project team. A focus towards reducing the prevailing bottlenecks for opportunity identification is needed followed by establishing a solid foundation that would act as a positive catalyst for opportunity identification. This is possible by focusing towards the 33 crucial factors at different levels. For some of the factors, it needs adjustment on the company policies. If an organization makes opportunity management a mandatory step during tender preparation, it would ensure the required attention needed for opportunity exploration, which could be given less preference if kept only as a desired step. Making policy adjustments and incorporating crucial factors would not be effective if the project team does not have a clear concept of what opportunities are. So, a common understanding of opportunity and project value is required and can be done through established definition and circulating them through knowledge enhancement trainings. Opportunity emerges from the uncertainties related to the project and this must be well understood by the project team.

An increased focus towards opportunities in projects is needed specially in the tender phase to find possible benefits while minimizing major changes on later stages that could turn lethal for such large projects. However, not all opportunities could be identified and incorporated during tender phase, thus the submitted contract should have the space for incorporating later opportunities. For exploring opportunities, separate opportunity management workshop during tender phase could act as a valuable step to identify, assess and prioritize opportunities in a group consent so that it is openly communicated and mutually agreed for its exploitation. The finalized opportunities within the capacity of the company could be exploited or enhanced based on its character. For incorporating such opportunities during execution phase, the submitted contract should be flexible enough (work specification in higher level, adequate buffer in cost and time for planning adjustments, and so on) to absorb the changes caused while exploiting such opportunities. While the ones which are outside the formulated solution space and might need change approval from the client, could be shared among the two parties. This increases the chance of exploiting such opportunities in the project while maintaining a good relationship with the client.

Opportunities finalized through the workshop should be recorded through a well-maintained opportunity database which would prevent loss of work and information and could be reviewed for its progress. Identifying opportunities is not a one-time process and should be repeated for exploring new opportunities, while some of the old ones might become obsolete as well due to project's changing dynamics. Moreover, each session could act as a feedback source where knowledge transfer should be done from previous steps.

Thus, the identification of opportunities needs an open and flexible approach and needs increased attention towards it with essential activities, as exploiting opportunities could increase the profit margin for the contractors dealing with such large projects while also giving an overall benefit to the client and eventually to the society in a broader level.

7.2 Limitation

This research has few limitations which are listed here in several points.

- During this study, nine performance criteria as project value drivers have been identified based on literature and interviewees. It is possible that there could be more value drivers from a contractor's perspective for a large infrastructure project under D&C contract.

- Due to time constraint, two cases are investigated as a reference for exploring constraints that generally hinders the opportunity identification in such projects. Although, few similar constraints are discovered during the detailed interviews, more constraints could have been identified if the number of cases would have been more.
- The final procedure for opportunity identification proposed in this report has been developed based on some feedbacks forwarded by the experts during the validation session. However, the corrected procedure is not validated again by the expert due to the limited time for this study. Thus, although the correction made are primarily based on the experts' suggestion, it is not sure that the changed framework will work more effectively unless used in an opportunity workshop for a real project.
- It is suggested that the benefits of an opportunity should be more than the required resources for exploiting it. However, it hasn't been investigated as how higher the benefit should be than the required resources in order to exploit that opportunity in the project.
- The opportunity identified during the tender phase could be both type 1 and type 2 opportunities. To decide which opportunities to categorize as type 1 or type 2 depends on each project scenarios and opportunity characteristics like probability and impact (benefits for using it in the bid or keeping it for later use). Here, the opportunities with a very high probability of occurrence can be made type 1 opportunity while opportunities with a medium probability can be made type 2 opportunity. However, it needs careful decision making and perhaps more research to identify other elements for making this decision.

7.3 Recommendation

Several recommendations can be made from this study. The recommendation is divided into two parts, one is for future research and the other is practical recommendations.

7.3.1 Recommendation towards academics and future research

After conducting this study, several possibilities have been found while could be investigated further for developing a holistic view regarding opportunity management in such large projects.

a) Opportunities arises from uncertainties in project and a project cannot have zero uncertainty. Thus, the focus should be shifted from a controlled approach on fulfilling the initially planned project objective to a flexible approach on focusing on the end result to enhance the project value. This can be done by prioritizing value drivers and focusing on high impact areas for exploring opportunities and incorporating them in the project while allowing changes to gain higher benefits from the project. This might need adjustment in the project planning but should be done to exploit new opportunities from such uncertain situations. The focus should be towards creating and identifying positive business cases for the project which is different from sticking to baseline estimates and restricting the focus towards pre-defined objectives.

b) An organization should be resilient to absorb changes while incorporating opportunities. At a project level, the contract could be made flexible enough to incorporate any new opportunities that is to be exploited after contract award (type 2 and 3 opportunities). A strategy as standardization of work at some level for reaching the targeted aim (to win the bid and deliver the project as target) could be done but also should have that flexible space in the specification for incorporating newer changes and opportunities.

c) Since sharing opportunity benefits enhances the client-contractor relationship and creates chances of exploring more opportunities in the project. It is recommended to research towards developing a benefit-sharing mechanism between the involved parties which could be used as a motivation for

identifying sharing opportunities by contracting companies. The sharing mechanism would be different for different project based on characteristics like; varying contract type, different stakeholders involved, and varying technical, organizational and external complexities but, perhaps common elements and prerequisites could be found for developing such benefit-sharing model. It should be done at organization level between client and involved contracting companies during pre-tender phase so that the contractors could identify opportunities with sharing strategy during tender phase. Thus, more value creating opportunities could be identified giving benefit to both parties.

d) It is recommended to study more towards how to differentiate between type 1 and type 2 opportunities i.e., to decide on using the identified opportunity to win the bid or to take it further for exploiting during the execution phase. Although some criteria like the probability of impact, project scenario, market condition, available time of solution, competition and company's strength have been identified in this study, it is still not an easy decision to make and could depend on more factors.

e) Every opportunity would have different benefit for a project. For the assessment of an opportunity, it is suggested that the benefits should be more than the required resources while exploiting it. However, it hasn't been investigated as how higher the benefit should be than the required resources in order to exploit that opportunity in the project. Thus, a study regarding the minimum requirement or benchmark towards the minimum gap between investment and benefit could be done for categorizing an opportunity as value creating opportunity.

f) It was observed during the interview and case study that contractors generally don't work extra for adding value to the project if they don't get any extra benefit. For that, a mechanism for providing rewards to the contractor and involved parties could be developed from the client side which would motivate the main parties involved in the project for exploring opportunities that is beneficial not only for the contractor but also for the client and the society. For such mechanism, a reward fund could be established where each actor involved in identification of such opportunities is assessed in terms of their performance regarding cost, time, SHEQ, community and shareholder, and so on. Based on the weighted score on each criterion, percentage share of reward could be allotted among each involved party. Further study could be done towards how such mechanism could look like and how to incorporate such mechanism in different forms of contract.

7.3.2 Practical Recommendations

Following recommendation is for Hochtief Infrastructure, or a similar contractor company, if followed, could improve their approach towards opportunity identification while dealing with large infrastructure projects.

a) *Organizational level:* Opportunity management should get enough attention while executing such large projects and opportunity identification process should be repeated on a suitable interval as per the length and dynamics of the project. Opportunities identification should be done in a separate session and company should bring policies related to opportunity management so that it is taken more seriously while dealing with such large projects. Perhaps, the exploration should be mandatory step while executing such large projects so that the employees has it as a regular scope of work to be done.

b) *Project Team Level:* It is recommended to use the proposed procedure for identifying opportunities during the tender phase in a real project setting to test for its effectiveness and further improvement since no procedure could be made perfect at the first attempt and need adjustments based on user experience.

c) *Project Team Level:* Identifying opportunities needs open minded and dedicated project team members. Thus, it is suggested to involve highly motivated team members who are passionate and enthusiastic about creating overall value to the project for opportunity identification. This will create higher chance of conducting an effective opportunity workshop session which could produce impactful opportunities to be worked for.

d) *Project Team Level:* It is recommended to maintain a well descriptive opportunity log for each project. This log could then be used to store all the identified opportunities in similar projects. As an example, an opportunity log can be seen in appendix A where the database could be maintained with a further classification such as type of contract, size of the project, type of infrastructure and so on.

e) *Project Team Level:* Opportunities could also come as an additional scope in the project. So, the concept of creating future value presented as value ladder in the literature could be adopted for creating additional scope in the project, keeping in mind the premature convergence of solution which could create a possible lock-in of the value ladder. This type of opportunities would come under sharing strategy. Thus, the benefit could be shared with the client which would also ensure a good client-contractor relationship during the project.

