

Delft University of Technology
Faculty of Civil Engineering and Geosciences

Construction Management & Engineering (CME) Master

MSc Thesis:

Value Based Tendering:

A model for the contractor to provide added value on bid documentation
and increase the chances of winning the tender

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Preface

This report contains the results of the study that I conducted for my master thesis at the TU Delft. This thesis is the last step in completing the Construction Management and Engineering (CME) program and the last step in acquiring my MSc grade. The research is performed in the form of an internship at Ballast Nedam, in Utrecht. It has been a challenging period in which I learned a lot about procurement of public infrastructure projects, the mechanisms applied and the processes followed by contractors for preparing the design proposal. Now, I am proud to present the interesting results that I have found in this study and suggest a model for adding value in the bid documentation based on the social responsibility of the client and the contractor during the project execution.

I would like to thank Ballast Nedam, for making this research possible and bringing me in touch with the procurement of large infrastructure projects in the Netherlands. Special thanks to Harbert van der Wildt for his guidance on the vision to investigate the potentials on adding value on the public infrastructure projects and to Ronald Verkerk for introducing me in the world of procurement of public projects as well as for giving me a very interesting and challenging time during my graduation research in Ballast Nedam. The fact that Ballast Nedam offers me the opportunity to apply the suggested model on the real situation through the job position of the research engineer in the tender department make it even more special and reflects the desire for advanced social responsibility of the company as well as the trust on the suggested model for effective results. Many thanks also to the tender managers of Ballast Nedam for their support and supply of very important information and knowledge in respect to the procurement process.

Also, I would like to thank Hennes de Ridder, the chairman of the graduation committee, for sparking my interest on public infrastructure projects and guiding the whole research in a motivating and inspiring way. I thank him for all that he gave me during my years at TU Delft and beyond. Furthermore, I want to express my thanks to Mohhamad Suprpto, my second supervisor, for providing me with useful feedback at the right moments in the graduation process.

Finally, I would like to express my thanks to my family and friends for all the support and at the most to my girlfriend, Marina Spyridonos, for supporting me during all this period and the understanding which has showed me.

Vyron Giannikis
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Executive summary

The research presented in this thesis was initially a visionary proposal with very broad concept but with many potential benefits once could take shape. The proposal was involving the desire of all contractors to incorporate elements into the project of which the client perceives them as valuable, and thus he is willing to increase the budget. Or more simply to add value to the project and increase the chances of winning the tender.

The reasoning lies on the difficulties faced by the contractors as well as by Ballast Nedam as member of this part of the construction industry, to identify what is valuable for the client because of the difference on value perception. An argument that becomes even more realistic under the EMAT award mechanism that most public infrastructure projects are procured with. A mechanism that beside the price element of the design proposals, involves also quality evaluation criteria which are usually difficult to be assessed objectively, like how good is project management, how much sustainable is the solution, is there good collaboration between the participants and other, where the concept of perception is restricting a collaboratively value optimization.

In that respect it is crucial for the contractor to minimize the lack of clarity in the evaluation criteria by directing properly the focus on the qualitative objectives of the project which are related to the evaluation criteria from the preliminary stages and thus deliver greater value with benefits to all the involved parties and indispensably to the society. With this in mind the main research question of the thesis come to be *“In what ways Ballast Nedam can effectively prepare bids with added value for public infrastructure projects which are procured with the EMAT award mechanism?”*.

In order to respond to that question, a literature study is performed first where all the relevant key concepts in the area of procurement of public infrastructure projects are explored. Thus the main characteristics of public infrastructure are studied together with the EMAT award mechanism and its different types of application. In addition basic and valuable information in relation to the impacts that projects can have on the social environment and their costs are explored in order to broaden the knowledge over the effects of the developments during the implementation period. Further, based on the objective of this research project to *“develop a structured model to investigate the critical factors which are related to the project’s objectives and the quality award criteria offered for evaluation”*, it is studied a Multi-criteria decision model which can serve to the selection of the correct decisions to direct properly the focus of the design on the qualitative objectives of the project. At the end, the current tender work instructions followed within Ballast Nedam are presented for acquiring the necessary insight to support the exploration of the research topic for embedding and incorporating the results into the company’s procedures.

Structuring the theoretical basis, the next step is to define the research methodology to guide the research towards the answering of the sub-research questions and the research strategy to follow. This is a very important step out of which the conception of how you can approach the intended objective is structured. As a first point, the necessary pieces of information are collected through case studies and interviews, and a valuable insight for the real application is created. The

findings are then used to acquire qualitative and interesting results which are coming to the surface and help on the identification of the research's central concept. This is that not all the aspects of a project have technical "substance" as mainly addressed by the clients. Thus the focus should not only be on which technical solutions are the "best" but on the mindset used for the acquisition of the quality, because construction activities can have significant impacts on their "environment" in the real life which are not of technical nature or have technical solution. The exclusion of social aspects from tenders' evaluation will become the cornerstone of the research answer that creates a competitive advantage for Ballast Nedam and the basis for developing the intended model.

So, using that backbone concept and based on the findings and the information gathered, the implicit and explicit prerequisites of a 12 – step model are composed. The named Value Creation Model (VCM) exploits the project's contextual information and intends to add value to the proposal. It is a structured methodology consisting of 3 phases (Preparation, Evaluation and Value Creation) that runs in parallel to the main activities followed during a tender in order to guide the tender management from the beginning up to the end of the tender with a goal to add value on the bid documentation. In pursuance of validating its applicability, interviews with procurement experts are conducted and a simulation of a past tender is presented.

Having at the end a valuable tool to apply during the tender and increase the chances of winning the tender, as the thesis title states, becomes a fact and the initial desire takes shape. Its success is a matter of implementing it properly with the right support and resources, but mainly it is a matter of belief on changing the mindset on more socially sustainable construction. A belief that Ballast Nedam involves in its values and in that respect the studying of the model's results after adequate applications, suggests a further research which can enhance the proposed model and its concept. Off course it will be an effective model after the winning of substantial number of tenders and the proof that some of them were because of its existence or at least its new paradigm of mindset.

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1. Introduction

1.1 Background of the investigation

Unlike other industries, the building and construction industry is traditionally one where those who produce (the supplier or the project contractor) are not the ones who come up with the initial idea (the client, the government or architects). Therefore, the client does not get as much as he should or could when he would enable the contractor to come up with innovative solutions which can add value to the project and increase the benefits for all the involved parties.

The reasoning relies with the fact that construction is a social activity and implies complex product development as unique endeavours in a changing context, involving many parties, delivering products with value to society, and pulling high levels of resources from the economy. The conditions become more complex if we consider that, clients and contractors have conflicting interests. On the one side the client tends towards competitive tendering to maximize value for money meaning in most cases realizing the required functionality at the lowest capital cost. On the other side the contractor tends towards negotiation and longer term contracts to strive for delivering value for money through the exploitation of the information and competencies that the owner does not possess in-house, and thus to maximize his returns from executing the work (Pasquire & Collins 1996).

This contractual combination of conflicting objectives and asymmetric information between the parties forms the basis of the ‘principal-agent’ model which consists a big part of (managerial) economics today. In a ‘principal-agent’ relation the price of a development divides the total benefit into benefit for the client and profit for the contractor and in spite of the different interests, there is one common goal: to enlarge the difference between value and costs in such a manner that the resulting price is beneficial for both (

Figure 1.1).

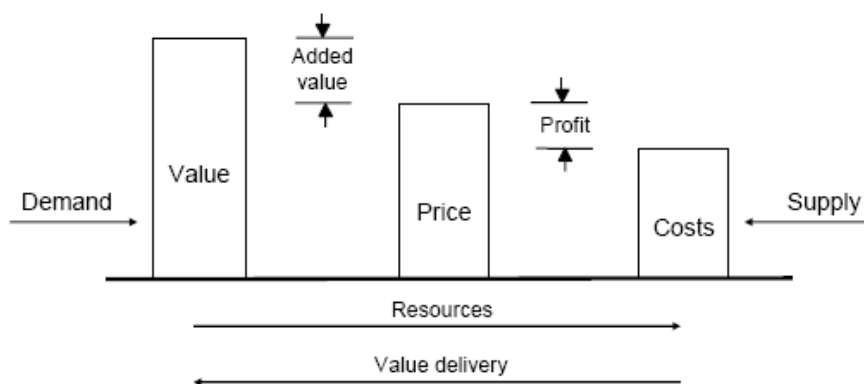


Figure 1.1: Basic transaction model; Value – Price – Costs

However enlarging the benefit as the difference between value and costs, is difficult to be quantified because of the perception over the value of the development. Perception affects strongly the benefit (value minus costs). The client's perception of desirable benefit together with the supplier's possible benefit causes both needless as well as extra benefit, which implies inefficiencies and extra work. This is basically the result of the tension between value and costs, i.e. the interest of clients' value versus suppliers' profits.

In order to specify all stakeholders' values and project priorities and maximize development's efficiency, value engineering has to be used as a structural component of the tendering process. Besides perception problem that affects "value optimization", value engineering must be aimed at target costing, in order to increase and maximize the gap between value and costs, i.e. maximizing the total benefit for client and supplier (Heller 1971). This kind of "value for money" approach has the largest potential in the early stages of the project, i.e. the briefing phase, when strategic decisions are made, together with application of integrated life cycle contract types (Kelly & Male 1999, Kelly et al. 2003).

Consequently in that respect, both the client and the contractor must be committed to invest and use extra budget during the value engineering approach of the tender in order to develop the design collaboratively based on life cycle incentives within an alliance or partnering arrangement (Bresnen & Marshall 2000).

1.2 Problem Analysis

For at least ten years now, the Dutch construction industry is struggling to implement new competitive tendering processes. The traditional process which awards the contract to the lowest bidder has got many negative side effects, the main one being that contractors are not stimulated to develop themselves towards mature, responsibility-taking counterparts (Dreschler, 2009).

In the current situation of the construction industry and under the contractual relationship that results from the used procurement methods, the client perceives as most important the value-price ratio of the project while for the contractor the good price-cost ratio is more essential (Figure 1.2). Especially in Large Engineering Construction Projects (LECPs) as usually are the public infrastructure developments, the long project lifecycle brings turbulence through changes in project dimensions and/or the business environment. In those situations the contractual relationship between the client and the contractor is often characterized by confrontation, whereas both parties would benefit from cooperative modus operandi (Turner, 2003).

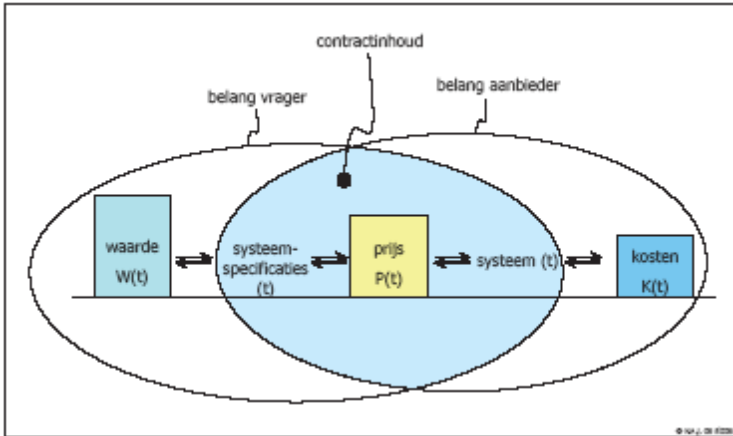


Figure 1.2: The interests of the client and the contractor in a project

In addition, the client's perception of desirable benefit is not always the best available that can result when can be in line with the contractor's competencies and capabilities. That difference of perception on benefit causes many times both needless as well as extra undetermined benefit because of the restrictive and non-cooperative contractual relation of the parties, which implies inefficiencies and extra work (Figure 1.3). That extra effort is basically the result of the tension between value and costs, i.e. the interest of client's value versus contractor's profit.

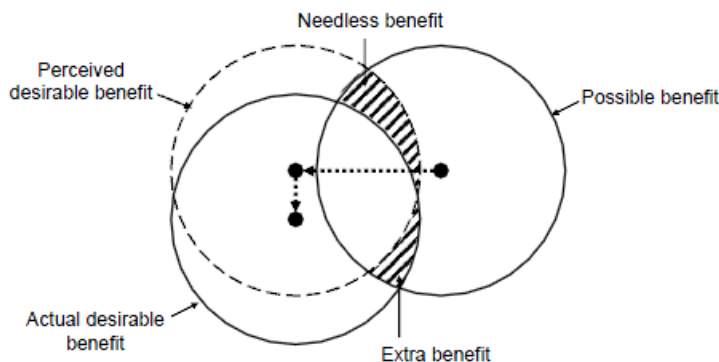


Figure 1.3: The effect of value perception on the project's benefits

An alternative competitive tendering process to overcome the previous deficiencies is the so called Value Based Tendering which is promoted by the European Community since 2004 for large public infrastructure developments. It uses an award mechanism based on the Economically Most Advantageous Tender (EMAT) where the bid is evaluated in quality award criteria set by the client besides the project's cost components. However, clients face difficulties on applying the EMAT award mechanism because they lack confidence in value based procurement. It is hard to formulate transparent quality award criteria with objective and explicit evaluation mechanisms where even small details of these criteria may have potentially large consequences on quality and costs.

In that respect there is the possibility to have subjective evaluation of the award criteria which on their turn impede the preparation of coherent to the values of the project and competent bids from the side of the contractor. The contractor has to be able to measure and evaluate the value of the project's elements as client perceives them in order to be able to achieve the best value-cost ratio. In addition, to improve the delivery of client best value, meaning the best value-price ratio, the contractor has to convince the client that he is capable of providing added value on the development for the standing bid price and he is voluntary to unfold it for mutual benefit maximization.

Ballast-Nedam is now exception within the realm of the large contractors that are capable to undertake LECPs and is faced with this new challenge in order to remain in the list of the top contractors in the Netherlands by developing public infrastructure projects based on profitable and competent tenders with enhanced value for the society. Especially for Ballast-Nedam which supports horizontal value chain in its strategy and opts for the best alignment with customer wishes, it is crucial to minimize the lack of clarity in award criteria by being able to direct properly its focus on the qualitative objectives of the project from the preliminary stages and thus deliver greater value with benefit to all the involved parties and indispensably to the society.

1.3 Research objectives and questions

The new challenge faced by Ballast-Nedam and contractor firms in general comes to be how to shape and adapt their procedures towards more effective bids and contractual relationships on the way of winning more tenders and attaining their strategic goals. A concise development of better internal practices in the design and procurement phases is needed. These practices have to identify and define critical factors which are related to the project's objectives and the award criteria in order to be aware where to focus during the tender and how to enhance the value of the bid documentation. The result is that the value created is maximized and the rewards are equitably distributed between all stakeholders. In principal, the new practices have to unlock the hidden value that contractor possesses through his knowledge and experience and make it accessible to the client.

The objective of this research project derives from the aforementioned argument, and can be state as follows:

“Develop new practices that involve a transparent and structured model (or methodology) to investigate the critical factors which are related to the project's objectives and the quality award criteria offered for evaluation, while formulates focus points for value creation of public infrastructure projects' bid documentation”

In relation to the objective of the research, the following main question is formulated and has to be answered:

MQ: In what ways Ballast-Nedam can effectively prepare bids with added value for public infrastructure projects which are procured with the EMAT award mechanism?

However, for answering the main research question, a breakdown on its important elements has to be structured. Starting from the end, the characteristics of the EMAT award mechanism have to be researched and in particular the following sub-questions must be answered:

SQ1: What is an EMAT award mechanism?

SQ2: Which evaluation criteria are the most important for public infrastructure projects that are procured with the EMAT award mechanism?

Continuing with the aim to prepare bids with added value, the following sub-question must be answered:

SQ3: Which critical factors related to the project's objectives and its award criteria can add value to the bid documentation and respectively to the project?

And ending with the intention to find ways to effectively prepare the bids, the following sub-question must be answered:

SQ4: Which process can be followed to effectively prepare bids with added value?

In order to reply the main question and the subsequent sub-questions, a literature study is initially conducted and then the research methodology that will describe the steps towards the fulfilment of the study's objective is presented.

1.4 Report Outline

Following the introduction of this research thesis and the statement of the main and sub research questions, the second chapter deals with the necessary literature background to support the research objectives. In that chapter the basics of the public infrastructure projects is discussed and then the EMAT award mechanism for those projects is presented. In addition the construction impacts at the project's environment are acknowledged, a multi-criteria decision model is introduced and the tender work instructions of the Ballast Nedam are presented. In the second chapter, the research methodology and the research strategy to reach the thesis' scope are communicated. The findings of the thesis research followed by the research strategy are presented in the fourth chapter and the important conclusions are guiding the conception of the value creation model which is presented in the fifth chapter. Finally in chapter six the conclusions of the report are discussed and in the chapter seven are presented the recommendations to the contractors and the clients with proposals for further research.

2. Literature Study

2.1 Public Infrastructure Projects

Public Infrastructure Projects or Public Works as they stated in the European Directives (2004/18/EC), are a broad category of projects, procured and (co-)financed by the government, for recreational, employment, and health and safety uses in the greater community. They can be bridges, roads, parks, municipal buildings, dams, schools, hospitals and other, usually long-term physical assets and facilities that serve the public. Reflecting increased concern with sustainability, urban ecology and quality of life, efforts to move towards sustainable public infrastructure are common in developed nations and especially in the European Union.

In the past, public infrastructure projects were financed and constructed completely by the state, but the large capital needed together with the often cost overruns and demand shortfalls because of optimism bias and strategic misrepresentation resulted in frequently haunted public infrastructure projects (Flyvbjerg et al. 2002, 2005). The solution came from the involvement of the private sector in the public works in order to acquire a better strategic and construction management that would result in successful public works in terms of quality, time and cost.

While it is argued that capital investment in the public works can be used to reduce unemployment, opponents of internal improvement programs support that change, and argue that such projects should be undertaken by the private sector, and not the public sector, because public infrastructure projects are characteristic of socialism. However, in the private sector, entrepreneurs bear their own losses and so private construction companies are generally unwilling to undertake projects that could result in losses or would not develop a revenue stream. In this case, governments will invest in public works because of the overall benefit to society when there is a lack of private sector benefit (a project that will not generate revenue) or the risk is too great for a private company to accept on its own (Overseas Development Institute, 2008).

Finally in the recent years, the internalization of the economies, the united European market and the new conditions in the national economies have resulted in the creation of new ways of cooperation between the public and the private sectors for infrastructural developments. The necessity of these projects is apparent in relation to the competitiveness of the national economies and the national progress in total. Nonetheless, their realization demands substantial resources which exceed by far the financing from the E.U when applicable, as well as the capabilities of the national budgets, especially in developing countries, resulting in the search of a third fellow, which is the private sector. Thus, nowadays it is often that public infrastructure projects are developed under the specialized service of Public Private Partnership (PPP) or Private Finance Initiative in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project (K. Palmer, 2000).

2.2 Procurement Award Mechanism (EMAT)

This section presents the answer to the first sub-question “what is an EMAT award mechanism?”. The original definition of the EMAT award mechanism is displayed and the available forms of evaluation techniques are presented.

2.2.1 Definition of the EMAT award mechanism

Pijnacker Hordijk et al. (2004) define procurement as the act of purchasing goods or services from an outside body by the government with a specified contract and a specified award procedure. In this definition, the government comprises of traditional state authorities (state and regional), and bodies governed by public law and associations of these first two bodies. So in contrast with associated concepts as acquisition, buying or purchasing, procurement is always ‘public’ (Dreschler, 2009).

Since 2004, the context of the procurement procedures is formed by the Directive 2004/18/EC (European Parliament, 2004). Especially, the new competitive tendering processes directed by the European Community in respect to value based tendering of public infrastructure projects are applying the Economically Most Advantageous Tender (EMAT) award mechanism. The EMAT award mechanism is defined in article 53.1 of the Directive 2004/18/EC and according to its clauses the contracting authorities have two possibilities for award contracts:

“Without prejudice to national laws, regulations or administrative provisions concerning the remuneration of certain services, the criteria on which the contracting authorities shall base the award of public contracts shall be either:

(a) when the award is made to the tender most economically advantageous¹ from the point of view of the contracting authority, various criteria linked to the subject-matter of the public contract in question, for example, quality, price, technical merit, aesthetic and functional characteristics, environmental characteristics, running costs, cost-effectiveness, after-sales service and technical assistance, delivery date and delivery period of completion, or

(b) the lowest price only.”