f) *Project Team Level:* It is recommended for type 2 opportunities, to identify them during the tender phase in an opportunity workshop while the resources should be invested to exploit those opportunities only after the contract has been awarded to make worth the resources invested.

g) *Organizational level:* From the literature it was found that, an organization can shape their long-term policies as such they could retain their skilled and experienced human resource so that the gained knowledge could get transferred for future benefits. During the empirical study also, retaining key employees in the project was found as a major suggestion for knowledge transfer between project phases which could improve the chances of opportunity identification in such large projects. Thus, company policy should be focused towards retaining key employees while dealing with such large projects.

h) *Organizational level:* During the detailed interview and case study, it was observed that a tight project budget generally acts a constraint regarding opportunity exploration. Thus, it is important that the board (higher management level of the company (e.g., Hochtief) discuss with the client (e.g., Rijkswaterstaat) to find a way to solve tight project budget in such large projects.

i) *Organizational level:* During this study, it was observed that project members tend to be busy with their own regular work in a project while generally no one is fully assigned for managing opportunities. It was also observed that the identified opportunities were simply left out and wasn't chased properly because of time constraints. Thus, a separate employee as opportunity/value manager could be assigned by the company whose sole purpose is to focus towards conducting and ensuring the process of identifying and exploring opportunities and coordinating with the team during project. Identifying opportunity is not a one-man job thus, this employee would be responsible for coordinating all the activities related to it. Activities like; conducting opportunity workshop, maintaining database, tracking the progress of each finalized opportunity, coordinating with different opportunity task owner for its exploitation, coordinating with risk and change management team/manager, and overall opportunity management could be some of the major responsibility to be taken by the employee.

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Appendices

Appendix A: Opportunities in various projects

These entries of opportunities are found from the literature and experience of practitioners in their past projects collected during detailed interviews, questionnaire survey, and case study.

Entry 1, 5, 8, 17, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30 are (type 2) opportunities that are specifically identified during tender phase and is exploited/or could have exploited only after the contract is awarded to the contractor. This kind of opportunities highly depends on the negotiation done to implement them in the project after the contract award. Entry 25 gives another way of getting benefits from the opportunities by the contractor where an agreement is made with the client in advance to share the benefits of opportunities if explored during the project.

The purpose of this appendix is explained below;

- The collection of opportunities is done from large infrastructure projects, so it acts as a preliminary source of commonly occurring opportunities in such projects. However, the entries are very few (35) and cannot act as a sufficient database, so further collection of opportunities in similar projects is needed. The commonly occurred opportunities within this limited dataset are;
  a) Design and scope related solution
  b) Technical solution
  c) Contractual space
  d) Work method optimization
  e) Development of better organization form in the project
  f) Better decision making
  g) Initiating valuable activities, and so on.

  So apart from the proposed list of opportunities, other opportunities could also occur in such projects. Thus, the company should be adoptive enough to absorb newly emerging opportunities which are basically not known till it occurs in the project.

- It acts as an example of how an opportunity log could look like for maintaining a database by the company. This log could be further categorized based on type of contract, size of the project, type of infrastructure and so on.

- The collection also acts as a source for observing how opportunities could be developed and exploited in various projects under different circumstances.

- It could be seen from the entries that each opportunity has a positive effect in at least one of the 9 value drivers (kept between brackets on reason and result sections of the table) identified in this study. Thus, it acts as an evidence that opportunities should increase project value and the 9 identified value drivers are important in such large projects. Hence, validating the relation between opportunities and project value through empirical data.

S.N	Country	Organization	Project name	Opportunity	Year	Phase of project	Kind of opportunity	Reason behind it	Implemented? (Yes/No)	If yes, the result	Source
1	Netherlands	NS Railinfratrust	Betuweroute	Archeology	Around 1995-1999	Design and conditioning phase	Cultural heritage	Increase support for the project (*Good relation with client)*	Yes	Exhibitions, articles in newspapers, involvement of schools, more awareness of cultural heritage (proud) etc.	Prof. Marcel Hertogh
2	Switzerland	AlpTransit Gotthard Ltd	Gotthard Base Tunnel	New construction concept (deformable steel rings)	2004-2007	Construction Phase	Technical solution	Assistance for tunnel excavation in geologically difficult terrain	Yes	Impact of 6 months on schedule and lowered project cost (*cost and time*)	(Lieb, R. H., & Ehrbar, H., 2011)
3	USA	Port of Astoria and Oregon State Highway Department	Astoria-Megler Bridge	Proper marketing strategy used for the project (e.g., using clowns to reach common people)	1961 - present day	Execution and Operational Phase	Improved communication through promotional activities	Gaining support from the local community and budget from the state government for construction (*End user satisfaction*)	Yes	Resulted as multi-purpose bridge: 1)Toll taxes covering the construction cost in two years ahead of schedule due to unexpected high traffic volume 2) Tourist attraction 3) Used for communication and fiber optic cables	Eskerod et. al., 2018
4	Finland	Finnish Transport Agency and Lemminkäinen Infrastructure Ltd	Rantatunneli tunnel	Widening of ventilation duct at one of the tunnel's end	2011-2012	Development Phase	Technical solution	It can be used as a work tunnel; one ventilation fan room could be omitted which was costlier than just excavating and making the tunnel wider.	Yes	2.9 million euros was saved (*cost*)	Hietajärvi et. al., 2017
5	Netherlands	Contractor	A15 Road Project	Not constructing a bridge from the provided original reference design	2010-2015	Tender Phase	Scope and Design solution	It was a better solution to save money (*cost*)	Yes	Saved cost of a bridge which was additional benefit for the contractor	DI01 (Design Manager)
6	Netherlands	Contractor	Bridge Project	Prefabrication of deck, beams and columns	2007	Design Phase	Design and technical solution	Seen during execution phase as improved solution that can give better results	Yes	Saved time and money, from safety point of view reduced amount of working at heights	DI03 (Execution Manager)
7	Netherlands	Contractor	SAAOne	Time shits allocation-allocating two working shifts instead of one	2015	Execution phase	Better scheduling/working method optimization	Project was in the verge of getting delayed	Yes	Risk of getting delayed was prevented (*Time*)	DI03 (Execution Manager)
8	England	Crossrail Limited	London Crossrail project	An integrated project team: shared learning from past projects	2008	Front-end planning phase	Development of better organizational form	For incorporating innovations and ways of doing the project more economically *(Project team satisfaction*)	Yes	Better organizational decision making; Help in better execution for operation phase due to early knowledge transfer	Davies et. al., 2014
9	England	Crossrail Limited	London Crossrail project	Procurement approach: Optimized Contractor Involvement	2009	Tender Phase	Better procurement procedure	To reduce the downside risks while exploiting upside innovative opportunities for the project (*End User satisfaction, Client satisfaction*)	Yes	Increasing emphasis on technical elements rather than lowest cost. This improved the solutions submitted during tender. Also, contractors were encouraged with incentives for better solutions.	Davies et. al., 2014

S.N	Country	Organization	Project name	Opportunity	Year	Phase of project	Kind of opportunity	Reason behind it	Implemented? (Yes/No)	If yes, the result	Source
10	England	Crossrail Limited	London Crossrail project	Allocation of dedicated innovation team	2012-2014	Execution Phase	Development of innovation stategies	To find new ideas and to check if the ideas would benefit the project (*cost, time,safety, etc.*)	Yes	30 innovative ideas were supported and fundings were provided for them after three rounds of evaluation by an innovation working group comprised of industry experts, representatives of the contractors, and senior representatives of the Innovation Program	Davies et. al., 2014
11	Netherlands	A lanes (Consortium)	Broadening of A15	Demolition of viaduct all at once instead of gradual demolition and construction	2014	Construction Phase	Better decision making; done together with client	Required to demolish the old viaduct and build and new one at the same place; one of the client requirement less hindrance, and also the cost was less for this solution	Yes	Less hindrance period for the traffic, and in terms of noise it was better for all parties, cheaper in cost for contractor (*cost, time and relation with client*)	DI06 (Stakeholder Manager)
12	Netherlands		New court house, Breda	Insulation works and user companies move in was done simultaneously		Construction phase	Good cooperation between client and contractor/better working strategy	Some user companies wanted to move in but, it was not mentioned in the contract, and the insulation works wasn't finished then	Yes	Both sides got a longer period of time for completing their work and the project was completed on time (*Time*)	DI06 (Stakeholder Manager)
13	Norway	Statsbygg	National Museum of Oslo	1) Changing the construction of the Office building- Going from site-cast production to pre-fabrication 2) Simplified ceiling and overlight solution in the glass hall	2016-2018	Construction Phase	Technical solution	Project was running behind schedule and was signalling cost overrun. As a solution project owner decided to change the project management team and implemented new uncertainty management process.	Yes	Saved time of around 4 months and saved cost of around 1.25 million euros. (*Cost and time*)	Johansen et. al., 2018
14	Netherlands	Province Zuid Holland	N211 Hague Poeldijk highway (major repair of road)	Innovative solutions (22 in total) ; cathodic protection for sheet piles, bamboo sign boards, geopolymer as a replacement for cement, etc	2014-2018	Tender phase	Innovative solution, cooperation with other companies, symposiums for knowledge sharing	For finding better solution for lower energy consumption	Yes	Resulted into energy positive road with energy saving of 150% (*Sustainability, relation with client, company reputation*)	DI09-Client (https://www.zuid-holland.nl/onderwerpen/energie/energiewegen-0/n211-geeft-energie/)
15	Netherlands	Contractor	A9- Highway project	1) Giving space to use the road for longer period of time; 2)Also proper front end loading of ideas and concepts by the contractor		Construction Phase	1) Good cooperation between client and contractor thus client becoming flexible 2) Technical solutions	To make the work easier for the contractors so that they could do the work more efectively, but this was only possible through open communication	Yes	1) Contractor could keept their equipmments easily, thus the execution work was quick and easy and some amount of money was saved 2) Better execution of project with better solutions to work on. (*Cost and time*)	DI10 (Client_Project Manager)

S.N	Country	Organization	Project name	Opportunity	Year	Phase of project	Kind of opportunity	Reason behind it	Implemented? (Yes/No)	If yes, the result	Source
16	Netherlands	Contractor	A9- Highway project	Initiative taken by contractors towards safety		Construction Phase	Initiating important activity		Yes	Client could talk to the press and governmental bodies how good and concerned the contractor is towards safety, uplifting their image on the market (*Company recognition*)	DI10 (Client_Project Manager)
17	Netherlands	Contractor	Via15 (Road project)	Finding incorrectness in the client's requirement (Between dike and an over bridge, there was a requirement of 1m gap from the client)	2018	Tender Phase	Contractual opportunity/Technical solution	Better solved as increasing the height of the bridge and the extra space could be used for bicycle path, vegetations could grow over, etc.	Yes	Finding better solution. The new solution was better appreciated by the client so, improvement in client-contractor relation (*Relation with clinet*)	DI04 (EPC director)
18	Netherlands	Contractor	Zuidasdok	Additional scope of work that the client has not foreseen	2016	Early design phase	Additional scope	Additional scope of work gives additional profit to the contract since the contractor has already won the contract (*Cost*)	Not sure		CS01 (Risk Manager)
19	Netherlands	Contractor	Zuidasdok	Optimization of construction methods	2016	Tender Phase	Work method optimization	Better working method than previously proposed (*Time*)	Not sure		CS01 (Risk Manager)
20	Netherlands	Contractor	Zuidasdok	Finding alternative construction materials	2016	Tender Phase	Material optization	Cheaper in construction and equal in quality (*Cost*)	Not sure		CS01 (Risk Manager)
21	Qatar	Contractor		Additional scope of work that the client has not foreseen	2006	Design Phase	Additional scope	Contractor could earn extra since payment was on cost plus percentage system (*Cost*)	Yes	Extra profit for contractor	CS02 (Financial Director)
22	Netherlands	Contractor	Tunnel project	Finding alternative construction materials for lining of tunnel		Tender Phase	Contractual space (Material optization)	Cheaper in construction and equal in quality; according to the contract minimum level of quality was to be maintained; Also, the contract was awarded based on performance level of the tunnel (*Cost*)	Yes	Extra profit for contractor	CS02 (Financial Director)
23	Netherlands	ZuidPlus	Zuidasdok	Rupsje nooitgenoeg	2016	Tender Phase	Construction Method	Reduced impact to; Stakeholders Hindrance Geotech Risk Cost	No	Client declined, Solution was too innovative, and too different from Competition (wish for comparable bids).	QR_02 (International Project Manager)
24	Netherlands	ZuidPlus	Zuidasdok	Eliminating 8 major weekend railway-closures.	2016	Tender Phase	Construction Method and Planning In combination with additional new scope	Dramatically reduce impact to Stake-holders; - Hindrance -Cost	No	Client declined during tender.	QR_02 (International Project Manager)

S.N	Country	Organization	Project name	Opportunity	Year	Phase of project	Kind of opportunity	Reason behind it	Implemented? (Yes/No)	If yes, the result	Source
25	UK	HMJV	London Power Tunnel 2	More than 20 Opportunities identified and discussed with Client, pre- Tendersubmittal.	2019	Tender Phase	Various; -Design -Construction -Planning -Logistics	Part of Contract Requirements, a mechanism (Project13) is in place asking for Opportunities and sharing the benifits.	Yes	Project Delivery not to start before October 2019.	QR_02 (International Project Manager)
26	Netherlands	Contractor	ZuidasDok	Using a logistic Hub for efficient logistics	2019	Tender Phase	Work method optimization (Logistics)	Efficient logistics. Less disruption of traffic in project area. (*Time and User satisfaction*)	Yes	Reduction of transport movement in project area	QR_10 (Process Coordinator)
27	Netherlands	Contractor	A15: Temporary connection Suurhoffbrug	By using another type of asphalt after award, there are no noise-reducing structures needed	2019-2021	Tender Phase	Scope and Design solution	Client has changed the requirement to apply OPA8 to Single-layer ZOAB. As a result, noise barriers must also be applied to the road beds (aardebanen). In the event that the client requests OPA8 for the period after the award (this is also applied by A-Lanes), we can assume that the noise-reducing structures are no longer needed at these locations	No, the work was not adopted	cost saving and better design	QR_11 (System Engineer)
28	Netherlands	Contractor	A15: Temporary connection Suurhoffbrug	Current condition existing bridge is worse than expected	2019-2021	Tender Phase	Implementation and maintainability	During maintenance it appears that the current condition of the existing bridge was worse than expected. This offers opportunities for the contractor in the future	No, the work was not adopted	Better design (future-proof design) with scope extension options (*Cost*)	QR_11 (System Engineer)
29	Netherlands	Contractor	A15: Temporary connection Suurhoffbrug	Relocation costs telecom cables and pipes are reimbursed by Client (question 309 in NvI)	2019-2021	Tender Phase	performance (Uitvoering)	Relocation costs telecom cables and pipes are reimbursed by Client	No, the work was not adopted	*Cost* saving and better/accurate budget	QR_11 (System Engineer)
30	Netherlands	Contractor	A15: Temporary connection Suurhoffbrug	With our implementation method, only one weekend of TVP, WBU and waterway closure is required	2019-2021	Tender Phase	Phasing design (Faseringsontwerp)	With our implementation method, only one weekend of TVP, WBU and waterway closure is required	No, the work was not adopted	*Time and cost saving*	QR_11 (System Engineer)
31	Netherlands	Contractor	Zuidasdok	Other design link KNM10 (connection) and Schinkel	2018-2028	Preliminary design phase	Scope and Design solution	applying Soil Body between KNM10 and Schinkel instead of interconnected structures. **Point of attention:** geotechnical risk.	work in progress	*Cost* savings for the contractor	QR_11 (System Engineer)
32	Netherlands	Contractor	Zuidasdok	Change position of columns in passages	2018-2028	Preliminary design phase	Execution method	Change position columns in passages or add extra columns. decks can then be flatter (instead of trough form)	work in progress	*Cost* savings for the contractor	QR_11 (System Engineer)

S.N	Country	Organization	Project name	Opportunity	Year	Phase of project	Kind of opportunity	Reason behind it	Implemented? (Yes/No)	If yes, the result	Source
33	Netherlands	Contractor	Zuidasdok	Adjust Execution methods (more pile driving and vibrating) to fit in with legislation and regulations	2018-2028	Preliminary design phase	Execution method	**General:** Adjust Execution methods (more pile driving and vibrating instead of drilling and pressing foundation elements) to fit in with legislation and regulations	work in progress	Better quality and in line with the legislation and regulations (*Quality*)	QR_11 (System Engineer)
34	Netherlands	Contractor	Zuidasdok	Simplify lighting system	2018-2028	Preliminary design phase	Scope and Design solution	Lighting level and degree of uniformity lighting level must be reduced, making the expensive Dalí system simpler.	work in progress	Cost savings for the contractor (*Cost*)	QR_11 (System Engineer)
35	Netherlands	Contractor	Zuidasdok	Optimize phasing and Execution methods	2018-2028	Preliminary design phase	Execution method	**General:** Applying fewer/narrower lanes and applying barriers for temporary situations or work at lower speeds (RO 90 km / h and a requirement of 100 km / h) leads to: - Less night and weekend work - Fewer material transports - Fewer phases - Planning benefits	work in progress	Cost and time savings and better quality of delivered work (*Cost, time and quality*)	QR_11 (System Engineer)

Appendix B: Initial Exploratory Interview Questions

Date:
Interviewee code:
Duration:
Role:

General Questions:

1. Current professional designation and experience
2. Experience with large infrastructure projects

Short-exploratory interview for understanding the current process and problem

Q1. How HOCHTIEF generally classify a project as large infrastructure project? Is there any minimum amount in euros?