It is important to note that in the article 53.1, the word ‘criteria’ has two different meanings. In the first paragraph of the article, the word ‘criteria’ has the notion of ‘award mechanism’. However under (a), the word ‘criteria’ has the notion of ‘product dimensions’. In this thesis, the notion of ‘award criteria’ will be only used for the word ‘criteria’.

In general, the goal of an award mechanism is to evaluate the bids of the contractors/ suppliers and to select the best bid under a common basis, as illustrated in Figure 2.1 (Dreschler, 2009).

¹ The term “Tender Most Economically Advantageous” is similar to “Economically Most Advantageous Tender” used in the present thesis and in the majority of the research literature.

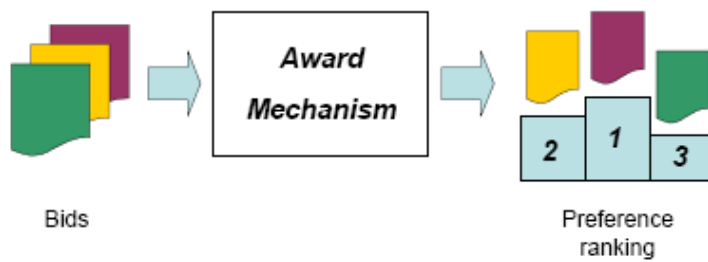


Figure 2.1: The goal of an Award mechanism

Specifically, within the evaluation technique of the lowest price award mechanism, the basis consists of the compliance of the bid with the Terms of Reference (ToR) and then selection of the cheapest bid (Figure 2.2).

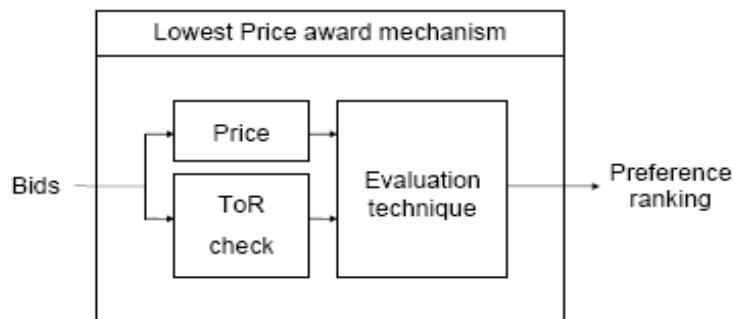


Figure 2.2: The lowest price award mechanism

In contrast to the lowest price award mechanism, in the EMAT award mechanism, besides the price and the compliance of the bid with the Terms of Reference, the evaluation is based also in other quality and performance criteria (Figure 2.3). These criteria, hereby defined as “award criteria”, are used to ascertain the performance of each bid and through the evaluation technique to establish the preference ranking. In general, the evaluation techniques use some mathematical formulas and assigned value price to the award criteria defined by the procurer (Dreschler, 2009).

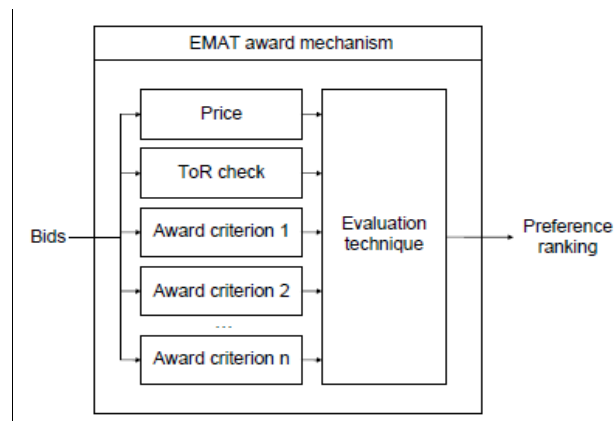


Figure 2.3: The EMAT award mechanism

Finally it should be noted that although the EMAT award mechanism refers to the award phase of the procurement, quality and performance criteria can be applied in previous phases of the process, like the pre-qualification or the dialogue phase. These criteria, hereby defined as “success criteria”, can be similar or not to the “award criteria” and are assigned with a weight of same magnitude or not to the “award criteria”. However, “success criteria” do not have an assigned value price since they are not decisive for the project’s award but their scoring serves only for the evaluation and selection of the candidates to continue at the next phase of the procurement.

2.2.2 Types of EMAT award mechanism

As was discussed above, a mathematical formula is used in the evaluation technique of the bids in the EMAT award mechanism. However, the evaluation technique presents similarity to Multi Criteria Evaluation techniques which thus can be used to formulate the mechanism that fits within the framework of the EMAT award mechanism. The difficulty is how to combine price information with qualitative criteria in such a way that it satisfies the legal criteria of transparency (“objectivity” of criteria), proportionality (balance of the weighting criteria so that the value which is attached to performance remains “economically realistic”) and equal treatment (not making distinctions on criteria) that apply in the procurement processes (Dreschler, 2009).

Doornbos (2005) presented three main EMAT forms of evaluation techniques: the point system, the ratio system and the price correction system. Their characteristics are presented in the Table 2.1.

Table 2.1: The types of EMAT award mechanism

Type of EMAT award mechanism	Evaluation technique
Point System	Both the price and the quality of the bids are expressed in points. The bid with the best combined score wins the tender.
Ration System	The total value of the bid is expressed in a number which is divided by the price. The bid with the highest ratio wins the tender.
Price Correction System	Extra performance of the bid is rewarded with an added value which is subtracted from the initial tender price. The bid with the lowest fictitious tender price wins the tender. (Based on the tender instructions, there is also the alternative of adding the added value to the initial tender price)

Specifically in the price correction system, the procurer assigns a value price and a weight (Article 53.2, European Directive 2004/18/EC) to each award criterion, and the scores provided by the evaluation committee for these criteria are used together with the bid price in the evaluation technique to set the preference ranking of the bids. The price correction system is used extensively in the Netherlands and has been confirmed by Rijkswaterstaat (RWS 2005b), the Dutch government agency for procuring public works and water management projects. RWS (2005b) prescribed the use of the price correction mechanism, due to some limitations of the point system and the limited application of the ratio system (Dreschler, 2009).

2.3 Social impacts of construction projects

The fundamental objective of the European Directive 2004/18/EC in respect to the EMAT award mechanism is to ensure that government procurement activities achieve best value for money in supporting the delivery of public works. This is not only measured in respect to the costs of goods and services, but also takes account of the mix of quality, cost, resource use, fitness for purpose, timeliness, and convenience to judge whether or not, together, they constitute good value (European Directive 2004/18/EC).

Especially the European Union uses integrated assessment to identify the "likely positive and negative impacts of proposed policy actions, enabling informed political judgments to be made about the proposal and identify trade-offs in achieving competing objectives" (Commission of the European Communities, 2002). Policy-makers use sustainability assessment frameworks to decide which actions they should or should not take to make society more sustainable. Policy-makers want to know the cause and effect relationship between actions—projects or policies—and whether the results move society toward or away from sustainability (Indiana Business Research Center, 2001).

In that respect, and considering the government's pursuing of sustainable growth, social sustainability pertains in the broader sense to the social responsibility where actions focus on the three dimensions of performance: social, environmental and financial or people, planet and profit, the known as "the three pillars or 3Ps" where (Brown, D, J. Dillard and R.S. Marshall, 2006):

"People" refers to fair and beneficial government practices toward the community and the region in which the public development is conducted, attempting a reciprocal social structure where the well-being of citizen and other stakeholder interests are interdependent.

"Planet" pertains to sustainable environmental practices which benefit the natural order as much as possible or at least do no harm and curtail environmental impact. And

"Profit" is the economic value created by the public development after deducting the cost of all inputs, including the cost of the capital tied up. It therefore differs from traditional accounting definitions of profit, and within a sustainable framework needs to be seen as the real economic benefit enjoyed by the host society.

All in all, human developments and primary public projects must be based upon a better social, environmental and economic balance resulting by the employment of the “three pillars” (Figure 2.4).

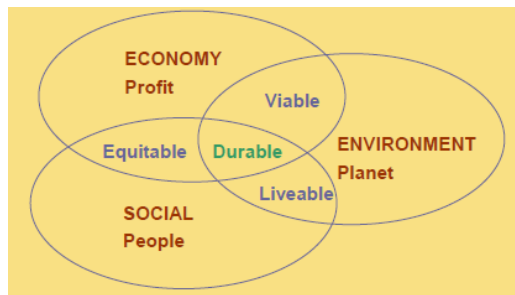


Figure 2.4: Sustainable development: the 3Ps

However, the social responsibility applied by the consideration of the 3Ps is related to the long-term or “macro-level” impact of the final product to the society rather to the short-term or “micro-level” impact of the development to the local community. In that respect and in the attempt to set the social responsibility one step further toward its “micro-level” application, it is important to consider the impacts of the project during the construction. This step becomes even more crucial in the case of public works where the state has to promote its compliance with the social objectives one of which is the socially sustainable construction as result of the social responsibility that serves.

It is particularly true for urban societies, that construction activities on their area can have a significant impact on the surrounding environment, where the term ‘environment’ refers to the ecological, sociological and economical systems that surround these activities or that are directly impacted by them. Thus communities with an operating construction site in their environment often find themselves subjected to negative impacts such as annoyances and economic losses. The latter often called “social costs”, refer to the economic equivalent of consumed resources, loss of income, loss of enjoyment etc, experienced by parties not engaged in the contractual agreement, solely due to the construction process. In addition, these costs cannot be classified as either direct or indirect costs incurred by the parties engaged in the contractual agreement. The reasoning lies with the difficulty associated with quantifying them and the fact that although widely acknowledged, are rarely considered in the design, planning or bid evaluation phases of the construction projects but are rather usually borne by the community (Gilchrist, A., Allouche, E.N., 2004).

Following the three dimensions of performance or 3Ps applied in a development with respect to the social responsibility on the “macro-level”, the following Table 2.2 summarizes the impacts that a construction project can have on the surrounding environment of the community on the “micro-level”. There is a categorization on the ‘causes of the impacts’ resulting from the construction activities and a classification in sociological, ecological and economical ‘impacts’ in the society during the construction as paralyzied to the 3Ps: People, Planet and Profit.

Table 2.2: Causes and Impacts in the social environment during the project construction

Cause of Impact	Cause Description	Sociological/Health Impact	Ecological/ Environmental Impact	Economical Impact
1.Noise	Any sound that has the potential to annoy or disturb humans, or cause adverse psychological or physiological effects due to: i) Noise from increased road traffic ii) Construction noise (heavy machinery move, vehicle back-up alarms, pneumatic equipment and/or demolition activities)	Quality of life (i.e Sleep disturbance, Happiness of people at home or leisure)		Values of real estate
		Increase of human stress levels, behaviour and mental health		Productivity reduction of people (due to reduced concentration)
		High blood pressure & Cardiovascular disease		Productivity reduction of company (due to absence from workplace)
				Disability allowance costs, long-term care and rehabilitation costs (due to health impacts)
2.Dust / Air pollution	Construction dust is significantly disturbing residents within 150m of a construction site. Rainfall, wind, topography and ambient dust levels are the main determinants of the net impact of construction-related dust. / Air emissions from machinery i.e carbon & nitrogen oxides	Lower aesthetic quality of the environment	Environmental pollution	Electrical damage of equipment
		Respiratory illnesses, cardiovascular diseases, allergies and anxiety		Mechanical damage of equipment
				Increased cleaning and maintenance services
				Reduced agricultural production
3.Vibration	The impact from pile driving, dynamic compaction, blasting and the operation of heavy construction equipment.	Lack of safety		Productivity reduction of equipment (Impact on sensitive equipment, i.e. equipment in hospital, high precision manufacturing facilities)
				Property damage (due to movement as result of vibration)

4. Water pollution / disruption	Associated with the project in sites as deposits, borrow sites, material treatment areas and quarries. Water pollution/ disruption due to: i) Project's interception with water flows affecting the volume, velocity and sedimentation rate. ii) Dewatering operations that lower water table.		Surface/ Subsurface disruption (i.e. bank erosion, flooding, alterations of rivers flows, damage to aquaculture)	Property damage (due to soil settlement)
			Deterioration of green life	
			Reduction of water for agricultural use	
5. Proximity to recreational facilities	Construction projects may temporarily or permanently affect natural recreational facilities such as parks, surface water bodies and forests due to the presence of heavy equipment and the generation of noise, dust, vibration and visual pollution	Reduced accessibility of recreational facilities	Affect on an ecosystem for a longer time period than the duration of the project. (It takes years if not decades for trees to rejuvenate and for the ecosystem to restore its balance).	Restoration costs for reforestation, re-establishment of spawn areas for aqua life and re-establishment of migration paths
6. Construction Traffic	Changes in the established traffic patterns result in: i) Prolonged closure of road space to locate machinery, place signage and provide entry/exit measures ii) Changes of the provided infrastructure	Increase of human stress levels, behaviour and mental health		Productivity reduction of businesses/people (due to traffic delays i.e. just-in-time manufacturing and assembly operations)
		Increase of accident rates (resulting in health-related expenses, disability claims, property damage and litigation costs)		Increased fuel consumption (due to longer distances and speed changes resulting from traffic congestion)
		Increase in number of "road rage" incidents (due to stress levels related to congestion and frustration)		Reduction in tax revenues (Due to lower municipal, provincial and federal revenues i.e. parking meter revenues and ticket fines)
		Cycling difficulties		Loss of income for retailers and businesses (ie. Petrol stations)
		Loss of parking spaces		

7.Detours	Redirection of traffic to secondary roads that are not normally designed for heavy traffic loads			Accelerated deterioration of the secondary road (impacting the useful life of the pavement, the maintenance and repair costs)
8.Utility cuts	Cutting and restoration of paved surfaces due to construction rehabilitation and/or replacement of buried services	Reduced travel comfort (due to pavement irregularity)		Reduced useful life of pavement structures
		Cycling difficulties		
9.Visual Inconvenience	Permanent or prolonged temporary landscape alterations i.e by the presence of singular elements as cranes or iconic structures or noise barriers	Changes in the landscape		Values of real estate
10. Soil / Public space pollution	The ambient is polluted due to: i) Use of cleaning agents or surface-treatment liquids at the construction site. ii) Dumping derived from the use and maintenance of construction machinery iii)Municipal waste by on-site construction workers		Pollution of the ambient	Increased cleaning services
			Soil pollution	

(Source: Gilchrist, A., Allouche, E.N., 2004)

2.3.1 Techniques for evaluation of costs of social impacts

After the identification of the relevant adverse impacts to the social environment of the project, there is the option for some of these to evaluate the costs associated with their impacts. In particular there are in literature two groups of valuation techniques: the direct techniques and the indirect techniques. The list of methods presented is by no means exhaustive, but intend to serve as a guideline in the evaluation of “social costs” associated with construction projects. The choice of the evaluation technique for a given social impact is a function of the quality and quantity of the available data as well as the nature of the indicator being considered (Gilchrist, A., Allouche, E.N., 2004).

Starting from the direct valuation techniques, these are based on market and measurable values and their strength is also their weakness since adequate market data must be available regarding the loss under consideration in order to be applicable. The most important of them are the following:

- **Loss of productivity (LOP):** It is used when a construction project directly affects the production of goods and services and the respective losses can be measured in terms of reduced income based on market prices.
- **Human capital:** It deals with the value of health or loss of earnings. The technique focuses on the impact of changes on human productivity rather than production of goods. It involves the monetary value of earnings that are reduced or lost associated with traffic or construction accidents, loss of sales for businesses, loss of jobs, health threats and environmental quality. Average values used to estimate losses should be representative of the people who are affected by the project. The technique can be used to assess the additional costs associated with older, more hazard prone construction methods versus newer, more automated and thus safer methods.
- **Replacement cost:** This approach involves the costs that would be incurred in replacing or restoring an asset if it was to be damaged. It allows comparison among alternative mitigation techniques.

As for the indirect valuation techniques are applied when some commodities and services do not have a market value (e.g. the atmosphere and public parks). When “social costs” cannot be measured directly in monetary terms, indirect techniques can be used to assign known market values for another good or service to arrive at an approximate cost. Commonly used indirect valuation techniques are the following:

- **Hedonic pricing:** This method analyzes the impact on property values due to pollutants and traffic factors. It compares prices of properties in affected areas with prices of similar properties in quieter, cleaner and safer areas. It can also be applied to the deterioration of the aesthetic quality of a property and thus its associated value reduction. The principal advantage of hedonic pricing is that it uses available and reliable market data. Its main disadvantage is that it is sometimes difficult to amass sufficient market observations to ensure the econometric validity of the estimates (Townley, 1998).

- **User delay costs:** It is a method to evaluate the total time delay that the user experiences due to reduced speed through construction areas or when traffic demand exceeds capacity due to congestion in the affected areas.
- **Contingent valuation technique:** This last technique is used to survey a representative sample of the local population on how much they value a particular non-market preference. It can be applied to environmental protection or society improvements. The method tries to identify people's preferences by asking direct questions about how much they are willing to pay (willingness-to-pay principle, WTP) to obtain, maintain, or increase some environmental and social benefits. Another form of the contingent evaluation technique is the willingness-to-accept (WTA) as compensation to tolerate an environmental or social loss. In general the technique uses self-generated survey data and therefore can be applied to all public goods and intangibles. One disadvantage associated with the contingent evaluation method is that individuals may respond to the survey questions strategically on their interests.

Concluding, it should be noted that in most of the situations a contractor is obliged to fulfil the project's objectives in accordance with the contract documents, drawings and specifications. Within these limitations, contractor's goals are to complete the project for the estimated cost, within the tightest time limits, and at the highest profit and quality (Heiber, 1999). As a result the contractor is unlikely to implement low impact practices and consider the impacts of the construction activities on the social environment unless are contractually defined or economically favourable to him. However, in case that the construction impacts should be acknowledged, it is evident that they are project specific, are based on the project design and its activities and thus their importance and presence varies and should prioritized. The same counts for the valuation techniques to calculate the costs of the impacts to the society, depending on the impact and the applicability of the technique.

2.4 Multi-criteria decision model – Preference model (AHP)

Multiple criteria decision analysis or multiple criteria decision making is a sub-discipline of operations research that explicitly considers multiple criteria in decision making environments. Whether in the daily lives or in professional settings, there are typically multiple conflicting criteria that need to be evaluated in making decisions. Cost or price is usually one of the main criteria while some measure of quality is typically another criterion that is in conflict with the cost. There is usually an implicit weighing with multiple criteria and with comfortable consequences of such decisions that are made based on only intuition. However, when stakes are high, it is important to properly structure the problem and explicitly evaluate multiple criteria. Structuring complex problems well and considering multiple criteria explicitly leads to more informed and better decisions (Köksalan, M., Wallenius, J., and Zionts, S., 2011).

Based on the objective of this research project to "*investigate the critical factors which are related to the project's objectives and the quality award criteria offered for evaluation*", it becomes evident that the employment of a Multi-criteria decision model can serve to the selection of the correct decisions to direct properly the focus of the design on the qualitative

objectives of the project. However, the focus point can never be only one in a Large Engineering Construction Project like the public infrastructures. In that respect it is crucial to be able to detect and define a set of focus points that can direct the contractor during the tendering for the creation of a dib with added value. Of course the time and resources limitations in the design phase result in the search of a model that has the capability to prioritize the focus points based on their importance so that a selection can be made.

The solution to the above prerequisites is the Analytic Hierarchy Process (AHP) which is presented in the following paragraphs and reasons its selection as the appropriate tool for supporting the thesis objective.