Q2. What is the current procedure of risk management at HOCHTIEF Infrastructure? Are there any joint sessions with various team members? Also, how frequently these sessions are done, is it only at the beginning or is it done more frequently in every phase?

Q3. Are opportunities also identified along with negative risks in these sessions? If yes, is it done in the same session or separate sessions are designated for opportunity explorations?

Q4. Could you suggest a project executed here by HOCHTIEF, where opportunities were exploited or, where the project gave more value than initially stipulated, performed better than expected?

Q5. Does the project team have the authority to change the planning of a project if an uncertain event is encountered during project execution or do they require higher-level management approval?

Q6. Please mention the activities done at HOCHTIEF towards opportunity management for a project (preparing opportunity log, brainstorming sessions, value engineering workshops, checklists)? How are these activities executed?

Q7. Are the activities mentioned in Q6 is also done for exploring opportunities in tender phase of the project so that it could be exploited during the design & construction phase? If yes, are you satisfied with the results?

Q8. How are changes managed in large infrastructure projects? What is the requirement to accept a change to an original plan (e.g., %increase in profit or saved time, etc.)?

Appendix C: Detailed Interview Questions

Semi-structured interview with practitioners

Date:
Interviewee code:
Duration:
Role:

General Questions:

- Current professional designation and experience
- Experience with large infrastructure projects

Subject Questions:

Opportunities

Q1. According to you, what is an opportunity in a project or, how do you define opportunity in a project?

Q2. What is opportunity in a large infrastructure project when you see it from a contractor's perspective?

Q3. As per your experience, how could contractors improve their approach in finding opportunities within projects during tender phase so that they could exploit it during execution of projects?

Q4. According to you, what are top (three to five) factors that would help in identifying opportunities during tender phase of a project? And why?

Q5. What do you think about these factors, are they relevant in Design & Construct contracts to be able to stimulate creation and identification of opportunities? Which ones are relevant, and which are not? (The factor list is the same as mention in Literature review section)

Q6. Do you recall any opportunities (one or more) that you encountered during your past projects?

- Country
- Organization
- Project name
- Opportunity
- Year
- Phase of project
- Kind of opportunity
- Reason for considering it an opportunity

Q7. Could you tell me what was the source of that occurred opportunity? Or, what led that opportunity to occur?

Q8. Was that identified opportunity exploited by the project team?

a) If yes, what was the result? How did you decide if it will be an opportunity for the project? Did you compare it with anything (e.g. invested resources) to know that the opportunity will bring benefit to the project?
b) If no, why? What were the reasons for not exploiting that opportunity? What essential elements were needed in that project so that the project team would have exploited that opportunity?

Project value

Q9. According to you, what is project value or, how do you define project value?

Q10. For a project team, do you think project value (value drivers) is something more than saved time, cost and enhanced quality when you see it from a contractor's perspective? If yes, what and why?

Opportunity management process

Q11. In your projects, how do you deal with change in a project's plan or scope? How do you assess the positive impact of accepted change?

Q12. Could you suggest a project executed here by HOCHTIEF, where opportunities were exploited or, where the project gave more value than initially stipulated, performed better than expected?

Q13. What type of contracts would help contractors in identifying and exploiting more opportunities in large infrastructure projects?

Q14. As a closing question, what would you recommend or do to properly identify and exploit opportunities in large infrastructure projects?

Appendix D: Case Interview Questions

1) Please give a brief introduction of approach used for opportunity identification in this project.

2) Do you see any similarity with this framework (ATOM framework) for identifying opportunities.

3.a) Please provide parts of the project where opportunities were identified and exploited.

b) What were the source of the opportunity, type of opportunity, reason for considering it an opportunity?

c) What was the result of the opportunity and in what way it helped the project and increased contractor's benefits?

4.a) What was the procedure followed to identify these opportunities during tender phase?

b) What could have been done or improved in the procedure so that these opportunities could have given more enhanced benefits?

5) What are the constraints faced in this project for identifying opportunities and how can the constraints be reduced? Please give your views in detail.

6) Finally, do you have any further suggestions or think what should be done in such large projects to identify more opportunities?

Appendix E: Detail description of stimulating factors for opportunity identification

In total, 33 crucial factors are identified in this study that would stimulate the creation and identification of opportunities in large infrastructure project under D&C contracts. These descriptions are based on the findings from past studied literature, various interviews, and questionnaire surveys done with the experts during this study.

F1 Project manager with business-oriented mindset (Avg. score: 4,09)
Opportunities can be discovered or created through uncertainties in project settings and to identify them project managers should perceive uncertainty correctly. Project managers with a business-oriented mindset are more likely to identify opportunities since critical project decisions are not solely driven by technical considerations (Lechler et. al., 2012). Further explained by QR02, Project Manager needs to be a mix of everything, knowing; contract, scope, strategy, and managing/concentrating on money/time/ organization. It is his/her business, to deliver the project as per the contract and secure a profit. Sufficient entrepreneurial drive helps, as long as it does not overshadow the original scope.

F2 Ability to capture stakeholders' view of value (Avg. score: 3,64)
The ability to capture stakeholders' views of value can assist project managers in identifying further opportunities and enhance decision making for future outcome and value maximization (Ang & Killen, 2016). QR04 explains, it is particularly very important when a project has MEAT(EMVI) criteria to win the bid during the tender phase. QR02 explains it further as, besides the ability to capture, communication and good timing are also essential. Opportunities shall preferably be defined and communicated with the client in the pre-tender submission phase to avoid them from being disruptive during the delivery process.

F3 Ability of project manager to develop a holistic view within the project (Avg. score: 3,64)
Olsson (2007) suggested for managing opportunities, project manager should be able to develop a holistic view within the project. Project Manager should also understand people, since project is just not a technical solution. People are the key and it depends on maintaining relations and respect for each other (DI10).

F4 Ability to understand how other organization affects the project objectives (Avg. score: 2,91)
Olsson (2007) suggested for managing opportunities, project manager should have the ability to understand how other organizations affects the project objectives. QR04 explains that is particularly important during the execution phase of the project since during tender phase, the contractor has very minimal contact with them. QR02 further explains as organizations which are also project stakeholders could surprise with new ideas and demands so it is always good to have the understanding to look ahead and plan accordingly.

F5 Organizational support and interest (Avg. score: 3,64)
Olsson (2007) suggested for managing opportunities, there should be organizational support and interest. The company should have the policy of exploring and managing opportunities and should be a part of their project management process. QR02 explains it further as this is important but could be hard work, since it needs the ability to look/plan ahead and have related experience which needs proper management. Also, it is important to retain key employee in the project and should continue working in tender and execution phase of the project for transferring complete knowledge and focus in all phases (CS01, CS02).

F6 Formation of collaborative work culture (Avg. score: 4,45)
Hietajärvi et. al. (2017) indicates that formation of collaborative work culture within the organization is essential for active opportunity management. QR02 further explains it as it should be done, and various types of contract like; partnering, open-book, Cost+, etc. are trying to fulfill that. Nice words and good intentions generally do not guarantee overall project excellence, especially when "Trust" between the parties is missing/lost (and this happens quick enough when the project goes sour). This is also the case for F7.

F7 Open communication with client organization (Avg. score: 3,82)
Hietajärvi et. al. (2017) also indicates that open communication with client organization acts as an enabler for active opportunity management.

F8 Individual and project-based incentives (Avg. score: 3,09)
Hietajärvi et. al. (2017) suggest individual incentives and project-based incentives could also help in exploring more opportunities since employees are more encouraged to find better solutions for added benefit to themselves and for the company. This point was supported by DI02 as he explains, people generally don't want to put extra effort for nothing. However, there was a counter agreement from CS01, that if such incentive schemes are kept while working then the employees' focus would be towards gaining that incentive and could create an unhealthy competition between themselves while affecting the main scope of work.

F9 Ability to balance between control and flexibility (Avg. score: 3,64)
Hietajärvi et. al. (2017) also suggests that a key enabler for active opportunity management is the ability to balance between control and flexibility i.e. the degree of formalization in the opportunity management process. Lechler et. al. (2012) also suggest that flexible management expertise is needed to quickly assess situations and identify opportunities in projects. QR02 further adds as skills like; timing, communication, structuring is also important (when is it ok to be flexible and creative, and when the plan must strictly be followed).

F10 Demanding goals in project (Avg. score: 3,64)
Hietajärvi et. al. (2017) points out that demanding goals challenges project team and encourages them to look for improved, better solutions, for opportunities within the project. This was elaborated by DI10 as without such goals, it won't simply happen in a project.

F11 Ability to analyze the impact of change (Avg. score: 4,55)
As an implication for project management practice, (Lechler et.al., 2013; Lechler, 2014) suggests skill to be developed by project managers as the ability to analyze the impact of the change. Since, implying an opportunity in a project would demand change and could leave a domino effect (threat) on other elements, apart from the benefits for which the idea was analyzed. Thus, the impact must be known. It was further elaborated by DI10 as there could be different scenarios that would occur in such a situation while implying change, so an impact assessment is needed to select the best-case scenario.

F12 Ability to communicate potential value of the opportunity (Avg. score: 3,91)
As an implication for project management practice, (Lechler et.al., 2013; Lechler, 2014) also suggests that project managers should be able to communicate the potential value of an opportunity to the company and client. This was further elaborated by QR02 as it is not just about the financial value, but the full impact as described in F11.

F13 Taking the lead for opportunity exploitation (Avg. score: 3,64)
The project manager should take the lead on opportunity exploration and should be able to use such window of opportunity occurring in a project while convincing the client and project stakeholders for proper opportunity framing (Hertogh et.al., 2016). QR02 explains it as it is wise to lead for exploration of opportunity but not exploitation. This is because, if the process is delayed, it will negatively affect the contractors' delivery process (most importantly design part).

F14 Shared commitment among involved parties (Avg. score: 3,64)
Requirement of shared commitment is needed in the project team and involved stakeholders for opportunity framing (Hertogh et.al., 2016). DI10 (client-side) expresses his concern as, nowadays it is being more and more difficult to find parties with a shared commitment for the project. QR02 (contractor side) further explains it as it is important to have party's' commitment when they are on board. Often, major issue is that various parties will not be involved until later (as they are not yet contracted). Thus, the client must bring all to the table, at a very early stage.

F15 Stakeholders being proud of the project (Avg. score: 3,27)
Eskerod et. al. (2018) explains opportunities are exploited more in projects when stakeholders are proud of the project because this creates a chance of engaging or even initiating activities by them that generates further benefits to themselves and others. CS01 explains it further as stakeholders are generally proud of a project during its beginning when a new project is announced or at the end when the project is completed and starts serving the user while during its execution, it is generally left to the contractors/developer for dealing with all sorts of issues and complexities. QR04 states that stakeholders being proud is particularly important during the execution phase of the project since during tender phase, the contractor has very minimal contact with them.

F16 Involvement of different categories of stakeholders (Avg. score: 3,36)
Eskerod et. al. (2018) also indicates that opportunities exploitation has its own time where some opportunities are exploited early, and others are in the later phase of the project but, exploitation of all opportunities created by a project needs involvement from many categories of stakeholders. They propose, to enhance project opportunity exploitation, the project needs to be so present in the minds of these stakeholders so that they choose to identify and exploit opportunity through a shared vision.

F17 Celebrating achievements of the projects (Avg. score: 3,55)
Eskerod et. al. (2018) also gives a proposition that celebrating achievements of the project stimulates stakeholders to exploit the opportunities created by the project which could contribute to further benefits of the project. DI10 further explains that celebrating achievements and being proud of what you do is very important. This drives energy within the project team thus making them better able to realize or even enhance the goal.

F18 Acceptance of change in the project (Avg. score: 3,73)
Opportunities identified in the later phase after some planning has been done will not give any benefits if there is no acceptance of change in project plan from the project owner and project team (Johansen, 2015). QR02 comments as all change in a project must be timely accepted since late changes are lethal for the project.

F19 Will and power to change the originally planned solutions and deliverables (Avg. score: 3,91)
Exploiting opportunities often requires project owner and project management team to accept changes and have both the will and power to change the solutions and deliverables described in the

initial plan. Identified opportunities must be significantly better than originally planned solutions as if it is to be worth considering since implementing them costs money and time (Johansen, 2015). QR02 elaborate it as project team should find out during pre-tender submittal phase that what the client/stakeholder wants exactly, and whether there is a "will" for opportunities.

F20 Learning and knowledge sharing (Avg. score: 3,64)
Johansen (2015) recommends companies should focus on learning and knowledge sharing so that new methods, tools, and techniques could be applied in new projects for better opportunity management. DI02 explains it further as knowledge transfer can be done from previous projects where the project team could refer to conditions which were successful in achieving benefits and adding value. Same commitment to the current project can be developed and the confidence level could be assessed for turning those ideas into opportunities. Thus, it can be priced in advance or could be listed as an opportunity where it is tangible enough to give it a price range, but it should always be tangible where you can follow it up. DI10 added, in project A9 (DBFM), during the realization phase the team started a learning program to collect all the learned knowledge in a systematic way to share the stories and learnings to other projects.

F21 Understanding human behavior (Avg. score: 3,55)
Johansen (2015) also claims that, if a company wants to develop skills regarding better opportunity management, then there should be a focus on understanding human behavior. The companies need to understand its employee's behavior, the culture in the company, the project owner's role, and how stakeholders interact with the opportunity management process. QR02 adds to it as, a company should invest, train and develop employees' competency and it will surely benefit back. In a study by McGregor & Doshi (2015), it was found that company culture shapes employees' motivation and if the employees are motivated enough then they will perform better in their work. It was found that people who are motivated to work exhibits three motives: play (if one enjoys working), purpose (if one values the work's impact and outcome), and potential (if one works for enhancing his/her potential). On the other hand, people who work as a result of: emotional pressure (one works because of fear, peer pressure, and shame), economic pressure (one works to gain a reward or avoid punishment), and inertia (if the work just becomes a habit and one does not realize the motive behind it) tends to reduce the work performance. Thus, company culture should maximize the play, purpose and potential and should minimize the emotional pressure, economic pressure and inertia felt by its employees.

F22 Tight project budget (Avg. score: 2,45)
In his case studies it was found that projects where project management team believes that the budget is too small or tight, they will start to seek opportunities and more actively exploit new ideas and willing to make changes to deliver the project within budget (Johansen, 2015). However, as described by D10 and supported by CS01 and CS02, tight budget generally stops in seeking extra opportunities because it doesn't allow enough room to play around and explore for more opportunities. Nowadays, clients are asking for giving some room for exploring ideas, but during the tender, bidders don't generally do that because when they make the project budget a bit flexible then they must quote with higher price and thus the chance of losing the contract. This is really a big problem. This also makes the job of a Project Manager from contractors' side very difficult to manage the project during execution, and to incorporate other factors to explore more opportunities. Tight budget could be a hindrance for fulfilling other factors like F16, F17, F20 because it asks for more time and money. DI06 and QR02 also agree that it acts as a constraint regarding opportunity exploration. Thus, it is important that the board (higher management level of the company e.g., Hochtief) talks

with the client (e.g., Rijkswaterstraat) that to incorporate all other factors, a solution must be found for tight project budget (DI10).

F23 Presence of opportunity identification process and its implementation (Avg. score: 3,73)
As explained by DI01 and supported by QR02, opportunity identification process should be there especially during the tender process and should be used by the team members in an appropriate time interval since old opportunities could become invalid while new one could occur due to project's dynamics.

F24 Trust and open communication between the project team members (Avg. score: 4,64)
Improved communication between team member is crucial. DI01, CS02 explains that it is not a one-man show to identify opportunities thus, the whole team needs to contribute towards it. This can be done by not keeping possible opportunities to themselves but putting it in the table, so everyone could look up to and analyze better. For such open communication, trust within each other is required.

F25 Flexible client (Avg. score: 4,27)
A flexible client could help and assist during the process of construction. However, a client could be flexible only if there is a healthy relationship between both parties. (Refer Appendix A, entry 15 for an example)

F26 Experienced project team (Avg. score: 4,36)
Team members with enough experience regarding similar projects could identify more opportunities in projects.

F27 Change in culture of how we see and approach opportunity (Avg. score: 3,18)
Self-serving mentality of project members involved in the process should be changed where members generally don't want to raise their performance benchmark to lose their regular incentives through their sub-optimal effort. Also, people generally tend to focus more towards the negative consequences which is already deep-rooted inside them because of the culture and way of working which prevents possible opportunities that could be explored in the project if given enough attention towards it (DI02, CS01).