2.4.1 Preference Model – The Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a structured multi-criteria technique for dealing with complex decision making and was introduced by Saaty (1977 and 1994). Rather than prescribing a “correct” decision, the AHP helps decision makers to find the decisions that best suits their goal and their understanding of the problem. The AHP has attracted the interest of many researchers mainly due to the nice mathematical properties of the method and the fact that the required input data are rather easy to obtain. The AHP provides a comprehensive and rational framework for setting a decision problem with the use of a multi-level hierarchical structure of objectives, criteria, sub-criteria and alternatives (Saaty, Thomas, L., 2008).

In respect to the research objective, the ‘focus points’ are parallelized to the ‘alternatives’ in the AHP model since they represent the qualitative objectives of the project that will achieve the decision goal to prioritize critical factors and increase the value of the bid when developed.

Users of the AHP first decompose their decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem – tangible or intangible, carefully measured or roughly estimated, well- or poorly understood – anything at all that applies to the decision at hand. This capability distinguishes the AHP from other decision making techniques.

Once the hierarchy is built, the decision makers evaluate the elements of the structure and the corresponding data results are deriving by using a set of pair-wise comparisons with respect to their impact on an element above them in the hierarchy (the parent element). These comparisons are used in order to obtain the weights (or priority) of importance of the decision criteria, and the relative performance measures of the alternatives in terms of each individual decision criteria. If the comparisons are not perfectly consistent, then the AHP provides a mechanism for improving consistency.

In the final step of the process, numerical priorities are calculated for each of the decision alternatives (focus points). These numbers represent the alternatives’ relative ability to achieve the decision goal, so they allow a straight forward consideration of the various ways of action.

All in all, the AHP technique has unique advantages when important elements of the decision are difficult to quantify or compare, or where communication among team members is impeded due to their different specializations, terminologies, or perspectives.

2.4.2 Procedure for using the AHP

Using the AHP involves the mathematical synthesis of numerous pair-wise judgments about the decision problem at state. While the math can be done by hand or with a calculator, it is far more common to use computerized methods for entering and synthesizing the judgments. The simplest of these involve standard spreadsheet software, while the most complex use custom software like the software package, called *Expert Choice* (Triantaphyllou, E., Mann., S.H., 1995), which has significantly contributed to the wide acceptance of the AHP methodology.

The procedure for using the AHP can be summarized as can be seen below:

1. Model the problem as a hierarchy consisting of the decision goal, the alternatives for reaching the goal, and all the criteria and sub-criteria for evaluating the alternatives.
2. Establish the weights of the criteria and sub-criteria of the hierarchy – if not provided – by making a series of judgments based on pair-wise comparisons of these elements.
3. Establish the preferences of the alternatives in comparison to the parent element of the hierarchy based on pair-wise comparison of the alternatives.
4. Synthesize these judgments to yield a set of overall preferences of the alternatives in relation to the weights (priorities) of the criteria and sub-criteria in the hierarchy.
5. Check the consistency of the judgments.
6. Come to the final decisions based on the results of this process provided on the priority list of the alternatives (focus points).

The above steps of the AHP are fully described in the following paragraphs.

1. Hierarchy structure

The first step in the Analytic Hierarchy Process is to model the problem as *hierarchy*. At that point, the participants or decision makers explore the aspects of the problem at levels from general to detailed and then express it within a multileveled structure. During that step, the understanding of the problem and its context is increased, together with the thoughts and feelings of the participants.

The design of the AHP hierarchy depends on the nature of the problem at hand when setting the *goal*, the group of *alternatives* for reaching the goal, and the group of *criteria* that relate the alternatives to the goal. However, beside the nature of the problem, the knowledge, the individual judgments and values, the opinions, needs, wants, etc. of the participants in the decision making also are important in setting the hierarchy. Constructing a hierarchy typically involves discussions, research, and discovery by those involved. Even after its initial setting, it can be changed to accommodate newly-thought-of criteria or criteria not originally considered to be important while alternatives can also be added, deleted, or changed.

The hierarchy can be visualized with a diagram like the one immediately below (Diagram 2.1), with the goal at the top, the three alternatives at the bottom, and the three criteria in between. There are useful terms for describing the parts of such diagrams: Each box is called a *node*. A node that is connected to one or more nodes in a level below it is called a *parent* node. The nodes to which it is so connected are called its *children*. Note that there are only three Alternatives, but in the diagram, each of them is repeated under each of its parents.

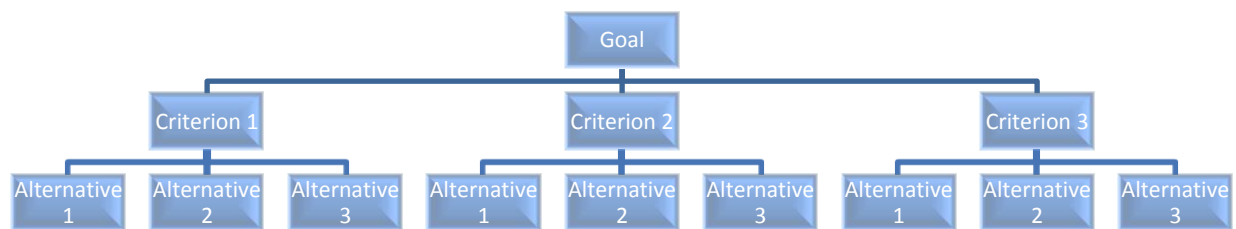


Diagram 2.1: Hierarchy structure in the AHP

2. Weights establishment

Once the hierarchy has been constructed, the participants analyze it through a series of *pair-wise comparisons* that derive numerical scales of measurement for the nodes. The criteria are pair-wise compared against the goal for importance. The alternatives are pair-wise compared against each of the criteria for preference. The comparisons are processed mathematically, and *weights* are derived for each node.

In general, *weights* are numbers associated with the nodes of the AHP hierarchy. They represent the relative priority of the nodes in any group. Like probabilities, weights or priorities are absolute numbers between zero and one, without units or dimensions. Depending on the problem at hand, “weight” can refer to importance, preference, or likelihood, or whatever factor is being considered as important by the decision makers. Also there can be the case that the weights are provided from the problem at stake.

By definition, the weight of the Goal is 1.000. The weights of the alternatives always add up to 1.000. Things can become complicated with multiple levels of criteria and sub-criteria that add to 1.000 at all the levels of the hierarchy. In that case, two more concepts apply when a hierarchy has more than one level of criteria: *local weights* and *global weights*. In the Diagram 2.2 below can be seen the *default* structure of the hierarchy. In particular, the *local weights*, shown in black, represent the relative priorities of the nodes within a group of siblings with respect to their parent. The *global weights*, shown in white, are obtained by multiplying the local weights of the siblings by their parent’s global weight.

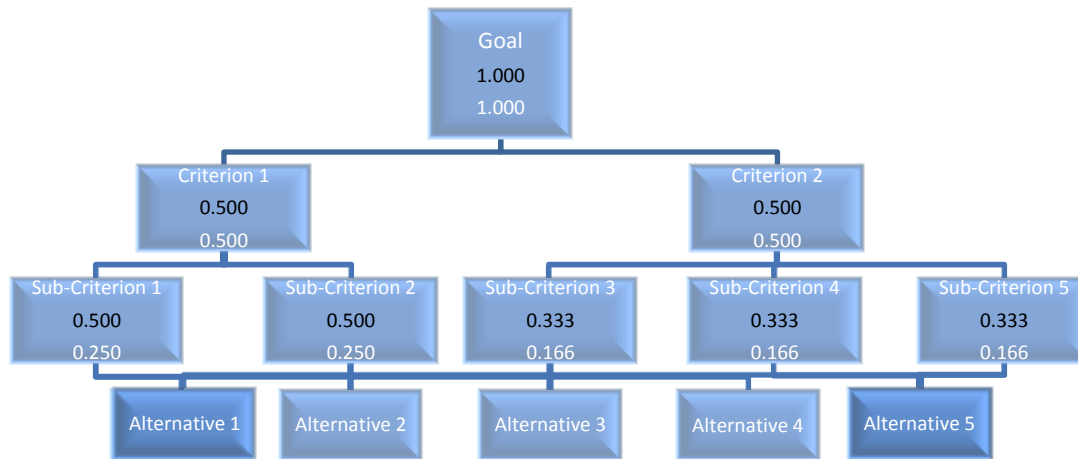


Diagram 2.2: Hierarchy structure in the AHP

3. Preferences establishment

So far, we have looked only at default priorities of the criteria and sub-criteria. As the Analytical Hierarchy Process moves forward, the weights will change from their default values, in case they are not provided, as the decision makers input information about the importance of the various nodes. They do this by making a series of pair-wise comparisons.

After setting the weights of the criteria and sub-criteria, the next step is to determine the *weights* for the alternatives with respect to each of the decision sub-criterion and criterion. In doing so, a series of measurements and assessments takes place, where *pair-wise comparisons* involving all the nodes are made. The alternatives at the last level of the hierarchy are compared, two by two, with respect to their contribution to the sub-criterion above them. For each comparison, the decision makers decide which alternative is the weaker with respect to the parent node, giving a score of 1. Then using the AHP Fundamental Scale (Table 2.3), the decision makers assign a score to the other alternative with respect to the certain parent node. The results of these comparisons are entered into a matrix which is processed mathematically to derive the weights of the alternatives. An example of a matrix of comparisons can be seen below (Table 2.4).

Table 2.3: The AHP Fundamental Scale

The Fundamental Scale for Pair-wise Comparisons		
Intensity of Importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment moderately favour one element over another
5	Strong importance	Experience and judgment strongly favour one element over another
7	Very strong importance	One element is favoured very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favouring one element over another is of the highest possible order of affirmation
Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities of 1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance		

Table 2.4: Matrix of alternatives pair-wise comparison in respect to Sub-criterion 1

Sub-Criterion 1	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Weight
Alternative 1	1	1/4	4	7	0.217
Alternative 2	4	1	9	4	0.286
Alternative 3	1/4	1/9	1	1/5	0.355
Alternative 4	1/7	1/4	5	1	0.142
				Sum of Weights	1
				Inconsistency	0.035<0.1

4. Final weights synthesis

Now that the weights of the Criteria with respect to the Goal, and the weights of the Alternatives with respect to the Criteria are known, the weights of the Alternatives with respect to the Goal can be calculated. This is a straightforward matter of multiplying and adding, carried out over the whole of the hierarchy.

The final results set the overall preferences of the alternatives (or focus points/critical factors for the purposes of the current thesis) in relation to the weights of the criteria and sub-criteria in the hierarchy. Based on these results, a list of alternatives preferences is derived and the decisions can be made by the participants of whether to focus in the design in order to increase the value of the bid. However, it is important before that, to check the consistency of the judgments.

5. Check for the consistency of the judgements

One of the most practical issues in the AHP methodology is that it allows for slightly non-consistent pair-wise comparison. However, perfect consistency rarely occurs in practice. In that respect, in the AHP method, the pair-wise comparisons in a judgment matrix are considered to be adequately consistent if the corresponding consistency ratio (CR) is less than 10% (Saaty, 1980). In that respect it is suggested to use on maximum 9 alternatives in the final level of the hierarchy since it has been scientifically proved that this is the maximum number of notions that the human brain can sustain separate when pair-wise comparisons are rendered (Saaty, 2001).

2.4.3 Objections over the AHP

The AHP and its use of pair-wise comparisons, has inspired the creation of many other decision-making methods. Besides its wide acceptance, it also created some considerable criticism; both for theoretical and for practical reasons. Since the early days it became apparent that there are some problems with the way pair-wise comparisons are used and the way the AHP evaluates alternatives. First, Belton and Gear (1983) observed that the AHP may reverse the ranking of the alternatives when an alternative identical to one of the already existing alternatives is introduced. In order to overcome this deficiency, Belton and Gear proposed that each column of the AHP decision matrix to be divided by the maximum entry of that column. Thus, they introduced a variant of the original AHP, called the revised-AHP. Later, Saaty (1994) accepted the previous variant of the AHP and now it is called the Ideal Mode AHP. Besides the revised-AHP, other authors also introduced other variants of the original AHP. However, the AHP (in the original or in the ideal mode) is the most widely accepted method and is considered by many as the most reliable MCDM method.

2.5 Tender procedure work instructions

As has been discussed from the begging of this research, Ballast Nedam and contractor firms in general have to shape and adapt their tender procedures towards the creation of more effective bids on the way of winning more tenders and attaining their strategic goals. Under that respect, the work instructions that represent a step by step description of the tender procedure followed at the moment, as referred to in the Company Manual (Ballast Nedam Infra Project Work Instructions, 2011), must be presented in order to identify the potentials for their improvement later on in this research thesis.

Their objective is to adapt a structural approach to the tender process for projects, with the final target of creating a successful proposal that not only meets the requirements specified by the client, but that it is also in line with the guidelines used by Ballast Nedam and that is consistent with the Ballast Nedam Infra Project's Business Plan.

Provided by Ballast Nedam for the purposes of this research thesis, the 16 steps (in summary) of the work instruction procedure employed during the tender, are the following:

1. General

In consultation with the executive board, the Head of Tender Department (HTD) appoints a Tender Manager (TM) responsible for managing the Tender Team and monitoring the tender process.

2. Assessment of Request for Proposal

The request for proposal is evaluated in accordance with the 'Assess Request for Proposal' document. The request for proposal is supplemented with a short description of:

- The scope of the work
- The evaluation criteria
- Contracting principles for construction contracts (deal breakers)
- Other relevant documentation (e.g. drawings, diagrams, etc.)

3. Identify actions required to produce the tender

An overview of the actions required to produce a tender that has a good chance of success must be prepared in this step. This requires the development of a tender strategy designed to address the most important strategic issues.

In succession, the actions required to produce a successful tender can subsequently be determined and are then included in the 'Tender Management Plan'.

4. Go/No-go Decision

The situation and the work up to this point, as well as external factors if necessary, are reviewed by the executive board, or in case of a combination by the Board of Management, on the basis of the Tender Management Plan after which a decision is taken about the continuation of the tender process. The Team Manager organizes a kick-off meeting to start off the tender process.

If a decision is taken not to proceed any further with the tender, the preceding phase will be evaluated.

5. Survey ideas and potential options

An initial effort is made during this phase to develop a series of concepts and designs for the project on the basis of the insights gained to date. This is succeeded by two steps:

- A brain storming session that includes a review on the basis of the client's statement of requirements of the potential options available to respond to these requirements.
 - ❖ Once the first rough ideas have been expressed, they are assessed in terms of their feasibility using a Trade-off Matrix.

- ❖ The results of this session, in particular the risks, forecasts and the degree to which the requirements are met, are documented.

- Development of a Design Plan.

6. Adjustment milestone

At this point, the executive board or in case of a combination, the Board of Management, makes a decision concerning the adjustment of certain components or whether or not to proceed with the tender process. This assessment is based on a Trade-off Matrix analysis, the design plan, the risk analysis, as well as the current situation, the results of the work up to this point and external factors if required.

If a decision is taken not to proceed any further with the tender, the preceding phase will be evaluated.

7. Develop ideas at high level

The solutions (a maximum of 2 to 3) that up to this point are considered the most likely to succeed are worked out in detail during this phase. A global Work Breakdown Structure is first developed for each alternative, after which an initial draft in broad detail is developed for each idea that addresses the following aspects:

- Cost forecast for the work
- Global schedule and high level construction schedule
- Brief description of the work methods to be used
- Project-related risks

Each solution is subsequently judged by an independent panel in terms of design, methodology and cost estimates. The conclusions resulting from this assessment are documented in the form of a Review Report.

8. Select most favourable solution(s)

One or two potential solutions are selected during this phase. To make this selection, a complete picture of the situation is required. Therefore, an initial estimate of the cash flow, internal and external financing and any price escalations are prepared first, after which the available information, evaluation criteria, tender strategy and previous reviews based on the Trade-off Matrix are assessed. One or two potential solutions are then selected. The rationale and considerations, on which the decision is based, are documented in a report.

9. Adjustment milestone

See previous description

10. Develop selected solution(s)

The design for each selected solution is developed in greater detail during this step. A provisional cost estimate based on these details and the information already available is also prepared.

11. Final selection of design proposal

The solution(s) developed in greater detail are once again subjected to review. The key issues in this review are the design itself, the proposed work methods and the provisional cost estimate.

Once a final decision is made to adopt a specific solution, it is documented in the form of a Review Report that clearly explains the underlying considerations.

12. Adjustment milestone

See previous description

13. Develop design proposal

The final development of the selected solution into a Design Proposal with all related documents in accordance with the specification of requirements, including internal documents is executed at this step. This result in the following deliverables:

- Design proposal, including management and work preparation plans
- Final Cost Estimate
- Personnel Assignment Schedule
- Production Personnel Assignment Schedule
- Cash Flow
- Financing Proposal
- Risk Matrix

14. Review of Proposal

The selected design, as well as the associated work methods and cost estimate are reviewed one final time in this step. The cost estimate is furthermore assessed internally on completeness. The factors underlying this Final Review are documented in the form of a Review Report.

15. Assemble Proposal

All previously gathered relevant information is reviewed one last time during this step before being assembled into a Proposal Package. This package consists of the final proposal and the supporting internal documents.

16. Tender evaluation

Finally, the complete tender process will be evaluated. This will include a description of the steps followed that will serve as lessons learnt for the future. The evaluation will then be sent to the HTD who is responsible for its distribution to all interested parties and for its archival.

The summarized flow-chart of the tender procedure work instructions of the company is visualized in the following Diagram 2.3 and the complete flow-chart with input and output elements up to the creation of the final design proposal can be seen in Appendix 1.

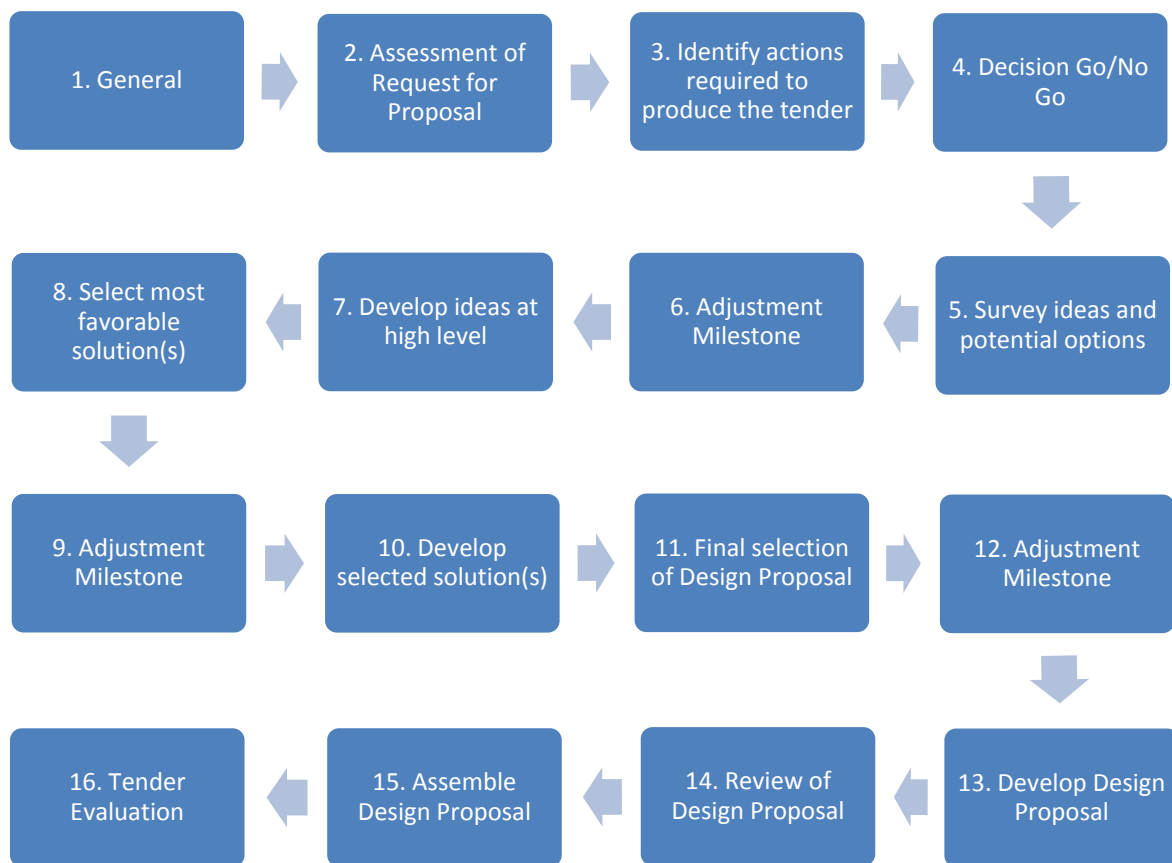


Diagram 2.3: Summarized Flow-Chart of the tender procedure work instructions

2.6 Discussion

The literature discussed in all the previous sections of chapter 2, present a complete background for the following steps of this research thesis. Initially some information in respect to the public infrastructure projects is provided in order to acknowledge the most important aspects of this kind of development. In the second section, the procurement process of the EMAT award mechanism was studied so that a better insight of the value based procurement can be achieved.

Through, the analysis of the EMAT award mechanism, the first research sub-question stating “*What is an EMAT award mechanism*” is answered. By citing the article of the European Directive concerned with this type of procurement, the differences between the low price contract award method and the EMAT award mechanism is becoming clear. The employment of quality award criteria in the EMAT award mechanism is distinguishing the two contract award methods and together with the presentation of the most used types of evaluation techniques applied for EMAT tenders, a solid framework is achieved to answer the sub-question.

Apart from answering the first research sub-question, the literature study serves for the acknowledgement of the key concepts to be used for the proper elaboration and accomplishment of the thesis’s objective through the following chapters. In particular, section 2 with the discussion over the social impacts of the construction, questions the very important implications of the construction activities in the social environment and challenge the social responsibility of the client in the “micro-level”. Further, section 3 presents the Analytic Hierarchy Process which exercised when there is need to prioritize alternatives over a goal with the use of criteria and its studying will constitute a valuable tool to support the elaboration of the third and fourth research sub-questions later on. Finally, in the last section are presented the steps followed in Ballast Nedam during a tender, and their knowledge is considered as crucial in the attempt to shape and adapt the current practices towards more effective bids as the thesis’ objective states.

3. Research Methodology

This chapter will describe how the research is performed and which research strategy was followed in order to find an answer to the main research question and the sub-questions. The strategy of case studies will be described, as well as how the data for the research was collected in all the different cases. A detailed description of the sample and the responses of the interviews are given in the end of the chapter.

3.1 Theoretical framework

As has been discussed in the first chapter, the aim of this research is to “investigate the critical factors which are related to the project’s objectives and the quality award criteria so that the contractor can be aware where to focus during the tender and prepare the design proposal with enhanced value”. The intention is to develop a model where it can apply a structured process that can guide the contractor towards the accomplishment of the above goal.

Procurement of public infrastructure projects

In order to attain the objective of this thesis, the theoretical framework has first to be established. For that purpose the first step is to acquire the knowledge related to the procurement of public infrastructure projects. This is achieved through the literature study of the characteristics of the public infrastructure projects and the relevant EMAT award mechanism presented in the first two sections of the 2nd Chapter. The most important in that point is to understand how the particular award mechanism applies in the procurement of public infrastructure projects and the available types of evaluation of the bid proposal that are in hand of the client. Thus a conceptual basis for value based procurement is build to support the following steps of the research while an investigation of the real situation would complete the two realms involved in research–theory and practice (Trochim, 2006).

Social responsibility

The next key concept to study is the identification of contractor’s social responsibility in respect to the period of the project’s construction. The reasoning lies on the fact that there has been a growing awareness among public as well as local government agencies on the significance of the construction impacts to the social environment and of their costs which are not examined in the bid evaluation process of the current procurement methods. Gilchrist et al. (2004) argue that mitigation of construction impacts can be accomplished effectively by incorporating them into the bid evaluation processes and this can be an important component of the paradigm shift needed to move the construction industry toward a more sustainable oriented frame of mind. In contrast with the traditional view of time, cost and quality, the new paradigm shown in Figure 3.1 uses broader terms and takes wider views of time (life cycle assessment), cost (construction and social costs; minimal resource consumption) and quality (human satisfaction; minimal environmental impact)(Gilchrist, A., Allouche, E.N., 2004).

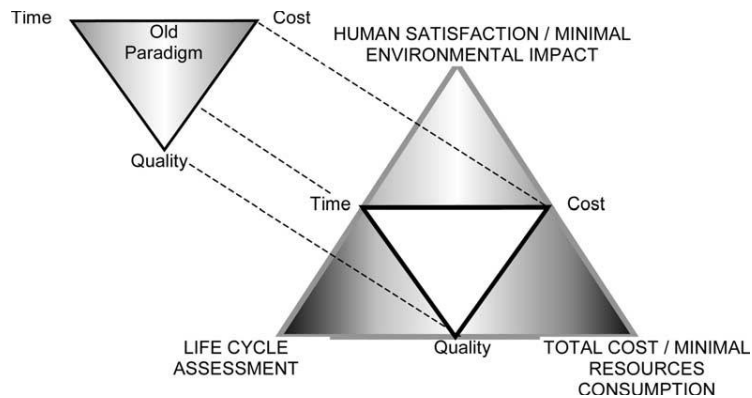


Figure 3.1: The new paradigm for sustainable construction (modified after Vanegas et al., 1996)

Based on the importance of shifting the mindset of the construction industry into a more sustainable framework on project execution in respect to the social responsibility where actions focus on the three dimensions of performance: social, environmental and financial or people, plant and profit (3Ps), the Table 2.2 with the causes and the impacts of the construction in the society is presented in the third section of the 2nd Chapter. In addition, the available valuation methods of the costs that some impacts may have, are discussed for the purpose of achieving a broader view of the concept of the construction impacts in the project environment.

Analytic Hierarchy Process model

However, the identification of the above impacts, are project-specific and of different importance. In that respect, there is a need to be able to distinguish the most important and prioritize their impact. Considering also the part of the objective of this research project to “formulate focus points for value creation of public infrastructure project’s bid documentation”, it becomes evident that the employment of a Multi-criteria decision model can serve to the selection of the correct decisions to direct properly the focus of the design on the qualitative objectives of the project. Thus the Analytic Hierarchy Process (AHP) model is studied as well for its ability to produce a priority list based on importance ranking while its application later on in this thesis becomes a prerequisite for providing a complete understanding.

Procurement process work instructions

Finally, in the attempt to develop new practices for the enhancement of the bid proposals as the ultimate goal of the thesis, the current procurement process work instructions used by Ballast Nedam have to be studied. This is important in order to research later on how it is possible to shape and adapt the procedures towards the creation of more effective and competent bids which can deliver added value to the client and as a result increase the possibilities for winning more tenders and achieving the strategic goals of the company.

All in all, the theoretical framework attempts to guide the research towards the specification of the theory used as basis for attaining the thesis’ objective and providing either the answers or the structure of the next steps to be followed for answering the main research question and the sub questions. Thus the literature study investigates the theories and the key concepts needed to build

a conceptual background for the value based procurement and its limitations in regard to the inclusion of the project's construction impacts in the society within the evaluation process. Finally it presents the tool (AHP) that can direct the current tender work instructions followed, in the direction of producing proposals with added value.

3.2 Research Strategy

The core of the theoretical framework relies on the acquisition of the appropriate knowledge required for answering the research questions, i.e “What is the EMAT award mechanism”, but mainly for providing the backgrounds of the next steps.

In that respect it is crucial to define the research method that can take advantage of the theoretical knowledge and set the research strategy which can result in the development of a model that accomplishes the objective of the thesis.

Based on the characteristics of the research, a qualitative and a quantitative research method would be beneficial in gathering information from real tender case studies. Through the qualitative research an in-depth understanding of the *why* and *how* an EMAT award mechanism is applied can be achieved. Together with a quantitative research method that focuses on the *what*, *where* and *when* an EMAT award mechanism is used, a complete insight of the fundamentals of the value based procurement from a practical point of view is succeeded. However, the connection with the theory is not supported through the employment of the particular research methods and the goal to combine the theory with the practice in a structured model that incorporates both insights cannot be attained (Creswell, J. W., 2003).

This combination though, is an aspect that the traditional evaluation research method offers. In traditional evaluation, an intervention (e.g. a model) is measured against a set of standards that provided from the theory or the practice. During formative evaluation, iterative cycles of development, implementation, and study allow the designer to gather information about how a model is or is not succeeding in ways that might lead to its better design. Then the intervention is ‘frozen’, and the rigorous summative evaluation begins. But research results are not contextualized because they are not connected with the setting where the research is conducted; meaning that the specific research method cannot support the creation of a structured model that exploits the information of the project's environment. This opposes to the need to have a model that is dynamic so that changes and different combinations of information from the project's context can be utilized and applied (Bailin, A., Grafstein, A., 2010).

As a result the design-based research (DBR) comes to be the most appropriate method. Like traditional formative evaluation, design-based research uses mixed methods to analyze an intervention's outcomes and refine the intervention but unlike evaluation research, DBR views a successful innovation as a joint product of the designed intervention and the context. Hence, design-based research goes beyond perfecting a particular product. The intention of design-based research is to inquire more broadly into the nature of learning in a complex system and to refine generative or predictive theories of learning (DBRC, 2003).

In detail, drawing on the literature, Wang and Hannafin (2005) defined the five characteristics of design-based research as are presented in the following Table 3.1.

Table 3.1: Design-based research characteristics

DBR characteristics	Description
Pragmatic	Its goals are solving current real-world problems by designing and enacting interventions as well as extending theories and refining design principles.
Grounded	It bases its application in both theory and real-work context. Theory is continuously developed and elaborated throughout the research process acting as framework for the enacted interventions. In addition is conducted in real-world contexts replete with the complexities, dynamics and limitations of authentic practice.
Interactive, Iterative and Flexible	Requires interactive collaboration among researchers and practitioners. Theories and interventions tend to be continuously developed and refined through an iterative design process from analysis to design to evaluation to redesign. This ongoing recursive nature of the design process also allows greater flexibility than do traditional experimental approaches.
Integrative	Researchers need to integrate a variety of research methods and approaches from both qualitative and quantitative research paradigms, depending on the needs of the research.
Contextual	Research results are connected with both the design process through which results are generated and the setting where the research is conducted.

Hence, the Design-Based Research method exploits the theoretical knowledge studies in regard to the characteristics of the EMAT award mechanisms but demands also the acquisition of information that derive from the practical application of the specific procurement method. As a result the research on real tender case studies of public infrastructure projects are needed in order to contribute to a thorough and wider understanding of the real situation. This way the integration of contextual information in the model can be supported to replete with the complexities, dynamics and limitations of the authentic practice. In the same moment the case studies can recognize at what level the impacts in the society during the project's construction are acknowledged in the evaluation of the bids.

Additionally, the DBR method requires interactive collaboration among researchers and practitioners. In that respect interviews with procurement specialists of the value based procurement can constitute an important source of information both in regard to the practical application of the EMAT award mechanism as well as to the process followed internally during the bid preparation. Their intrinsic knowledge can shed light into issues that cannot be justified by the theory or the studying of the real applications while they can also provide sound empirical ground on the applicability of the proposed model.

Summarizing the above, the intention to develop a model that is structured - follows a process (steps/techniques)- and employs theoretical and practical knowledge in evaluating a project –

applies criteria – means that the research is oriented towards a ‘design-based research’. Thus, together with the literature studies, the knowledge from the real application and procurement experts has to be acquired with case studies and interviews respectively. As a result the deficiencies of the value based procurement and of the bid preparation processes would be identified, while the elaboration of the AHP model would support the intention of focusing to elements which are considered as valuable for the project and the client. In favour of attempting the above considerations and direct the thesis toward the development of a ‘value creation model’, the following research strategy applies (Figure 3.1):

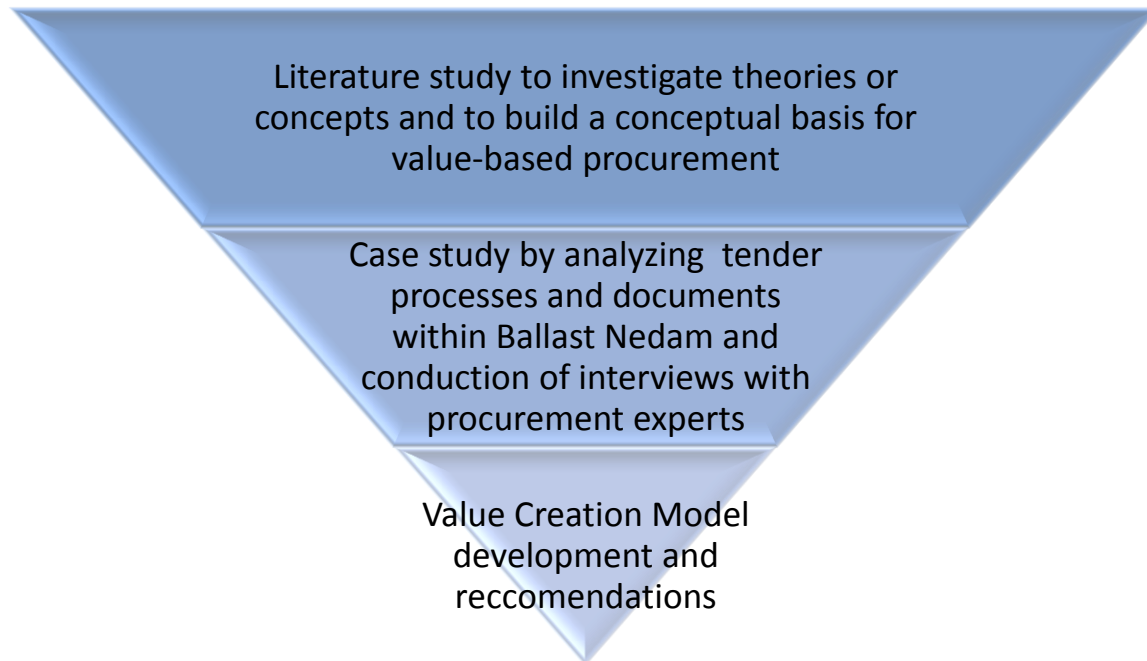


Figure 3.2: Research strategy outlook

Case Studies

Specifically, the case studies include the researching of 9 public infrastructure projects from Ballast Nedam’s archive, for the purposes of identifying the forms of evaluation used within the EMAT award mechanism as well as the most important and characteristic evaluation criteria employed. After performing the case studies, overviews can be made of the phases applied in the particular procurement method in chronologically order together with other characteristics of the studied tenders.

Finally, it should be noted that because a design-based research is applied, the model has to be tested and refined every time new knowledge is acquired. In that respect, its contribution to the enhancement of the bid value would be evident after many applications in the tenders where new useful insights are upgrading its structure. At the moment, for the purposes of providing sound empirical ground on the proposed model, a simulation of an old tender has to be applied in order to see to what extent the model can be understood and operationalized in practice.

3.3 Data collection method

Research methodology employs several different ways for obtaining information. Brinkman (2000) mentions for instance interviews (face to face or telephonic, structured or unstructured), file research (digital or on paper, at location or from distance) or using questionnaire (Dreschler 2009).

Based on the research methodology deployed in the previous section, a file research of past tenders and interviews with procurement specialists constitute the basic sources of information.

Files research data collection approach

Because of the level of detailed required, file research is the best information gathering method for this investigation. By studying 9 past tenders, the detailed information of applied EMAT award mechanisms was gathered through analysis of the relevant procurement documents. A hybrid approach of a quantitative and qualitative research was considered as the most suitable for collecting and evaluating the collected data. In the first level a quantitative approach is applied and once the most relevant parameters have been gathered within a structured frame, the qualitative dimension is added to the research for eliciting the most important data and conclusions.

In respect to the quantitative analysis, because it was considered as important to investigate the evolvement of the EMAT award mechanism in relation to the time, the tender documents were studied with chronologically order. The reason was to acknowledge if there is a tendency in regard to the phases applied in the procurement as well as to the forms of evaluation engaged. In addition, other quantitative information like the number of phases, the number of candidates in each phases, the number of the evaluation criteria for every phase and the number of the evaluation committees were reported.

The next step was the qualitative analyses of the sample in order to study more in-depth the characteristics of the tenders. In that respect, the type of the project was studied in relation to the description of the evaluation criteria while also the coherence between the descriptions of the evaluation criteria for each phase (the success and the award criteria when applicable) was analyzed. Additionally, the respective weights and value scores for every evaluation criteria were reported in order to recognize the importance attributed by the client in respect to their description. Finally, for the tenders that were available the tender results, the scores rendered for each award criterion were assessed in relation to the objective or subjective nature of the evaluation method provided by the client.

It should be noted here, that the 7 of the 9 tender documents were in the Dutch language, meaning that the collection of the information came upon a careful translation of the documents at the first level and a thorough-paced summary notes at the second level. On supporting the later, the interviews were important in order to verify the gathered information beside the acquisition of insight knowledge related to the projects and the EMAT award mechanism in general.

Interviews data collection approach

By using the data collection method of interviewing, intrinsic knowledge and information can be gathered while also they can be affirmed and enhanced the data and clues deriving from the file research. It might be necessary sometimes to come back to a certain question or topic during the conversation and conducting interviews is then the most suitable way in contrast to using structured methods such as questionnaires. Constructing semi-structured interviews, where there is a rough structure but also flexibility to discuss relevant to the topic issues, will lead to broader insights and understandings. At the end, by choosing interviewers with a representative function and position in the project organization, useful data can be collected.

In that respect, where conducted 5 interviews with the tender managers of the respective tenders which were studied initially so that insight knowledge could be acquired for forming focused questions together with other related to the procurement process general questions. Specifically, the interviews lasted approximately 1 hour, while 4 of them were conducted in-house, at Nieuwegein, and 1 in the company's project offices at Pernis.

Finally, regarding the structure of the interview questions, there was a distinction in three categories and namely: the project-specific, the general and the personal opinion questions. Particularly, the project-specific questions intended to verify the information gathered from the file research of the case studies and possible information which were not identified in the tender documents. Next, the general questions were related to the procurement with the EMAT award mechanism and the process of evaluation used by the client. At the end, the questions in respect to the personal opinions are focusing to the procurement method and the work instructions process followed internally. In detail, the complete set of the interview questions are presented in the following Table 3.2.

Table 3.2: Interview questions

A: Project-specific questions
1. What was the type of the project? (DB, DBFM) and what was the type of the procurement process (restricted, open)?
2. Which were the phases of the procurement process (pre-qualification, dialogue 1 or 2, award)?
3. How many participants were qualified to each phase?
4. Which were the success criteria to qualify to the next phase (if applicable)?
5. What was the award method used and which were the award criteria & the ceiling price?
6. What was the grading system for the award criteria? Did we have a fictitious tender price when the value of the award criteria is subtracted?
B: General questions
7. Do you notice changes in the processes followed in relation to past procurement processes using the EMAT award mechanisms?
8. Which are the processes followed more and which are more successful in the concept of transparency and minimum design costs?
9. At what level of the design (percentage) does the contractor has to come in order to answer the selection criteria and qualify to the next phase?

10. What is the design cost (percentage) at this level in comparison to the total design costs in case of tender award?
11. The scores at every procurement phase are provided by different evaluation committees. Can their evaluation be objective or not? Is the framework-method of evaluation set by the client clear? (TRANSPARENCY)
12. If not objective, then how the evaluation committee assigns the scores?
13. Would be possible to predict the score?
14. Are the award criteria described adequately by the client? Are their assigned values realistic? Meaning that the cost for the contractor to “cover” one award criterion is equal or higher in relation to other when both have the same value price.
15. Do always the award criteria have the correct value if compared between each other? Meaning that the client gives values for the award criteria that are coherent with the values of the project. (PROPORTIONALITY so performance is “economically realistic”).
16. “Bidding freedom” is the freedom that a contractor has in order to answer the selection criteria or even the award criteria. Do you believe that there is enough freedom for a contractor to make the differentiation (offer different solutions) or that freedom space is limited? Does he have to describe the function or the solution? Is the design already developed?
17. During the Dialogue Phases/Registration Phase there are few rounds of interviews with the client; what it is discussed during each phase?
18. Do you believe the procurement is transparent when it supposed that the evaluation is on an equal basis, but through the interviews/information meetings with the client there is already a “personal” contact?
C: Personal opinion questions
19. Are there problems at the EMAT award mechanism that make big contractors reluctant to participate?
20. Beside the evaluation process problems is there something that a contractor and the procurer/client could do in order to facilitate the procurement process in total?
21. What a contractor can do in order to reduce the effort put in preparing the bid?
22. Would be possible to streamline the procurement process? Meaning would be possible without interviews and evaluation committees to make the evaluation?