F28 Flexible reimbursement scheme (Avg. score: 3,36)
Pricing scheme of projects from the client could be improved for exploring more opportunities. There are already establish reimbursement scheme like cost+, open book, etc. which are more flexible than lumpsum payment (QR02). These could also be used based on the project's characteristics and client's preference towards exploring opportunities in a project.

F29 Interface management between different parties and discipline (Avg. score: 3,82)
Proper interface management between the parties and discipline involved in the project should be done effectively where each party should be up to date about the progress and changes of the project.

F30 Coordination between review team and execution team (Avg. score: 3,73)
Proper coordination should be maintained between review team which is not generally involved in the daily execution works of the project and the execution team, so while discussing any possible ideas, it could be easily understood by everyone and approved for exploitation. QR02 explains it further as it should be done with attention on having a structured/planned approach, ensuring required momentum and fast follow-up in the project. Apart from this, change management team and

risk management team should work closely as change in contract leads to change in project's opportunities and threats (CS01).

F31 Team members are proud and enjoy doing the project (Avg. score: 4,00)
Project team members being proud of what they are doing helps in creating a positive atmosphere in the work environment thus, increased work efficiency. QR02 clarifies it further as this is a very important point and it requires a very good project manager to make it happen.

F32 Awareness of possibilities for coupling of solutions (Avg. score: 3,36)
Thinking of extra possibilities – should be aware of other possibilities to combine it with a solution, like; energy, climate, health, etc. (Integrating specialization like integrating the building with climate, health, energy and attracting more investors and making the project more valuable).

F33 Able to handle increased complexity (chaos) (Avg. score: 4,09)
As a person, project member should be able to handle chaos for identifying opportunities, because it is easy to dive into every possible opportunity and try to fix them all but a structured approach by handling the chaos would help in making timely decisions, so the opportunity could actually be implemented in the project (DI07). In projects, the team is generally supported by persons, who excel in creating chaos. Those persons that understand "structured approach" are generally averse of chaos. Thus, it depends on what kind of project team is onboard for executing the project (DI07, QR02).

Appendix F: Questionnaire Survey

Appendix F1: Detail of respondents for Questionnaire survey

S.N.	Respondent Code	Role	Organization	Type of Organization	Practical Experience (years)
1	QR01	Design Manager	HOCHTIEF	Contractor	15
2	QR02	International Project Manager	HOCHTIEF	Contractor	28
3	QR03	Execution Manager	HOCHTIEF	Contractor	30
4	QR04	RAMS Engineer	HOCHTIEF	Contractor	15
5	QR05	Senior Consultant	AT Osborne	Management Consultancy	15
6	QR06	Stakeholder Manager	HOCHTIEF	Contractor	20
7	QR07	Risk Manager	ZuidPlus	Contractor	6
8	QR08	Project Director	HOCHTIEF	Contractor	32
9	QR09	Client (Project Manager)	Rijkswaterstaat	Client	25
10	QR10	Process Coordinator	HOCHTIEF	Contractor	4
11	QR11	Systems Engineer	HOCHTIEF	Contractor	10

Appendix F2: Scoring importance level of factors by the respondents

Q1. For this question, a list of factors is given which could help in stimulating the creation and identification of opportunities in large infrastructure projects.

Please allocate scores between 1 to 5 in a one-digit spacing (where 5 being most important and 1 being not important) for each factor. Consider assessing it from a contractor's perspective for a Design & Construct Contract project.

5 – Most important

4 – Important

3 – Moderately Important

2 – Slightly Important

1 – Not Important

F.N.	Factors	Score											Avg.
		QR01	QR02	QR03	QR04	QR05	QR06	QR07	QR08	QR09	QR10	QR11	
F1	Project manager with business-oriented mindset	4	4	4	4	3	5	5	5	3	3	5	**4,09**
F2	Ability to capture stakeholders' view of value	3	4	3	5	3	5	2	4	4	3	4	**3,64**
F3	Ability of project manager to develop holistic view within the project	5	4	2	5	4	2	5	2	4	3	4	**3,64**
F4	Ability to understand how other organization affects the project objectives	5	4	3	3	3	3	2	2	2	2	3	**2,91**
F5	Organizational support and interest	5	5	2	3	3	4	3	3	5	3	4	**3,64**
F6	Formation of collaborative work culture	5	5	4	4	4	5	4	5	5	5	3	**4,45**
F7	Open communication with client organization	4	5	3	4	3	4	4	4	3	4	4	**3,82**
F8	Individual and project-based incentives	3	4	2	5	3	3	2	1	4	3	4	**3,09**
F9	Ability to balance between control and flexibility	4	4	4	4	2	3	3	4	4	3	5	**3,64**
F10	Demanding goals in project	4	3	3	2	4	4	5	3	4	3	5	**3,64**
F11	Ability to analyze the impact of change	5	5	4	4	5	3	5	5	5	5	4	**4,55**
F12	Ability to communicate potential value of the opportunity	4	5	3	4	4	3	5	4	4	4	3	**3,91**
F13	Taking the lead for opportunity exploitation	4	4	2	3	3	2	5	5	4	4	4	**3,64**
F14	Shared commitment among involved parties	4	4	4	3	4	4	3	5	3	3	3	**3,64**
F15	Stakeholders being proud of the project	3	4	3	1	3	4	3	4	5	3	3	**3,27**

F.N.	Factors	Score											Avg.
		QR01	QR02	QR03	QR04	QR05	QR06	QR07	QR08	QR09	QR10	QR11	
F16	Involvement of different categories of stakeholders	3	4	4	1	4	5	3	5	3	2	3	**3,36**
F17	Celebrating achievements of the projects	4	4	3	1	3	4	5	4	4	4	3	**3,55**
F18	Acceptance of change in the project	4	5	3	2	3	3	5	3	5	5	3	**3,73**
F19	Will and power to change the originally planned solutions and deliverables	3	4	4	2	5	4	5	5	3	4	4	**3,91**
F20	Learning and knowledge sharing	4	4	3	5	4	2	3	4	4	3	4	**3,64**
F21	Understanding human behavior	5	5	2	2	3	3	4	3	5	3	4	**3,55**
F22	Tight project budget	4	1	2	2	3	2	1	4	2	2	4	**2,45**
F23	Presence of opportunity identification process and its implementation	3	5	4	4	2	2	5	4	4	4	4	**3,73**
F24	Trust and open communication between the project team members	5	5	4	5	4	4	5	5	5	4	5	**4,64**
F25	Flexible client	4	4	3	4	5	5	4	5	4	4	5	**4,27**
F26	Experienced project team	4	5	3	5	5	5	4	5	4	4	4	**4,36**
F27	Change in culture of how we see and approach opportunity	5	3	3	2	4	3	2	3	3	4	3	**3,18**
F28	Flexible reimbursement scheme	3	3	2	4	4	3	3	4	4	2	5	**3,36**
F29	Interface management between different parties and discipline	4	5	2	4	4	3	3	5	5	3	4	**3,82**
F30	Coordination between review team and execution team	4	4	4	4	3	3	4	5	3	3	4	**3,73**
F31	Team members are proud and enjoy doing the project	4	5	4	4	3	4	3	5	5	4	3	**4,00**
F32	Awareness of possibilities for coupling of solutions	3	3	3	2	4	4	4	3	3	4	4	**3,36**
F33	Able to handle increased complexity (chaos)	5	4	4	5	4	3	3	4	4	5	4	**4,09**

Appendix F3: Grouping of stimulating factors for opportunity identification in large infrastructure projects

F.N	Factors	F.N	Factors	F.N	Factors
F1	Project manager with business-oriented mindset	F5	Organizational support and interest	F10	Demanding goals in project
F2	Ability to capture stakeholders' view of value	F8	Individual and project based incentives	F22	Tight project budget
F3	Ability of project manager to develop holistic view within the project	F17	Celebrating achievements of the projects	F25	Flexible client
F4	Ability to understand how other organization affects the project objectives	F21	Understanding human behaviour	F28	Flexible reimbursement scheme
F9	Ability to balance between control and flexibility	F23	Presece of opportunity identification process and its implementation	F15	Stakeholders being proud of the project
F11	Ability to analyze the impact of change	F6	Formation of collaborative work culture	F27	Change in culture of how we see and approach opportunity
F12	Ability to communicate potential value of the opportunity	F7	Open communication with client organization	F31	Team members are proud and enjoy doing the project
F13	Taking the lead for opportunity exploitation	F14	Shared commitment among involved parties	F18	Acceptance of change in the project
F26	Experienced project team	F16	Involvement of different categories of stakeholders	F19	Will and power to change the originally planned solution and
F32	Awareness of possibilities	F24	Trust and open communication within the project team members	F20	Learning and knowledge sharing
F33	Able to handle increased complexity (chaos)	F30	Coordination between review team and execution team	F29	Interface management between different parties and discipline

Groups		Number of factors	Avg. Score	Group weightage in score	Group weightage in %
	Team competency	11	3,80	41,8	34,19
	Company policy	5	3,51	17,55	14,35
	Collaboration	6	3,94	23,64	19,33
	Client side decision	4	3,43	13,72	11,22
	Self reflection	3	3,48	10,44	8,54
	Project Management Process	4	3,78	15,12	12,37
Total		33		122,27	100,00

Appendix F4: Scores for project value drivers by the respondents

Q2. A list of project value drivers is given below which would be important for a project team working for a large infrastructure project.