3.4 Sample description

To be able to research how the EMAT award mechanism applies in public infrastructure projects in the Netherlands, what are the characteristics of the particular award mechanism, what are the evaluation criteria and forms provided from the client and elicit the quantitative and qualitative information that can support the objective of developing a model to enhance the bid documentation, a representative sample needs to be selected to work with during this research. Since the set of projects connected to Ballast Nedam represents the most large infrastructure projects in the Netherlands, a representative sample can be formed. The most relevant and complex highway and waterway projects in the Netherlands can be found in this section.

In addition, it has to be reported that because the tender documents were provided by the company, meaning that the available documents are depended on the procurement phase that the company participated, for one project that the design proposal was not succeeded to proceed to the next phase, the level of information is limited.

Specifically, the projects that have participated in this research are listed in Table 3.3.

Table 3.3: Case studies description

Project	Procurement period	Client	Project type	Key informant
LuVe A12. (Utrecht Lunetten – Veenendaal)	Jan. '09 – Sept. '10	RWS	30Km Road expansion, reconstruction and 20 years maintenance	No
A27-A28	Feb. '09 – Dec. '09	RWS	Maintenance and road preparation for expansion	No
Zuid-Willemsvaart Maas	Apr. '09 – Jul. '10	RWS	Creation of a new waterway and care of the surroundings	No
Kargo	Jul. '09 – Jul. '10	RWS	8 Bridges construction	No
MaVa A15. (Maasvlakte– Vaanplein)	Dec. '09 – Nov. '10	RWS	40Km Road expansion, reconstruction and 20 years maintenance. Old bridge demolition and new bridge construction	Yes
Noorwaard	Apr. '10 – Feb. '11	RWS	Realization of summer polders	Yes
Wegen Westland	Jun. '10 – Dec. '10	Province of South Holland	3 Roads construction, 1 road reconstruction and 1 bridge reconstruction	Yes
SAA A1-A10 (Schiphol-Amsterdam-Almere)	Sep. '10 – Apr. '11	RWS	Road expansion and maintenance during execution	Yes
A4 Delft-Schiedam	Nov. '10 – Sep. '11	RWS	Road construction and 8 years maintenance of installations	Yes

4. Findings

In this chapter, the results from the case studies and the interviews are presented. The aim is to elicit quantitative and qualitative conclusions through the consolidation of the information derived from the studying of the 9 tenders and the interviews with the tender managers. However, the ultimate goal from this chapter is to answer the second and the third sub-questions *“Which evaluation criteria are the most important for public infrastructure projects that are procured with the EMAT award mechanism”* and *“Which critical factors related to the project’s objectives and its award criteria can add value to the bid documentation and respectively to the project”*.

Based on the above objectives and research framework set in the previous chapter, the collected characteristics of the studied tenders are presented in the first section while in the following one are drawn the conclusions from the quantitative and qualitative analysis together with the most important findings of the interviews. Finally, in the last section are discussed the background concept for answering the forth sub-question *“Which process can be followed to effectively prepare bids with added value”* as well as the potentials for formulating a model which will correspond in the thesis objective.

4.1 Data description

In order to elicit the information needed for producing quantitative and qualitative conclusions from the case studies, the descriptions of the collected data have to be presented first. However before, some comments in respect to their demonstration are important to be made so that the reader would be able to read properly the complete Tables 4.1-4.9 situated in Appendix 1.

The first to state is that for all tenders there is a separation of the tender characteristics between the phases. In that respect all tenders have a pre-qualification phase during which all candidates are assessed on the grounds of exclusion and suitability requirements as it is imposed by the European Guidelines (2004/18/EC). But, this is not the case for two projects – the A4 Delft-Schiedam & the SAA A1-A10– where different requirements apply. Thus only for these two tenders will be presented the requirements of the pre-qualification phase since for the rest of the tenders are applied the casual ones which are considered of minor importance in respect to the project-specific evaluation criteria cited by the client.

The next point to note is that not all tenders are employing the same number and names of procurement phases beside the pre-qualification phase. So for every tender are presented the phases which lead to the tender award.

Finally, based on the phase of the procurement, different types and forms of evaluation criteria are applied – success or award criteria – in relation to their content but mainly regarding the fact that the award criteria are assigned with a value price so that the tender’s performance can be calculated. Thus for every evaluation criterion, the assigned weight and value price is noted next to it, together with the symbol (S) or (O) that stands for the subjective or objective nature of the evaluation mechanism employed by the client for their assessment.

4.2 Findings and discussion on them

Based on the description of the studied tenders presented in the previous section, the second sub-question which is dealing with the most important evaluation criteria applied in the EMAT award mechanism for public infrastructure can now be answered. However, as it can be understood from the data descriptions, there are two categories of evaluation criteria, the success criteria and the award criteria. Their difference is subject to the procurement phase that they apply but also on the fact that the success criteria have not an assigned value price since they are not decisive for the tender award and thus are not considered in the evaluation technique employed in the EMAT award mechanism. Nevertheless, both types of criteria have to be presented since the notion of the research is to acknowledge which criteria are considered as crucial in public infrastructure projects for the client and thus he employs them as evaluation factors. As it concerns which of them are reasoned as the most important, this is related to the times that were identified in the tenders. Thus the most important evaluation criteria of the tender case studies are presented below:

Most important evaluation criteria

The most important evaluation criteria have been summarized in general categories and in the Table 4.10 are presented together with the titles identified within the tender guidelines as demonstrated in the previous section. In addition in the Table 4.11 are cited the general evaluation descriptions of the evaluation criteria in order to acknowledge the objectivity or subjectivity of the applied mechanisms. Specifically, when the quality of a criterion described in the tender is objectively quantified directly along a ruler in the form of a performance unit then this is called **performance criterion**. Also it is important to note that tender by tender may present small differences on the evaluation descriptions and the scope of the Table 4.11 is not to provide their complete descriptions but rather to acknowledge a general evaluation framework. Finally, for all the criteria, the client takes into account for evaluation the degree to which the contractor's positions are described according to **SMART** principles, meaning: specific, measurable, acceptable, realistic and time-bounded.

Table 4.10: The most important evaluation criteria identified in the studied tenders

General Evaluation Criteria	Described Evaluation Criteria
Traffic nuisance during development period (x8)	<ul style="list-style-type: none"> -Traffic Regulations (Flow Measures) -Reduce nuisance during construction - Minimize traffic nuisance in the road - Transportation nuisance - Minimize disturbance - Limiting traffic nuisance
Sustainability (x6)	<ul style="list-style-type: none"> - Sustainable business operations/ Sustainable project execution - Environmental pressure during construction/ Energy/ Sustainable resource management/ Sustainable contractor organization - Environmental Management (Process to minimize disruption) - Sustainable tendering

	<ul style="list-style-type: none"> - Sustainable works - Sustainable procurement
Project Management (x5)	<ul style="list-style-type: none"> - Public-oriented Management - Project control
Collaboration & Role Distribution (x4)	<ul style="list-style-type: none"> - Cooperation between client & contractor (Project Vision, Client & Contractor interests, Contractor Organization) - Cooperation & Organization
Risk Management (x4)	<ul style="list-style-type: none"> - Risk distribution - Risk Management Plan (10 Risks for the contractor & 10 Risks the client)
Local disruption during development & availability period (x4)	<ul style="list-style-type: none"> - Reduce nuisance during construction/Dealing with nuisance - Construction nuisance - Minimize disturbance to companies (stakeholders)
Traffic nuisance during availability & maintenance period (x3)	<ul style="list-style-type: none"> - Reduce nuisance during maintenance control
Licensing Management (x2)	<ul style="list-style-type: none"> - Timely obtainment of building permit/opening permit
Technical Management (x2)	

Table 4.11: The evaluation description of the most important categories of evaluation criteria

General Evaluation Criteria	Evaluation description
1. Traffic nuisance during development period (Performance Criterion)	<p>The evaluation committee bases its rating on the overall picture of the quality of the proposed plan for keeping (the experience of) traffic nuisance to a minimum. Quality in this context is defined the degree to which the traffic nuisance is kept to a minimum.</p> <p>Aspects that play a role are: the degree to which the duration of traffic nuisance resulting from the Works is kept to a minimum, the degree to which the intensity of traffic nuisance during the Works is kept to minimum and the Point in time as of which greater capacity is made available to traffic. The candidate must calculate the number of lost vehicle hours (LVC) resulting from a Traffic System or Penalty-free Closure by means of the Traffic Nuisance in Development Phase Calculation Model.</p>
2. Sustainability (Conditionally Performance Criterion)	<p>The evaluation committee bases its rating on the degree that the infrastructure is realized and is kept available in a sustainable way - this includes accountability with material use, energy use, etc – with respect to the tendering processes, business operations policy and project execution measures.</p> <p>In some case studies, the degree to which the candidate after award wishes to commit itself to the implementation of the sustainability shall be established by submitting an environment score through the use of the DuWo calculation model. Contractor fulfil its obligation with regard to</p>

	Sustainability, if it can demonstrate, after actually having executed the Works, that, based on the material, work methods, measures etc , actually applied, with the aid of the DuWo calculation model, it has achieved an environment score that is at least equal to, or else lower than, the environment score that was offered.
3. Project Management	The evaluation committee bases its rating on the degree that the extent to which the proposed approach described in the project management plan, the objective of the client is achieved. In addition are assessed the degree of robustness, idegration and consistency of the descriptions in the PMP and with other tender products.
4. Collaboration & Role Distribution	The evaluation committee shall base its rating of the overall picture of the quality of the Basic Management Plan – the document produced to deal with the criterion. Quality is the degree to which the proposed BMP outline contributes to outstanding performance on the part of the Contractor. Thus, the interests and the position of the Client are grasped and supported to a maximum degree. The evaluation committee shall also take into account the consistency of the criterion in relation to the other evaluation criteria.
5. Risk Management (Performance Criterion)	The evaluation committee bases its rating on the degree that the risk management plan describes with completeness and consistency how risk management is performed in terms of moments that risk assessments are carried out, how is risk management in the organization, what is included in the risk management processes implemented and how is ensured effective interaction with (sub) processes. The contractor has the options to distribute listed risks as compensation event (client risk), delay event or contractor risk with defined increments on the tender price and adjustments of the ceiling price.
6. Local disruption during development & availability period	The evaluation committee bases its rating on the overall picture of the quality of the proposed plan for keeping the burden on the surroundings to a minimum . Quality in this context is defined the degree to which the burden, not classifiable under Traffic Nuisance, placed on the surroundings is kept to a minimum. In addition are assessed the quality of the analysis of the factors that cause nuisance and the effectiveness of the management measures.
7. Traffic nuisance during availability & maintenance period (Performance Criterion)	The evaluation committee bases its rating on the overall picture of the quality of the proposed plan for keeping availability to a maximum and keeping (the experience of) traffic nuisance to a minimum during the availability and maintenance period. Aspects that play a role are: the degree to which the (experience of) traffic nuisance during the availability period is kept to a minimum and the degree to which availability is maximized during the availability period. The candidate must calculate the number of nights per year in the availability phase in which planned Lane Closures are used and the number of Penalty-Free Closures in the same period by means of the Traffic Nuisance in Availability Phase Calculation Model.
8. Licensing Management	The evaluation committee bases its rating on the overall picture of the quality of the proposed licensing management plan . Quality in this

	context is defined the degree to which the risk on not obtaining a building/opening permit on time is kept to a minimum. Also are evaluated the methods which through a proper coordination with internal disciplines, client and external stakeholders is provided in a timely acquisition and compliance of the permits.
9. Technical Management	The evaluation committee bases its rating on the overall picture of the quality of the proposed technical management plan . Quality in this context is defined the completeness and consistency of the phasing plan per requirements and of the verification plan on meeting the requirements.

In addition to the identification of the most important evaluation criteria and the description of their evaluation, valuable conclusions are drawn from the quantitative and qualitative analysis. Due to confidentiality, not all conclusions can result from the data descriptions provided in the previous chapter. Nevertheless the most considerable conclusions are the following:

Quantitative analysis findings

- In all projects, the management for traffic nuisance during the development period is assessed.
- In 5 tenders, there are 1 general and 2 individual meeting available to the candidates during the first dialogue phase. In the rest 3 tenders, there is 1 general meeting and a period for individual.
- In the half tenders, the procurement process involves 2 dialogue phases beside the pre-qualification, while in the other half there is only one, the registration.

Qualitative analysis findings

- The 5 of the 9 tenders employ two procurement phases, namely the pre-qualification and the registration phase. In addition, there is a tendency based on the chronologically order of the tenders, that the procurement is adopting the process of these two phases.
- The majority of the success and award criteria are evaluated subjectively. There is no model or described method to assess the performance. The performance criteria are only those dealing with the numbers of nights' closure of road and the selection of the risks assumed by the contractor with sometimes also the use of sustainable principles.
- In three tenders a ceiling price is set by the client. At the two of them, the initial tender price offered by the candidates is around 20% lower than the provided ceiling price.
- The majority of the evaluation criteria (both success and award criteria) are of managerial or technical nature or demand technical solutions. Only the 6th criterion is dealing with aspects of the project's local environment.
- In all the projects that tender results were available:
 - ❖ The winner with the lowest fictitious tender price (Tender price – EMAT value price) had the highest quality score (EMAT value), with the first or second lowest

initial tender price. Similar conclusion is drawn by the study made by RWS in respect to the EMAT award mechanism².

- ❖ In 5 tenders, Ballast Nedam achieved less than 50% of the maximum EMAT value price and only in one achieved around 60% of the maximum EMAT value price.
- ❖ All final candidates score relatively high in the award criteria of traffic nuisance and risk management where an objective evaluation technique is available.

Interviews' findings

Finally, together with all the previous valuable conclusions, the results from the interviews can also be presented in order to acknowledge some of the issues that interviewers consider as important. Because of confidentiality issues the names of the interviewers are not provided but only some arguments that are relevant to the thesis. The concerning results from the interviews are:

- The EMAT value price assigned to the award criteria by the contractor is usually around the 50% of the ceiling price. This can be used as guidance for tenders that does not provide a ceiling price. In general the percentages between EMAT value price and tender price are 50/50 to 40/60.
- Because usually the evaluation score is between 6-8 (in the scale of 5-10), the difference in EMAT value price between the evaluation scores is translated in an amount that is relatively small when compared to the tender price. Thus the EMAT value score is not decisive if the tender price can recover the low EMAT score.
- In the latest tenders where only a registration phase applies, there were no competitive dialogues to discuss with the client, but only informative meetings as a result to be difficult for the contractor to understand what client perceives as valuable.
- Reduce of tender phases in the latest tenders is beneficial for cost and time parameters for both the contractor and the client. But although there is attempt to make procurement process faster, the quality is lowered when considered that there are no competitive dialogues and the time of design and preparation is smaller.
- Ballast Nedam goes for normal tender prices with normal profit and risk. This means that Ballast Nedam has to score high in the EMAT award criteria in order to acquire a low fictitious tender price and have higher chances of winning the tender.
- Usually the majority of the candidates achieve around the 50% of the total EMAT value price.
- It is important to think where there are options to achieve a competitive advantage and be better from the competitors when setting the tender strategy. In that respect it is important to find critical points of value creation from the beginning of the process.
- There is a limited time for in-house evaluation of the tender quality documents. If there would be that possibility, this should be from the first phase of tender in order to take the proper strategic decisions.
- There is a limited interaction between the design team that deals with the technical aspects of the tender and the “value” team that is responsible for the preparation of the

² Innovatieve marktbenadering brengt versnelling - Interne evaluatie innovatieve marktbenadering spoedaanpak, RWS, 2010.

tender value documents. In addition, the “value” team prepares the tender value documents after the design decisions have been taken and usually this is one-way connection resulting in restricted feedback to the design team.

Summarizing the findings from this section, very important and valuable conclusions can be drawn. Starting from the answer of the second sub-question “*Which evaluation criteria are the most important for public infrastructure projects that are procured with the EMAT award mechanism*”, Table 4.10 gives a complete answer, where both success and award criteria are presented in the attempt to acknowledge what the client perceives as valuable for public infrastructure projects. When combined with the Table 4.11 it becomes clear that the hesitancy of the client to apply the EMAT award mechanism has some basis. Beside few evaluation criteria, the majority of them are difficult to be assessed objectively, resulting in inefficiencies and extra work because of difference on perception between the client and the contractor as was discussed in the problem analysis of section 1.2. In addition, this lack of clarity is strengthened when informative meetings are only available in the procurement process like in the last studied tenders.

Maybe that lack of clarity on evaluation and on the perception of the value is the reason that most tenders achieve the half of the provided EMAT value price. In addition if it is considered the fact that most tender prices are 20% lower than the ceiling price, it is justified the desire of the client to pay more for higher value. But the critical point is, whether the extra costs associated with the increase of the EMAT value are in a level so that when the EMAT value price is subtracted from the initial tender price, the fictitious tender price is the minimum. When the above are combined with the interviewer’s arguments that Ballast Nedam goes for normal tender price and that the winners of the tenders achieved the highest EMAT value, it can be concluded that special attention should be given to the quality documents of the bid.

However based on the importance to set the tender strategy from the beginning of the tender as it is obvious and was argued also by the interviewers, it becomes evident the need to identify critical factors related to the project’s objectives and the award criteria which can direct the focus of the strategy and can add value to the bid documentation until the evaluation criteria, if possible, clarified during the procurement process. In particular, this approach should be employed from the first phases of the tender in order to acquire a competitive advantage in relation to the competitors as it was discussed by the interviewers.

But then the third sub-question rises and in particular, which can be these critical factors that are considered as valuable for any project beside the ones defined by the client. The answer is provided by one qualitative conclusion which states that the majority of the success and award criteria are of managerial or technical nature or have technical solutions. This implies that there is no proper consideration to aspects of social nature related to the impacts of the project in the area which are evident in any urban development and have to be appraised as important for any public authority like the RWS. In that respect the focus of the tender strategy should be related beside to the technical approach to deal with the quality value, also to the mindset used for acquisition of this quality. The reasoning lies on the fact that construction activities can have significant impacts on their ‘environment’ as was explained in section 2.3, which are not of technical nature or with a technical solution.

As a result, a ‘construction social-impact assessment’ approach has to be included in the evaluation of the projects, describing the process associated with the protection of the social, natural and economical environments. But since this approach is not supported by the current evaluation process applied by the client (public authority) during the procurement, it can constitute a path of creating a competitive advantage for Ballast Nedam.

In that respect the additional critical factors will emerge from Table 2.2 which are summarizing the causes and impacts in the social environment during the project construction. The added value on the bid documentation will result from the incorporation of aspects which are considered important for the social responsibility of the client in the “micro-level” of the society and which are not defined in the tender guidelines. The identification of the critical factors in relation to the social concern becomes the key to an evaluation which considers the social impacts together with the evaluation criteria and their managerial and technical concerns, towards the achievement of added value through a shift of the mindset during the design into a more socially sustainable construction direction.

4.3 Need for a model

Having identified the path of creating competitive advantage for Ballast Nedam through the employment of critical factors which can add value to the bid documentation, the next step is to find the way to combine this approach to the tender work instructions followed. Thus the final sub-question “*Which process can be followed to effectively prepare bids with added value*” can be answered. However, before, there is a need to create a structured methodology or model that can exploit the advantages of this approach. Through the use of the model, Ballast Nedam should be able to direct the strategy focus on aspects that can provide added value to the bid documentation.

All in all by developing the intended model and then adjusting the tender work instructions to include also its elaboration, the final sub-question but also the thesis objective and consequently the main research question “*In what ways Ballast-Nedam can effectively prepare bids with added value for public infrastructure projects which are procured with the EMAT award mechanism?*” can be answered.

5. Value Creation Model

In this chapter the model to support the creation of more effective and competent bids which can deliver added value to the client and thus increase the possibilities for winning more tenders as the ultimate goal of the thesis is going to be presented. Starting with its background framework in section 5.1, the model is then described in section 5.2 while its advantages are also discussed. Later on, in section 5.3 the integration of the model within the current tender work instructions for the enhancement of the bid proposals is justified. Finally, in section 5.4 a simulation of the model's preparation steps for the past tender A12-MaVa is presented and the results are discussed in the last section 5.5.

5.1 Model's framework

Based on the design-based research framework of the thesis discussed in chapter three, the model should be able to take into consideration both the theoretical knowledge and the project's contextual information. In that respect, it should be possible to use the Table 2.2 of section 2.3 with the causes and impacts of the construction in the social environment as additional critical factors which are relevant to the project's objective and the evaluation criteria of the client, while it can also consider the information that derive from the context of the project.

In addition, the model should be dynamic so that complexities and limitations of the real situation can be incorporated and changes of the information or of the strategy can be applied for acquiring better results. In the same time it is crucial to achieve an interactive collaboration among the researcher and the tender participants so that their intrinsic knowledge can be incorporated and a collective knowledge in respect to the tender can be succeeded.

Furthermore, it is very important for the model to achieve the thesis objective and “formulate focus points for value creation of public infrastructure project's bid documentation”, meaning that it has to be able to produce a priority list based on importance ranking of the critical factors. This list should include the most relevant to the project critical factors of social concern that can be used as focus points during the tender and can add value to the bid documentation by their elaboration.

However, although the priority list and the focus points can be valuable foundations for a better tender strategy, the essential is to support the creation of added value for the bid documentation and reasonably increase the chances for winning the tender. Thus the model should support the evaluation of this information by filtering it through a social perspective in order to develop measures to mitigate the construction impacts on the social environment. Meaningful in that point would be also the ability of the model to incorporate the costs for employing the mitigation measures and if possible together with the costs of the provided technical design solutions.

Finally, after all the information and measures are known, their involvement in the bid documentation is the final step for creating the added value. In that respect the model has to define the process to incorporate the valuable aspects of the previous steps in the documents and justify the creation of the added value.

5.2 Model description and its advantages

After the analysis of the model's framework in the previous section, the model can now be defined based on the description of its most important elements. From the previous discussion it is concluded that the model applies 3 phases namely: the preparation phase where the model's structure is set based on the theoretical knowledge and the project's contextual information, the evaluation phase where the complete information are assessed in order to be used for the last value creation phase where the valuable aspects of the previous phases are incorporated in the dib documents. In particular, every phase has 4 steps constituting a structured model of 12 steps which are presented below:

4 Preparation Steps

1. Study of the tender guidelines and the client's specification of requirements.
Identification and description of the most important construction processes from the global Work Breakdown Structure (WBS) developed for each alternative design solution.

In this first step the valuable aspects of the project are defined while also its context is set in order to acquire a better insight for the social environment of the development. In the same time the main construction processes of the design solution are determined so that their potential impacts on the society can be acknowledged later on.

2. Identification of the most relevant *causes* of social impacts for the whole structure in relation to the construction processes of the project.

In this second step the potential causes of impacts at the project's environment because of the construction, are selected from Table 2.2 of section 2.3 The choice of the most relevant causes is made in relation to the construction processes of the design solutions that may generate them.

3. Identification of the most relevant *effects* of social impacts for every construction process or section of the project which are related to the alternative design solutions.

Like in the previous step, the potential effects of the construction at the social environment are selected from Table 2.2. The choice of the most relevant effects is made in relation to the causes of the social impacts while they are described in general since not many design information are available at this point.

4. Execution of a tender team session to produce a list of the most important causes and effects of social impacts in relation to each alternative design solution and project environment.
Selection of the most important, for example the first 5, social impacts to use as focus points during the next steps of the design (use of AHP).

In this final step of the preparation phase, the tender participants are collaborating in a team session in order to provide their knowledge in respect to the project and conclude on the most important causes and effects of impacts that the construction processes of the alternative design

solutions can have on the social context. The elaboration of all the previous information together with the intrinsic knowledge of the participants are worked out with the Analytic Hierarchy Process model in order to produce the list of preference ranking of the most critical social impacts that have to be examined and mitigated later on.

4 Evaluation Steps

5. Use of marketing techniques and social studies knowledge to get the social-public feedback in relation to the selected social impacts of the alternative design solutions.

After the selection of the most important causes and effects of social impacts from the previous phase, information over the perception of the citizen from the project's context have to be gathered. Because the contracting authority does not permit any contact with the society before the tender award, public involvement processes cannot be applied at this phase. Thus the evaluation of the present living environment and the relative importance of the social impacts has to be made through i.e stakeholder analysis, SWOT analysis and the research of studies and articles related to the respecting environment.

6. Quantify the costs of the selected social impacts if possible.
Calculate the costs dealing with the social-public feedback always in relation to the award criteria and the technical design solutions.

Based on the type of the impact and the availability of an evaluation techniques from those described in section 2.3.1, the costs of the selected social impacts are quantified and calculated. The goal is to define a cost reference for the impacts in the society so that can be compared with the costs of the mitigation measures and/or the costs of the alternative design solutions to avoid their presence.

7. Develop a set of measures to mitigate the selected impacts by taking into consideration the social-public feedback (step 5) and the calculated costs of the impacts to the society (step 6).

In order to mitigate the effects of the impacts to the society, measures have to be developed for every case or in combination. The measures should exploit the information gathered in respect to the perception of the citizen for the impacts and their costs so that it can be supported the selection of one mitigation measure over another.

8. Use trade-off matrices of the costs of technical design solutions together with the set of the mitigation measures in order to select the one or two potential design solution to further elaborate and take decisions for the strategy to follow.

In the final step of the second evaluation phase, the preparation of trade-off matrices with the costs of the technical design solutions on the one side and the costs of the mitigation measures on the other side assists the tender team on continuing the design funnelling with focused elaboration on the critical factors of the social impacts which can provide more value to the project in respect to the social responsibility of the client (RWS).

4 Value creation steps

9. Imitate the evaluation process of the client.
Assess with an evaluation team the “quality” documents produced based on the decisions made to deal with the social impacts of the design proposal(s).
Provide comments from the evaluation.

After the development of the selected design solution(s) produced with concern to the impacts of the construction to the society, the quality documents are assessed by the evaluation team by employing the procedure followed within the EMAT award mechanism.

In respect to the evaluation team, compose it with relevant experts on the different disciplines related to the award criteria who have no prior detailed information for the project at stake. In addition exploit the internal personnel by employing tender managers in the evaluation team for reasons of:

- Document confidentiality
- Reduced costs in respect to evaluate the documents with external experts
- Collective knowledge creation for the project over all the tender managers

10. Use a spreadsheet to calculate the EMAT value price based on the scores of the evaluation team for the different award criteria.

The evaluation team assigns scores to the “quality” documents and with the same weights and value prices as have been applied by the client, is calculated the EMAT value price in order to set a reference point of comparison to the later steps.

11. Based on the results of the EMAT score (step 10) and the comments of the evaluation team (step 11), and by taking into account also the social and technical outcomes of the trade-off matrices (step 9) direct better the focus of the design proposal(s) into design solutions that can result in higher added value with minimum costs.
12. Re-evaluate the adjusted “quality” documents with a 2nd evaluation session and re-calculate the EMAT value price in order to make the final adjustments, take final decisions and prepare the final design proposal.

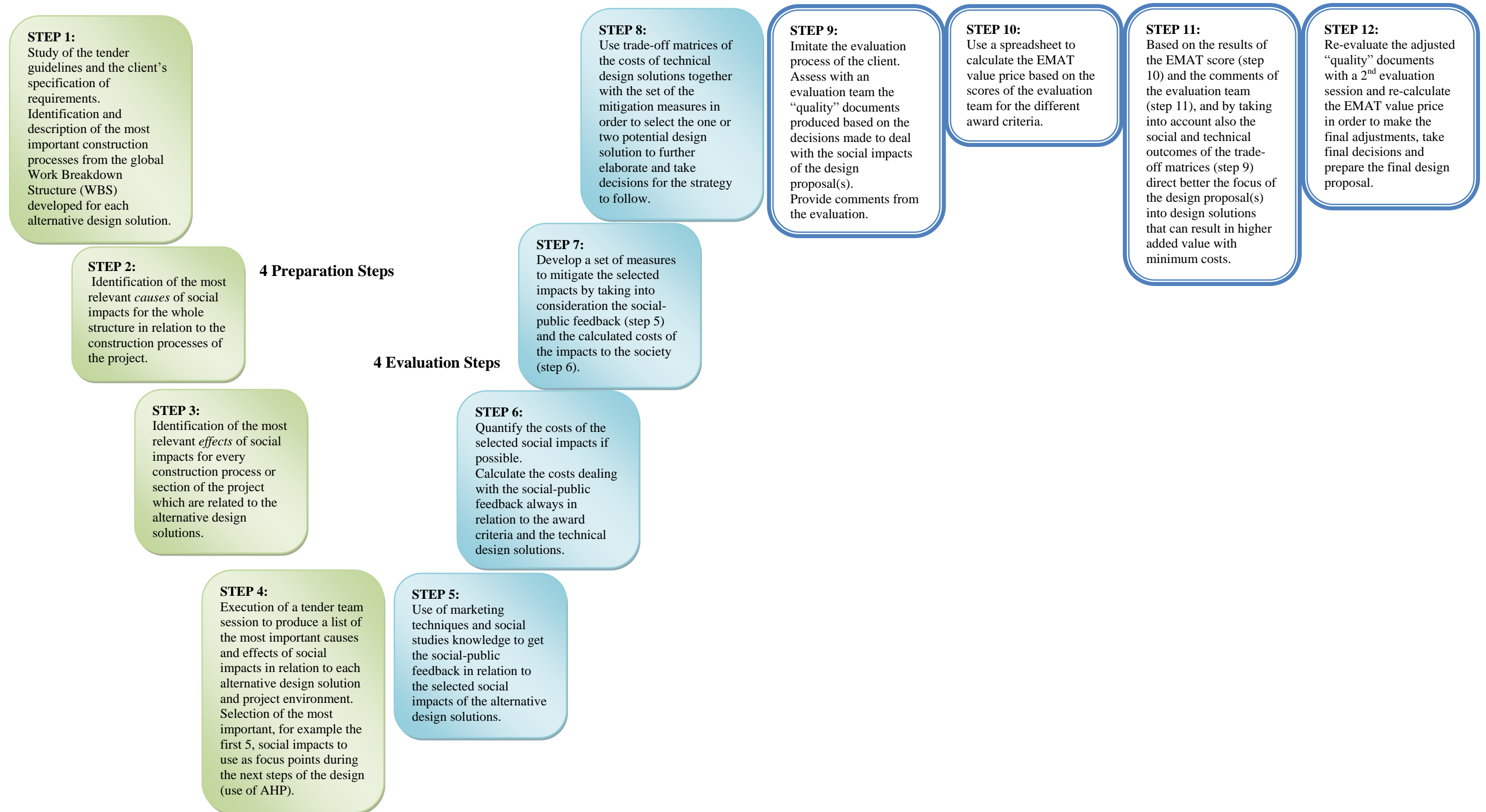
Through the application of the above 12 steps from the tender team, the creation of added value of the bid documentation is expected to be achieved. The model is based on the exploitation of the information deriving both from the project’s context and the participants’ knowledge. With the collaboration of the tender team’s members and the cooperation of the design team with the team responsible to produce the “quality” documents, the model takes advantage of the intrinsic and explicit knowledge to focus on critical factors of social concern that can add value to the project. However, it is very important as well to adjust the current tender work instructions of Ballast Nedam so that the structured model can be elaborated effectively within the tender process.

Model's Characteristics

- It employs a structured methodology with 12 steps within a preparation phase, an evaluation phase and a value creation. It has a start and an end.
- It exploits both scientific knowledge as well as information from the project's context.
- It provides a collaboration session between the tender team and procurement experts so that intrinsic and explicit knowledge and information in relation to the tender can be identified.
- It combines the evaluation criteria set by the client with critical factors of social concern that can be used as focus points during the tender and add value to the bid documents by their elaboration. In that respect it considers the social impacts together with the evaluation criteria and their managerial and technical concerns.
- It creates a competitive advantage for Ballast Nedam by taking into consideration factors which are considered important for the social responsibility of the client in the "micro-level" of the society and which are not defined in the current tender guidelines.
- It employs a process (AHP) to prioritize the critical factors in relation to the social concerns so that time and resources can be exploited with priority.
- It can be used from the very beginning of the tender in order to support the tender strategy decisions.
- It can be used iteratively during the tender to enhance as much as possible the strategy and the design proposal.
- Finally, it provides a structured procedure so that Ballast Nedam can convince the client that it is capable of delivering added value of the development for the standing bid price and can prove it.

The 12 steps of the Value Creation Model are illustrated in the following Figure 5.1

Figure 5.1: The Value Creation Model



5.3 Model's integration within tender work instructions

For the value creation model (VCM) presented in the previous section, it is of utmost importance to be embedded within the tender work instructions followed by Ballast Nedam at the moment. The reasoning lies with the fact that both processes are followed during the tender period, and the pieces of information needed for the VCM are produced during that period. In addition the enhancement of the design proposals that VCM focuses on has to be achieved before the assembling and delivery of the Proposal Package, meaning before the second from the end step of the work instructions as have been presented in section 2.5. In that respect and in order to have an effective application of the VCM with the expected results, its steps should be applied in correlation to the work instruction and the interaction points between the two processes are presented below:

1st Interaction Point: Step 7: Develop ideas at high level (of work instructions) – Step 1 (VCM)

In the first step of the model, the valuable aspects of the project are defined together with its context, while the main construction processes of the design solutions are determined. The determination of these main construction processes results from the WBS of the most likely to succeed 2 or 3 solutions as it is described in step 7 of the work instructions. However, the selected solutions should be developed by addressing together with the main aspects (Cost forecast, Construction schedule, Work methods and Project risks which are described in this step), also the broad social causes of impacts during the construction process.

2nd Interaction Point: Step 8: Select most favourable solution(s) and Step 10: Develop selected solution(s) (of work instructions) – Steps 2 to 11 (VCM)

During the elaboration and development of the design proposal(s) based on the steps 8 and 10 of the tender work instructions, there is a parallel process of identification of the social impacts, their costs and the potential mitigation measures as the steps 2 to 11 describe in the VCM.

Together with the trade-off matrices used at the tender design phases, as described in the work instructions, are produced the trade-off matrices of the social impacts in order to take decisions and set the strategy to follow. Thus the focus is not only based on the technical solutions but also on the social impacts that design solutions have during the construction, attempting the value creation through a socially sustainable development.

3rd Interaction Point: Step 11: Final selection of design proposal and Step 13: Develop design proposal (of work instructions) – Step 12 (VCM)

The assessment of the value documents and the EMAT scores from step 12 of the model are used to support the final selection of the design proposal. In the same time the produced outcomes of the steps followed during the application of the VCM are documented in order to support “SMARTly³” the mitigation measures and their incorporation in the development of the bid documentation.

³ SMARTly: with specific, measurable, acceptable, realistic and time-bounded way

5.4 Validation of the Value Creation Model

After structuring and describing a model, the next step is to validate its applicability in the real situation. The purpose from academic point of view is to see to what extent the model can be understood and operationalized in practice(s). This can be achieved either by presenting the model to procurement experts or by attempting to simulate its steps in a real situation. For the purposes of this research thesis both methods were followed.

5.4.1 Validation with procurement experts

In the case of validating the model with procurement experts, the model was described and presented at two tender managers and the head of tender management within Ballast Nedam as well as to a professor of the university with extensive knowledge on procurement mechanisms. The research's objective was first explained and defended in order to provide the necessary background information and then an illustrative presentation communicated the model's steps and its key concepts. At the end, a set of 10 statements were handed out to the participants for providing their personal opinion with 5 options of strongly disagree, disagree, neutral, agree and strongly agree which intend to support the validation of the model. The following Table 5.1 presents the statements that were asked to be answered by the procurements experts.

Statements
1. Is the Value Creation Model (VCM) easy to understand?
2. Is the VCM structured with clear separation of the phases?
3. Is the VCM easy to implement?
4. Can the VCM be applicable for any public infrastructure project procured with the EMAT award mechanism?
5. Can the VCM support the tender management and strategic decisions?
6. Can the VCM provide indeed added value on bid documentation?
7. Can the VCM be used for justifying the added value to the client?
8. Is the VCM dynamic so that complexities and limitations of the real situation can be incorporated and changes of the information can be applied?
9. Can the VCM be applied iteratively during the tender process to guide the tender strategy?
10. Can the VCM be applicable for integrated projects that Ballast Nedam tenders and which are procured with the EMAT award mechanism?

From all the experts, the feedback was very positive. It was argued that it is easy to understand the model and presents a well structure with clear separation of the 3 phases. In addition all experts consider that the model can easily be followed and implemented. Further, there was a difference on the opinions for the applicability of the model in any public infrastructure project procured with the EMAT award mechanism. The 3 experts agree with the statement but the one disagrees on the fact that project by project the evaluation criteria are different and there may be cases that many criteria are related to the construction period and thus can be utilized in the

model and other cases that its applicability is limited because on other focus of the evaluation criteria applied from the client. Also the possibilities for changing the EMAT award mechanism in the future challenge its applicability but that is an issue of the future and potentially with the correct adjustments the value creation model can remain valid. More, all experts agree uniformly that the model can support the tender management and strategic decisions which is very important statement in respect to the thesis because a main interest is to create focus points and enhance the tender strategy. Another important statement is that 3 of the experts agree and one has neutral opinion on the belief that the model can indeed provide added value on the bid documentation while the 3 experts agree and the one strongly agrees that the model can also be used for justifying the added value to the client which is also very important for the thesis' scope. Additionally the experts agree that the model can be dynamic to adapt changes of the project's context as well as that can be applied iteratively during the tender to guide the team from the first discussions up to the final decision proposal phase. Last but not least the 3 experts agree and the one strongly agrees that the model can be applicable also in integrated projects like building, energy, infrastructure and other types of projects that procured with the EMAT award mechanism, meaning that the model can become even more valuable.

All in all the procurement experts argued that the model can be applied in real tendering and have very valuable effects on the bid documentation. They pointed the importance of employing the impacts of the construction processes in the society as critical factors of focus points during the tender which can indeed offer added value to the project and in the case of a public client like Rijkswaterstaat provide also higher scores in the assessment.

5.4.2 Validation through simulation of a past tender

However, beside the presentation of the model to the procurement experts, it was consider as equally important for the purpose of this thesis, to apply the model in a real tender. Because of time parameters, it was selected to use a past tender and specifically one of the case studies, namely the A15 MaVa (Maasvlakte–Vaanplein) road project. But in the case of simulating a past tender, not all steps can be applied. In particular, the simulation involves the first preparation phase of the model since the next phases cannot be applied in a static environment. The reason is that the evaluation and the value creation phases of the model need the dynamic context that is developed during the tender. During the simulation cannot be available the alternative design proposals which were discussed and elaborated in the time of the tender while also the interaction and elaboration between the participants is not feasible. Thus the technical solutions of the alternative designs cannot be evaluated together with the selected social impacts of the first phase and the outcomes from the application of the model's steps that will enhance the quality and respectively the value of the bid documentation cannot be achieved. Considering all the above details and clarifications, the 4 first steps of the value creation model are presented below.

Step 1:

“Study of the tender guidelines and the client's specification of requirements.

Identification and description of the most important construction processes from the global Work Breakdown Structure (WBS) developed for each alternative design solution.”