Suppose you are at the start of a large infrastructure project working from a contractor's side in a Design & Construct contract and are discussing to fix the importance level for each project value drivers for this project. Please allocate importance point share that each factor should be given at the start of a typical project like this. There is a total point of 100 and all hundred points should be divided among these factors based on their importance in this project scenario.

	Project Value drivers	**Points**											**Avg.**
		QR01	QR02	QR03	QR04	QR05	QR06	QR07	QR08	QR09	QR10	QR11	
Tangible	Cost	15	10	10	15	30	15	30	15	5	15	25	**16,82**
	Time	15	5	25	15	15	5	20	15	5	15	10	**13,18**
	Quality	15	5	20	15	10	15	5	10	5	10	15	**11,36**
	Safety	20	5	10	15	10	15	5	10	20	15	10	**12,27**
	Sustainability	10	5	5	2	10	5	5	5	20	10	10	**7,91**
Intangible	Company recognition/reputation	5	15	5	3	5	5	5	15	5	5	5	**6,64**
	Relation with client/Trust building	5	15	10	15	5	15	20	10	20	15	5	**12,27**
	Satisfaction within project team/people	10	15	15	15	5	10	5	10	10	10	5	**10,00**
	End User satisfaction	5	25	0	5	10	15	5	10	10	5	15	**9,55**
	Total												**100**

The above table concludes that each employee has its own perception and experience regarding what is important in a project. Also, it is highly dependent on the kind of project and its characteristics along with the purpose of realizing it. Thus, the score for project value drivers should be decided during the tender phase after knowing what the client wants out of that project and what is his preference regarding the project. This way, the project team could decide better on what is important for that project and where could more opportunities be explored and possibly exploited.

Appendix G: Constraints for opportunity identification with suggestion to minimize the constraint effect in project

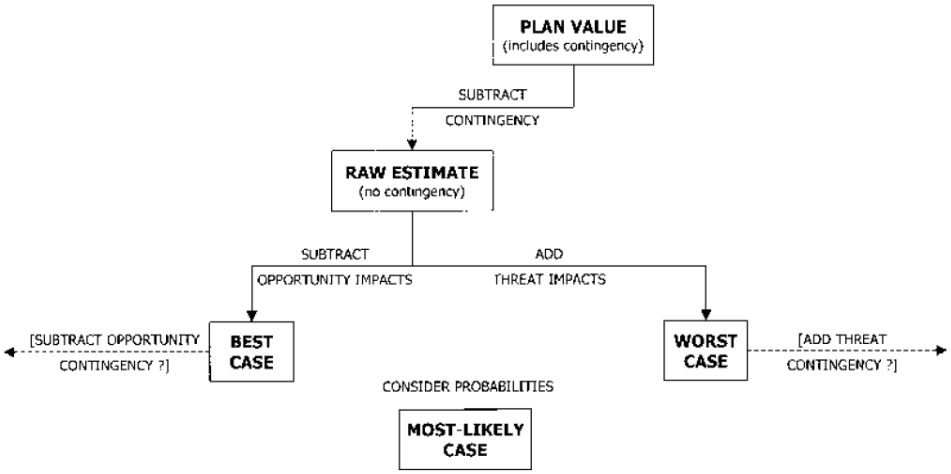
S.N.	Constraints	Case 1	Case 2	Suggestions from Case study	Description of suggestion	Factors helping in minimization of constraint's effect
1	High work pressure/Time pressure	Restricts to focus towards opportunities in execution phase	Restricts to focus towards opportunities due to slowing down of process after contract award	1) Retaining key employees in the project 2) Creating a database for commonly occuring opportunities 3) Separate dedicated employee	1) Same key employee should continue working in tender and execution phase of project for carrying complete knowledge and focus in all phases 2) Areas like design tolerances, cables and ducts, materials, etc. could be in a checklist as focus points for exploring opportunities 3) Separate employee for ensuring the process of opportunity management could be designated	F5, F9, F11, F24, F26, F29, F30, F33
2	Low profit margin	Low bids creates less profit margin which makes opportunity exploration process difficult to execute		Flexible contract	The contract should provide space between cost and profit so that opportunity exploration could be done better	F8, F11, F12, F13, F18, F19, F20, F20, F21, F23, F24, F26, F28, F32
3	Scope change	Changes applied from client side leads to previously identied opportunities not valid anymore		1) Close work between change and risk management team 2) Good understanding of Project scenario 3) Negotiation skills for acceptance of scope change	1) Since, change in contract leads to chance in opportunities and threats 2) Not overexploiting the space given by the client while maintaining good trust level in the project 3) Negotiation skills is needed to approve change so that benefits could be exploited from project variability like market rates	F2, F3, F4, F6, F7, F11, F14, F24, F29, F30
4	Perception of people	People being negative risk averse and focus towards threats prevention is also a major constraint		Encouraging organizational culture	Setting environment where both threats and opportunities are equally treated	F3, F10, F12, F13, F14, F17, F21, F24, F27, F31
5	Contractual restriction		Contractual clause of profit and benefit owner for an opportunity was mainly client which restricted the motivation towards opportunity identification by the contractor	Flexible contract	Clear explanation of clauses should be done on who should enjoy the benefits if an opportunity encounters in the project. It should be in agreement with both parties for benefit sharing.	F25, F28

Appendix H: Risk Breakdown Structure (Source: Own illustration based on Hillson & Simon, 2012)

Preferred RBS level is based on this study for opportunity identification during the tender phase to use it after the contract award. The category suggested is through the observation from uncertainty sources (section 3.1.2), detailed interviews, case study, opportunity log (appendix A) and opportunity workshop done for validation. External opportunities are generally uncontrollable so, a project team could only be prepared for any changes but cannot really predict and take benefit out of it. These limited categories are preferred because of time constraints during the tender phase and other constraints mentioned in the case study chapter (section 5.4).

RBS LEVEL 0	RBS LEVEL 1	PREFERRED RBS LEVEL	RBS LEVEL 2
PROJECT OPPORTUNITY	1. TECHNICAL OPPORTUNITY	1.1 Scope	1.1 Scope
		1.2 Technical process	1.2 Requirements definition
		1.3 Technology	1.3 Estimates, assumptions and constraints
		1.4 Design	1.4 Technical processes
		1.5 Safety	1.5 Technology
		1.6 Performance	1.6 Technical interfaces
			1.7 Design
			1.8 Performance
			1.9 Safety
			1.10 Security
			1.11 Test and acceptance
	2. MANAGEMENT OPPORTUNITY	2.1 Project management	2.1 Project management
		2.2 Program Management	2.2 Program Management/Portfolio Management
		2.3 Organization	2.3 Organization
		2.4 Resourcing	2.4 Resourcing
		2.5 Communication	2.5 Communication
		2.6 Information	2.6 Information
		2.7 Health, Safety & Environment	2.7 Health, Safety & Environment
		2.8 Quality	2.8 Quality
		2.9 Reputation	2.9 Reputation
	3. COMMERCIAL OPPORTUNITY	3.1 Suppliers and vendors	3.1 Contractual terms and conditions
		3.2 Subcontracts	3.2 Internal procurement
		3.3 Partnerships and joint ventures	3.3 Suppliers and vendors
		3.4 Market rates	3.4 Subcontracts
			3.5 Client/customer stability
			3.6 Partnerships and joint ventures
			3.7 Market rates
	4. EXTERNAL OPPORTUNITY	4.1 Legislation	4.1 Legislation
		4.2 Site/facilities	4.2 Exchange rates
		4.3 Competition	4.3 Site/facilities
			4.4 Environmental/weather
			4.5 Competition
			4.6 Regulatory
			4.7 Political
			4.8 Country
			4.9 Social/demographic
			4.10 Pressure groups
			4.11 Force majeure

Appendix I: Adjustment estimating method including opportunities (Hillson, 2004)



Appendix J: Validation

The proposed roadmap in section 6.2 is validated in two steps i.e., opportunity workshop and feedback session. First, an opportunity identification workshop was conducted with six practitioners from HOCHTIEF, their details could be found in the table below. After the workshop, feedbacks were collected with the group about the proposed framework. The opportunity workshop was for around 85 minutes and the feedback discussion is done for around 30 minutes.