Based on the guidelines of the tender, the evaluation criteria and their weights and specifically the success criteria used in the 1st Dialogue Phase of the procurement as have been presented in Table 4.5 of section 4.1., are the following:

- Collaboration & Role Distribution (35%)
- Traffic Impediment during Development Period (50%)
- Traffic Impediment during Availability Period (15%)

However, because the concept of the model is based on the causes and effects on the social environment during the development period, the last success criterion is considered as inapplicable to be included in the model. In that respect, its weight is equally distributed to the other two criteria which are assigned at the end with a 42.5% and 57.5% weight.

Furthermore from the studying of the client's specifications, the WBS of the projects presents the following 4 construction processes as the most crucial:

- Road widening
- Construction of viaducts
- Old bridge demolition
- New bridge construction

As for the details of the project's context from the study of the tender documents, the client's specifications and the internet research, the following are known about the project and its environment:

- The project is executed in a business area where there are present mainly Chemical, Oil and Energy related industries.
- The project is in close proximity to the Rozenburg and Hoogvliet boroughs, and the Spijkenisse, Brielle and Barendrecht municipalities.
- The project is executed close to the Oudellanse Park at Hoogvliet, green spaces around the Benelux tunnel and the Drechterweide Park at Oud Charlois.
- There is special interest in respect to noise at: the Rozenburg and Hoogvliet boroughs, and the Spijkenisse, Brielle and Barendrecht municipalities.
- There is special interest in respect to accessibility at: the Rozenburg and Hoogvliet boroughs, the Barendrecht, Albrandswaard and Rotterdam municipalities and the South Holland Province.
- There is special interest in respect to physical nuisance at: the Spijkenisse, Albrandswaard and Barendrecht municipalities, and the Hollandse Delta Water Board.
- In all these areas beside the main road construction there are secondary viaducts to be constructed like:
 - ❖ The Welplaatweg viaduct between chemical and oil related businesses has to be widened.
 - ❖ The new pillars for the Oudeland viaduct have to be realized.
 - ❖ The demolition and installation of viaduct pillars in the Vaanplein have to be realized.

Step 2:

“Identification of the most relevant *causes* of social impacts for the whole structure in relation to the construction processes of the project.”

Based on the list with the categories of causes described in Table 2.2 in section 2.3 and in relation to the 4 main construction processes identified in the project, the broad causes of social impacts are the following:

- Noise
- Dust/Air pollution
- Vibration
- Water pollution/disruption
- Proximity to recreational facilities
- Construction traffic
- Detours
- Visual inconvenience

From the list are excluded the two categories of utility cuts and soil/public space pollution because it is not expected to have utility cuts of pavements since the works involve new road construction while the type of the project is not considered as pollution prone.

Step 3:

“Identification of the most relevant *effects* of social impacts for every construction process or section of the project which are related to the alternative design solutions.”

Based on the Table 2.2 in section 2.3, the effects of social impacts which are related to the construction processes and are coming from the categories of the causes of impacts selected in the previous step, are the following:

- Productivity reduction of working personnel in the industries due to reduced concentration as result of the noise.
- Reduction of values of real estate in the near urban areas due to noise, dust and construction traffic.
- Electrical and mechanical damage to equipment of the industries due to vibration and dust.
- Respiratory illnesses, increase of human stress levels and mental health due to noise and dust.
- Property damage due to vibration and soil settlement.
- Loss of income for retailers and businesses due to changes in the traffic patterns i.e petrol station
- Reduced accessibility of recreational facilities due to the construction processes.
- Increased fuel consumption due to traffic congestion and construction traffic.
- Reduction in tax revenues due to lower municipal revenues i.e. ticket fines.
- Accelerated deterioration of the secondary road due to the forwarding of traffic as a result of the changes in the established traffic patterns.

Step 4:

“Execution of a tender team session to produce a list of the most important causes and effect of social impacts in relation to each alternative design solution and project environment.

Selection of the most important, for example the first 5, social impacts to use as focus points during the next steps of the design (use of AHP).”

At this step the tender team is working together during a session in order to share their intrinsic and explicit knowledge in respect to the tender, and a selection list of the most relevant causes and effects of social impacts can be prepared with the use of the AHP. However because that option is not available, for the purposes of the thesis the whole process has been executed, with the use of the Expert Choice 11 software⁴, by the writer based on personal opinions and knowledge acquired from the studying of the tender guidelines and the information gathered in steps 1, 2 and 3. Thus, below are presented the actions followed during the elaboration of the AHP as would be ensued during the session:

- Action 1: Model the problem as a hierarchy consisting of the decision goal, the alternatives for reaching the goal, and all the criteria and sub-criteria for evaluating the alternatives. Also provide information details for the elements employed in the structure.

The decision goal as has been discussed is to produce a priority list of the social impacts because of the construction in order to further evaluate them in the later steps, while the alternatives are the causes of social impacts defined in step 2. As criteria are used the 2 award criteria selected in step 1 and as sub-criteria are used the 4 main construction processes defined in the same step.

All in all, the causes of social impacts are related to the construction processes since they are generated because of them, while the construction processes are related to the award criteria in order to level the effect of the social impacts on the award criteria and valuable conclusions can be drawn for evaluation in the next phase. The structure of the hierarchy is depicted in the following Figure 5.2.

⁴ <http://www.expertchoice.com/>

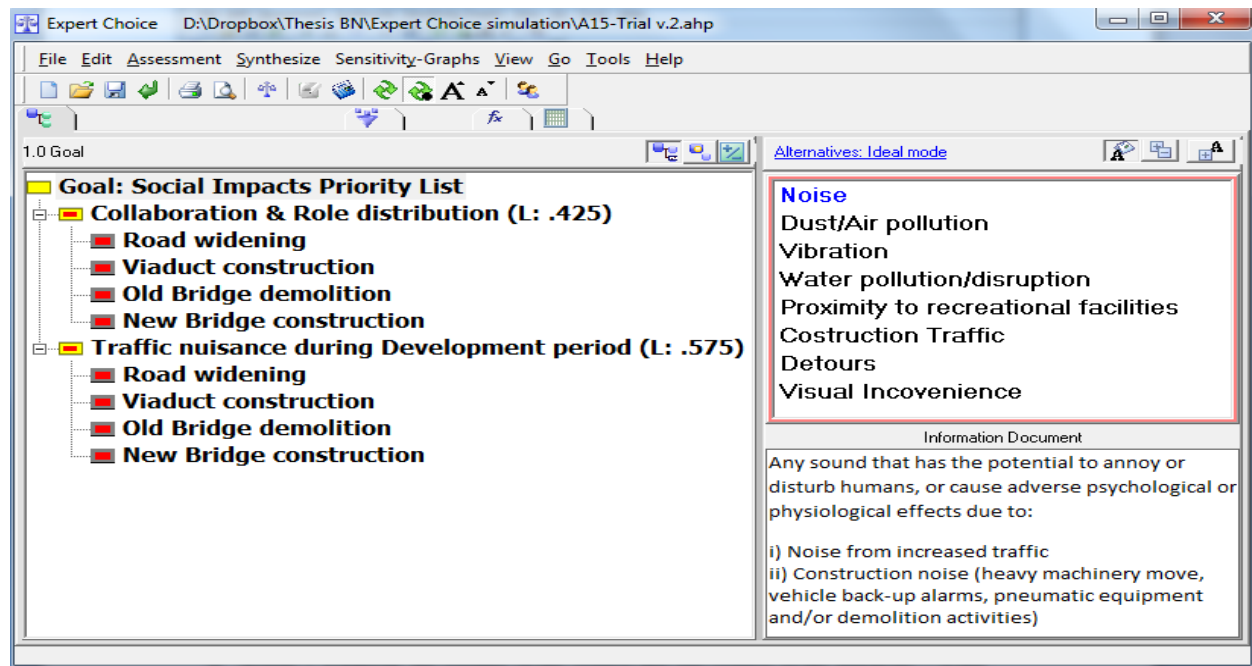


Figure 5.2: The AHP hierarchy structure

- Action 2: Establish the weights of the criteria and sub-criteria of the hierarchy – if not provided – by making a series of judgments based on pair-wise comparisons of these elements.

In respect to the criteria (success criteria), their weights have been provided by the tender guidelines and are mentioned in step 1, while the weights of the sub-criteria (construction processes) are established with their pair-wise comparisons in relation to the above elements in the hierarchy, meaning the 2 success criteria. An example of this pair-wise comparison is presented in the following Figure 5.3 while the result with the calculated weights is presented in Figure 5.4.

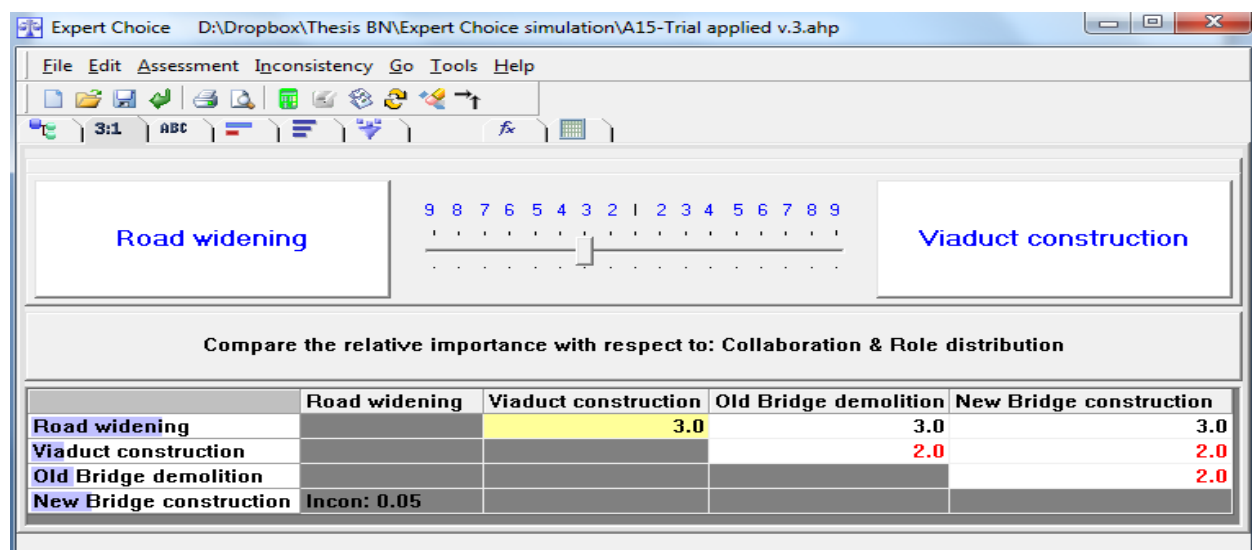


Figure 5.3: Road widening and Viaduct construction pair-wise comparison with respect to the Collaboration & Role distribution criterion

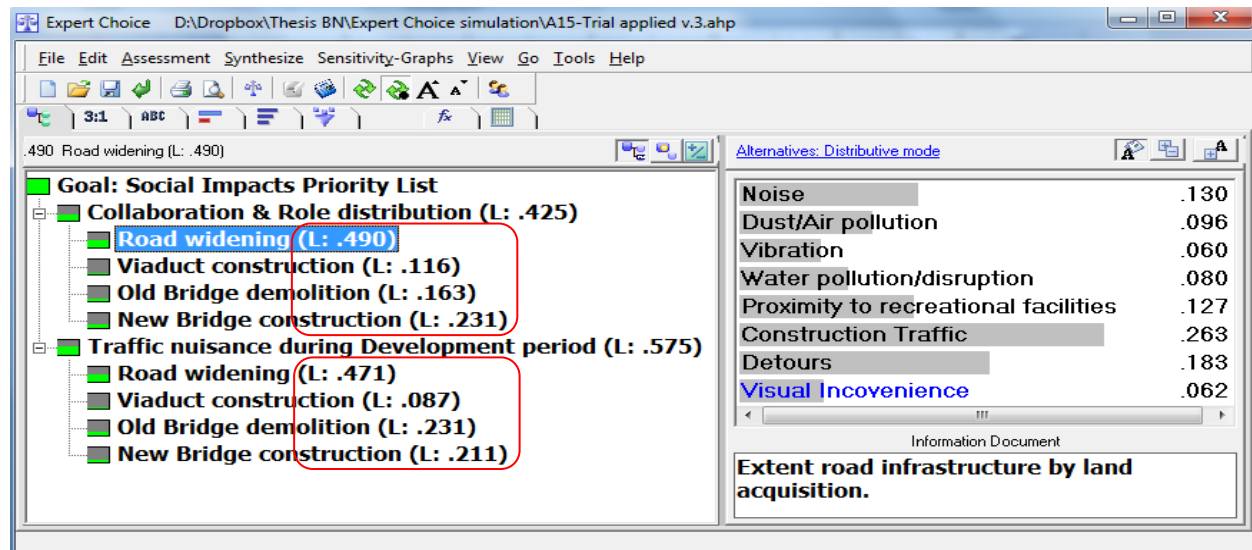


Figure 5.4: Relative importance percentages of construction processes for each sub-criterion

- Action 3: Establish the preferences of the alternatives in comparison to the parent element of the hierarchy based on pair-wise comparison of the alternatives.

After having defined the weights of the criteria and sub-criteria, the preferences of the causes of social impacts should now be established. Following the same method of pair-wise comparisons, the tender team collaboratively sets the preference of one cause of social impact over another in respect to every parent construction process for each success criterion. An example of the pair-wise comparison of the causes of the social impacts is illustrated in the following Figure 5.5. In this example, the impact of the noise is considered equal to moderate more important from the dust/air pollution impact in respect to the road widening construction process under the collaboration & role distribution success criterion. Also the method of the pair-wise comparison is not numerical like in the previous example of pair-wise comparison (Figure 5.3), but is based on verbal judgements which is an alternative method provided by the Expert Choice 11 software.

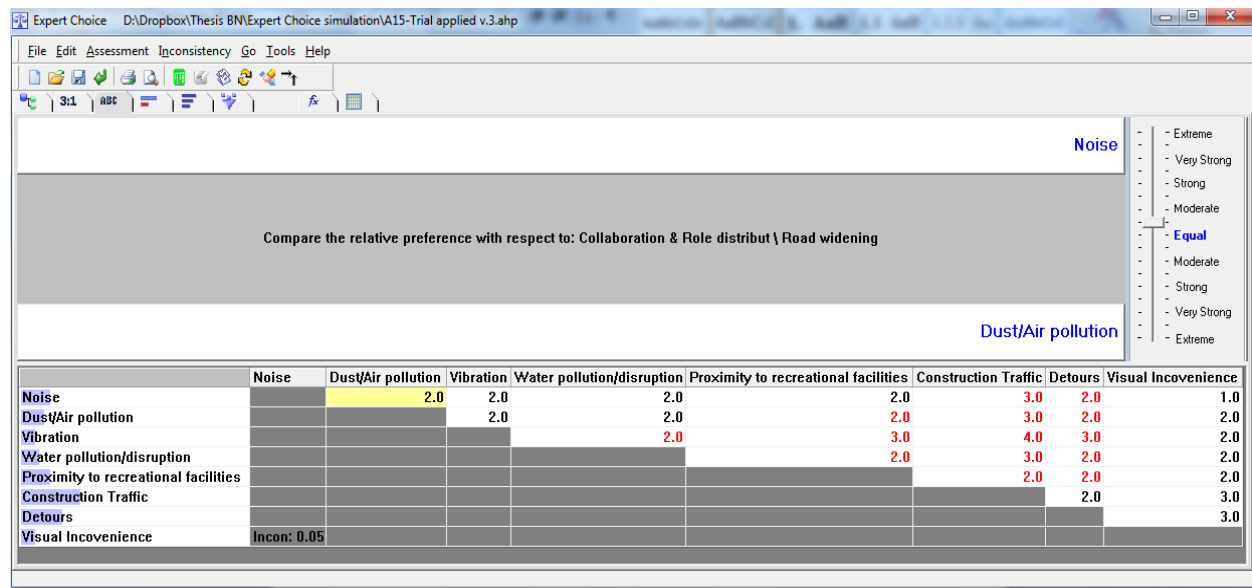


Figure 4: Pair-wise comparison of causes of social impacts in respect to the construction processes

- Action 4: Synthesize these judgments to yield a set of overall preferences of the alternatives in relation to the weights (priorities) of the criteria and sub-criteria in the hierarchy.

When all pair-wise comparisons between the alternative causes of social impacts have been made, the synthesis of these judgements is feasible in order to establish their overall preferences. The software provides the opportunity to calculate the overall preferences in respect either to the final goal or either to the criteria and sub-criteria depending on the information that tender team wants to elicit. However, based on the scope of the value creation model, the overall preferences in respect to the goal are desired in order to set the priority list to utilize as focus points for improving the tender strategy in the beginning of the tender and extract valuable conclusions for the next steps of the model elaboration. An example with the relative percentages of the causes of social impacts in respect to the goal is presented in the following Figure 5.6.

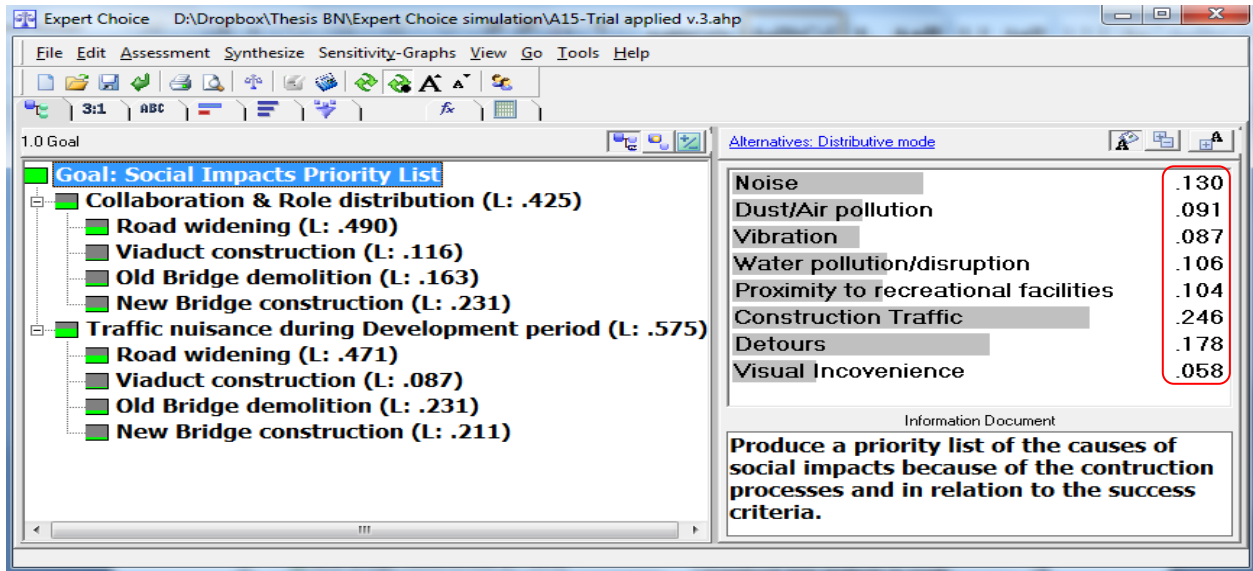


Figure 5.6: Relative preference percentages of the listed causes of social impacts in respect to the goal

- Action 5&6: Check the consistency of the judgments & Come to the final decisions based on the results of this process provided on the priority list of the alternatives (causes of social impacts).

Before the final selection of the causes of social impacts with the highest impact on the project and its evaluation criteria, the consistency of the judgements has to be checked and be lower than 0.10 so that results are faultless. In that respect, the following Figure 5.7 presents the final priority list with the overall inconsistency of the previous judgements which is 0.04 and thus the results can be considered as correct.