Participants for the opportunity workshop/validation session

S.N.	Role	Organization	Type of Organization	Years of experience
1	Senior Project Engineer	HOCHTIEF	Contractor	13
2	Contract Manager	HOCHTIEF	Contractor	7
3	Senior Project Engineer/Lead planner	HOCHTIEF/ZuidPlus	Contractor/Consortium group	13
4	Stakeholder Manager	HOCHTIEF	Contractor	9
5	EMVI (MEAT) Coordinator	HOCHTIEF	Contractor	10
6	Project Engineer	HOCHTIEF	Contractor	1

1) Opportunity Workshop

A reference project case of building a bridge near the Schiphol airport was taken for the workshop which is to be built over a highway and train tunnel. Initially, the case description is done to the participants and the objective of the project was clarified. Then, as per the roadmap definition of opportunity was introduced so that the participant could focus on what exactly to search for. After explaining the concept, the workshop was conducted based on the procedure explained in figure 23. Hundred points were distributed among the project value drivers based on their level of importance as per the project's characteristics.

After allocating the points, brainstorming for opportunities is done based on the Risk Breakdown Structure presented in appendix K to identify opportunity from possible categories. For the brainstorming session, six participants were divided into two teams of three people each and were allocated to find opportunity from RBS level 2, series 1 and 2 for one team and series 3 and 4 for the other team (see appendix K). The brainstorming duration for identifying possible opportunities was around 20 minutes. 10 opportunities were identified during this session which was then filtered for the ones that could be quantifiable during the session due to limited time and could be assessed explicitly. Out of 10, four opportunities were chosen based on expert judgment for their ease of quantification. The assessment was done based on the example presented in table 12 for an alternative material discovered during tender phase while the importance level was adjusted based on the point allocation for value drivers decided in step 3 of figure 23.

The opportunity workshop was concluded at step 7 of figure 23 because of the difficulty in quantification. Constraints analysis (step 5) and opportunity log review (step 6) was also not done during the workshop due to the unavailability of detail client's requirement for the reference project and lack of an opportunity database maintained by the company. Also, the 33 factors listed in this study was not applied because of the feasibility constraints and limited time like client-related decision, changing company policy, self-reflection and adjustment in Project Management procedure. However, few factors related to collaborative working with open communication was observed during the workshop. Although, few qualities in the participant were observed that are related to team competency factors like awareness of possibilities and experienced project team, but it wasn't possible to observe other factors in a single workshop. These 33 factors are not only for the opportunity workshop but are useful for the entire tender phase of the project, if not for the entire project.

Observation

1) While prioritizing the project value driver, some difficulty was seen to allocate the points on each value drivers and different opinions were seen from each participant regarding the points distribution.

2) During the workshop, it was observed that the participants weren't exactly going through all the categories provided in RBS level 2 but, were more looking at a higher level at RBS 1. This could be due to the limited time of 20 minutes given for the brainstorming where the participants could not refer to all the categories at RBS level 2.

3) The quantification based on the provided scheme was complicated and time-consuming. The provided quantification method needed improvements to make it simpler to use with only relevant and doable steps during the tender process so that the assessment could be done in a limited amount of time.

2) Feedbacks from validation session

The feedbacks were immediately provided after the opportunity workshop explained in the above section so that the comments and suggestions are fresh and as per what the participants experienced. The main feedbacks provided from the session was regarding the prioritization of project value drivers (step 3) and the impact assessment of opportunities (step 7).

Comments

1) Generally, in projects, the team is more focused towards finding opportunities during the tender phase to win the project (type 1) opportunities while focusing towards opportunities which are identified during tender phase but exploited only after contract award could bring extra threat to the project.

2) Opportunities identified during the workshop was on the high/surface level due to limited time.

3) Project value drivers seen from the eye of the client would be a better approach for allocating points to them. Contractors then could ask what the client wants and what is more or less preferable value drivers for this project and could add more ideas towards preferred areas to be in a position to ask for additional benefits for the company. Opportunities identified based on the value drivers could then be used by the contractor to get benefits after contract award. For example, if time is ranked high as a value driver then the client needs the project to be well in time. Here, the contractor could negotiate for added money after contract award on time enhancing opportunities like; prefabrication.

4) From the discussion, it was suggested that cost is a consequence of the other four value drivers towards the return side but is difficult to quantify all other value drivers in terms of cost.

5) The investment for the required resources could be anywhere during the project i.e., during tender, design or execution phase. So, a decision should be made on when to invest in working towards the opportunity.

Because, if the investment is during tender phase of the project for identifying opportunity and working towards it, it needs very large amount in terms of return because the chance of winning the bid is approximately $1/5^{th}$. Therefore, the likelihood of return would be decreased by $1/5^{th}$. Thus, it should be made clear that where an investment needs to be made for working towards cashing the opportunity.

6) For identifying opportunities, investment on time (manhours) is needed during the tender phase to work towards possible extra solutions. Thus, towards the investment side, cost and time are the only resources that could be used as an investment. Other three could only affect the project planning but is not an investment. For example, if you change a design in your project then it could influence the quality but, it's not an investment because the project team again have to work towards fixing the quality if that idea is to be taken in the project. So, the investment is again in terms of time and cost.

Another example, an alternative material taken as an opportunity (for cost-saving and sustainability as a return) might reduce the quality of the final product (as an investment). But, for maintaining the preferred quality while using the new material again the investment would be in terms of cost and time to find a way to match the required quality by the same material for getting the return of saved cost and sustainable product.

7) If the project team finds an alternative for a solution, they could work for it as a side job but would be preparing their regular tender works. For these kinds of alternatives, the team should know the tentative cost and likelihood of occurrence to list them as an opportunity for later use.

8) The importance level allocated from the value drivers is not logical because if an investment of 50k is to be made for an opportunity, and it has been decided that cost is 25% important as a value driver, then only 25% of 50k is being taken as effect while the actual investment is 50k. Thus, investment and importance level are not related because an investment is only the money that needs to be put for getting the opportunity. While return (benefits) and importance level of value drivers are understandable and are important to look at.

The return could be in terms of all five value drivers like; increasing the safety level or reducing the required time by a few weeks. These should not be converted in terms of money and neither should be kept in their own units but should be in a much broader level just as a description that the opportunity will either save time, increase quality and safety level, or is more sustainable. Because, deciding safety, quality, and sustainability in terms of money is very difficult and complicated task

making the process more complex to use during the tender. The level for other four value drivers could also be allocated from 1 to 5 in terms of their intensity of effects (like; RisMan).

9) An added value for the company during the tender phase would be to think of opportunities and decide on when and how it can be cashed in. So, if the team has identified some opportunities then knowing what value each opportunity carries would be helpful for the project team.

From the discussion, it was concluded that cost is a consequence of the other four value drivers for the benefits side.

3) Feedback on various criteria

Various comments discussed in the previous section (validation section 2) are arranged on various criteria as per the suggestions forwarded by the experts during the validation session. These suggestions concern the improvement of the proposed roadmap for opportunity identification during tender phase in a large infrastructure project. The comments and suggestions provided were in a group setting.

S.N.	Criteria	Comment	Suggestion
1	Is the roadmap understandable (understandability)	The roadmap needs improvement in some parts for its understandability.	It should be clearer regarding value driver score distribution and assessment of opportunity i.e., calculating resource required and added benefit.
2	Does the roadmap provide a clear goal	The roadmap provides a clear goal of identifying opportunities in a project during tender phase.	
3	Are the steps logical	The importance level provided towards resource investment side is not logical, i.e., time and cost both should be considered at 100% as 50k invested is 50k gone for the company and cannot be multiplied by 30% or 50% as importance level. Importance level towards benefit sides is logical and understandable.	One thing should not be forgotten that the opportunities identified during the tender phase automatically have less likelihood to occur after the contract award because winning the bid itself has a chance of approximately 20%.
4	Is the roadmap comprehensive (area coverage)	The provided framework gives enough area to be covered while brainstorming for opportunities.	Could be adjusted based on limited time availability during the tender phase.
5	Is it appropriate to use (Usability)	Currently, it needs clarity on how to fix the value drivers and how to assess the opportunities.	For value drivers, it could be seen from client's eyes and for assessment, time and cost could be only invested as a resource and in the benefits side, cost could be taken as an effect of others while other four tangible value drivers could be assessed in a higher level, probably in their own units.