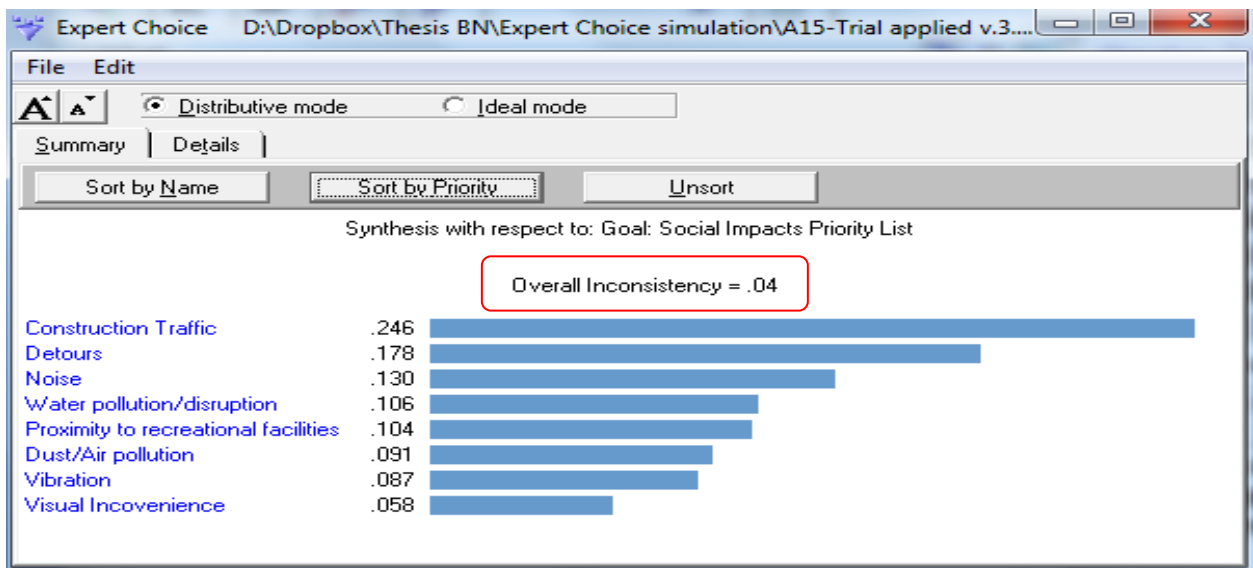


Figure 5: Synthesis of the social impacts priority list in respect to the goal

5.5 Simulation's analysis and results

The previous section was focused on simulating the preparation phase of the value creation model with the presentation of the 6 actions followed during the application of the Analytic Hierarchy Process software. In this sections are going to be discussed the available analysis from the elaboration of the AHP model and the results of the model's first phase.

After the completion of the AHP model, together with the generation of the priority list, very valuable information can also be elicited from the possible types of analysis of the data that are offered from the AHP software. In that respect the first available is the Dynamic Sensitivity analysis which is used to dynamically change the priorities of the objectives (criteria and sub-criteria) in order to determine how these changes affect the priorities of the alternative (causes of social impacts) choices. If a decision-maker thinks an objective might be more or less important than originally indicated, the decision-maker can drag that objective's bar to the right or left to increase or decrease the objective's priority and see the impact on alternatives. In addition the decision-maker can view from which components (objectives) are composed the alternatives. Following the simulation of the A15 MaVa tender that was applied in the value creation model and respectively to the AHP software, the Figure 5.8 below presents the composition of the causes of the social impacts from their construction processes, illustrating how much every cause of social impact is related and/or affected by every construction process (sub-criterion). The same Dynamic Sensitivity analysis can be depicted for the causes of the social impacts in respect to the criteria (success criteria) one level higher in the hierarchy (Figure 5.9).

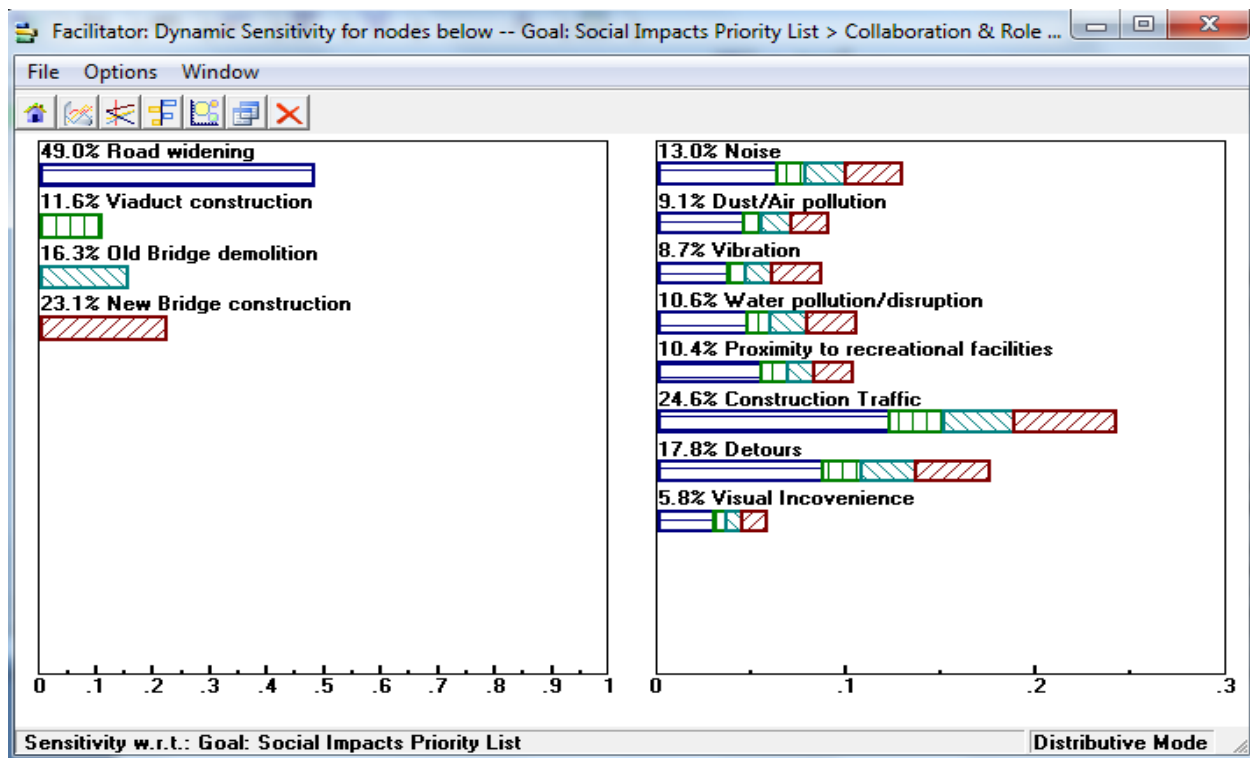


Figure 5.8: Dynamic Sensitivity analysis of the components of the causes of social impacts in respect to the construction processes

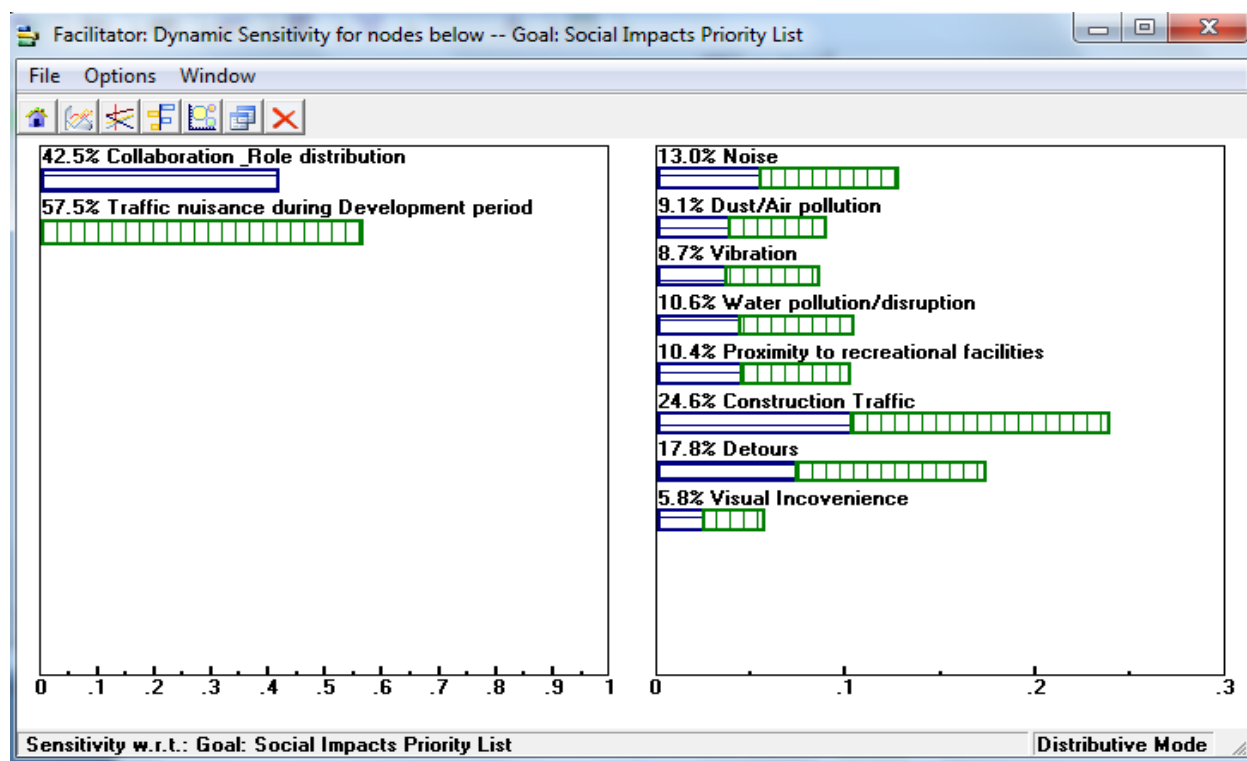


Figure 5.9: Dynamic Sensitivity analysis of the components of the causes of social impacts in respect to the success criteria

Another available type of analysis where important conclusions can be drawn is the Performance Sensitivity analysis. The Performance Sensitivity analysis, displayed in following Figure 5.10, shows how the alternatives (causes of social impacts) were prioritized relative to other alternatives with respect to each objective (criteria and sub-criteria) as well as overall. To see the most important alternative compared to the other, read the overall priority from the intersection of “right y-axis” and the overall priority for each alternative. Thus, in the simulation of the A15 MaVa project, Construction Traffic is approximately 25%, Detours is approximately 18% and so on.

Also, to read each objective’s priority (based on the tender team’s pair-wise comparisons) use the “left y-axis”. In the simulation Road Widening is approximately 50%, New Bridge construction is approximately 23%, Old Bridge demolition and Viaduct construction are approximately 16% and 12% respectively.

Finally, to read the alternative priorities with respect to each objective, read from the “right y-axis”. In the simulation, with respect to Road Widening, Construction Traffic has priority of approximately 24%, Detours is about 17%, Noise is approximately 13%, Water pollution/disruption and Vibration are about 12% and finally Proximity to recreational areas and Dust/Air pollution have priority of approximately 8%.

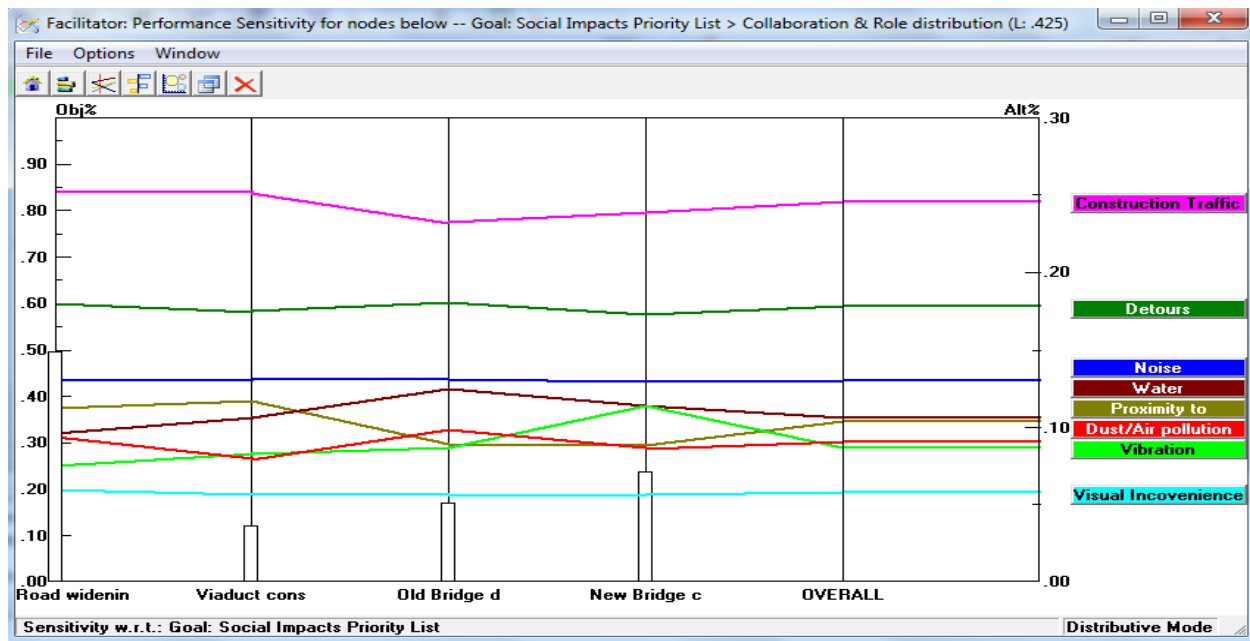


Figure 5.10: Performance sensitivity of the causes of social impacts in respect to the construction processes for the Collaboration & Role distribution criterion

After the analysis of the A15 MaVa tender simulation, the final conclusions can be drawn. Following the completion of the 4 preparation steps, the priority list of causes of social impacts because of the construction activities in the project's environment has been elicited. The 5 most important with priority over 10% are the following (from Figure 5.7):

- Construction Traffic with 25% priority on causing impacts in the social environment
- Detours with 18% priority
- Noise with 13% priority
- Water pollution/disruption with 10.5% priority, and
- Proximity to recreational facilities with 10.5% priority

The above 5 causes of social impacts together with their analysis provide the first information for the identification of the effects of the social impacts and provide focus points for the strategic decisions during the development of the design proposals.

Further elaboration for the effects of the social impacts from the Table 2.2 in section 2,3 as have been discussed in the beginning of the chapter, need more information in respect to the design solutions discussed during the tender preparation together with detailed information of the project's environment. If these were available and based on the design solutions, a lower level with the most relevant effects of the social impacts has to be created in the hierarchy structure of the AHP model. Their elaboration would result in a new list with the effects of the social impacts which can be used for the following Evaluation and Value creation phases of the proposed Value Creation Model.

Nevertheless, based on the Table 2.2 on the causes of social impacts and the project's context acknowledged previously, some suggestions of the most relevant social impacts to be identified are the following:

- In respect to Construction Traffic:
 - ❖ Traffic congestion (if not examined separately).
 - ❖ Travel delay / longer trip times (if not examined separately).
 - ❖ Productivity reduction of businesses due to traffic delays.
 - ❖ Increased fuel consumption due to longer distances and speed changes.
 - ❖ Reduction of tax revenues e.g. reduced traffic of the petrol station due to accessibility issues.
 - ❖ Loss of income for retailers and businesses e.g. Shop near to the prolonged closed exit/entrance section.
 - ❖ Increase of human stress levels, behaviour and mental health.
 - ❖ Increase of accident rates due to road works resulting in health-related expenses, disability claims, property damage and litigation costs.
 - ❖ Increase in number of “road rage” incidents due to stress related to congestion and frustration.
 - ❖ Cycling difficulties due to road works.
- In respect to Detours:
 - ❖ Traffic congestion in secondary road network (if not examined separately).
 - ❖ Accelerated deterioration of the secondary road.
- In respect to Noise:
 - ❖ Values of real estate.
 - ❖ Productivity reduction of people due to reduced concentration.
 - ❖ Productivity reduction of businesses due to absence of employee from workplace.
 - ❖ Increase of human stress levels, behaviour and mental health (High blood pressure & Cardiovascular disease).
 - ❖ Quality of life (Sleep disturbance, happiness of people at home or leisure).
 - ❖ Disability allowance costs, long-term care and rehabilitation costs for sick employees.
- In respect to Water pollution/disruption:
 - ❖ Settlement of road surface due to dewatering activities.
 - ❖ Property damage due to soil settlement.
 - ❖ Surface/subsurface disruption i.e. bank erosion, flooding, damage to aquaculture.
 - ❖ Deterioration of green life because of green areas around the project.
- In respect to Proximity to recreational facilities:
 - ❖ Quality of life resulting from reduced accessibility of recreational facilities.
 - ❖ Affect on an ecosystem for a longer time period than the duration of the project.
 - ❖ Restoration costs for reforestation, re-establishment of spawn areas for aqua life and re-establishment of migration paths if they exist.

6. Conclusions & Recommendations

In the final chapter, the conclusions from all the literature study and the other worked out chapters of this thesis are going to be presented and discussed.

6.1 Answering of RQs

The main research questions and the subsequent sub-questions are answered either from the literature studies or from through the elaboration of the other chapters. In particular:

Sub-question 1, “*What is an EMAT award mechanism?*” is answered from the literature study and specifically from section 2.2 where the specific procurement process is studied and its characteristics are presented. Thus it is acknowledged that EMAT award mechanism is a process followed for evaluation of projects where beside the price and the compliance of the bid with the Terms of Reference, the assessment is based also in other quality and performance criteria. These criteria are used to ascertain the performance of each bid and through the evaluation technique to establish the preference ranking of the candidates.

Sub-question 2, “*Which evaluation criteria are the most important for public infrastructure projects that are procured with the EMAT award mechanism?*” is answered in section 4.2 and in particular are cited and described in Table 4.10. Based on the case studies, the most important evaluation criteria identified and summarized in general categories are those related to the traffic nuisance during development, the sustainability, the project management, the collaboration and role distribution between the client and the contractor, the risk management, the local disruption during development and availability period, the traffic nuisance during availability and maintenance period, the licensing management and last but not least the technical management.

Sub-question 3, “*Which critical factors related to the project’s objectives and its award criteria can add value to the bid documentation and respectively to the project?*” is answered in chapter 4 where the findings from the case studies are discussed. It is identified through their qualitative analysis that usually managerial or technical evaluation criteria are applied, implying that a focus on critical factors with concern to the impacts of the construction on the “project environment” can add value when elaborated with the Value Creation Model. Thus Table 2.2 with the description of the causes of impacts on the society is used to identify the critical factors. In particular the nine most important causes of social impacts which are used as critical factors for focus points are noise, dust/air pollution, vibration, water pollution/disruption, proximity to recreational facilities, construction traffic, detours, utility cuts, visual inconvenience and soil/public space pollution. Based on the category of cause of social impacts, three classifications of effects of these impacts on the project’s environment are acknowledged, namely the sociological/health, the ecological/environmental and the economical impacts.

Sub-question 4, “*Which process can be followed to effectively prepare bids with added value?*” is answered through the presentation of the Value Creation Model which intends through its structured steps to effectively prepare bids with added value. Specifically, the model consists of 12 steps which by 4 steps comprise the 3 phases of the model, namely the preparation, the

evaluation and the value creation phases. As the name of its phase states, in the first phase the relevant and necessary background information in respect to the project are collected to be used in the AHP model for identification of the most important social impacts of the project, so that can be evaluate in the second phase through research on the society's perception over the impacts and on their costs so that can be processed and exploited accordingly by the inclusion of their mitigation measures in the bid documentation and the creation of the value in the last phase.

Finally, for the Main Research Question, "*In what ways Ballast-Nedam can effectively prepare bids with added value for public infrastructure projects which are procured with the EMAT award mechanism?*" the answer is provided through the embedding of the VCM into the tender work instructions followed in the company, which focuses at the end on shaping and adapting the current instruction towards more effective bids and contractual relationships on the way of winning more tenders and attaining their strategic goals as it states the thesis objective. Thus 3 points of interaction are identified between the tender work instructions and the value creation model which are worked out as one parallel process in order to yield the model's potential benefits.

6.2 Scientific contribution

The scientific contribution of this research thesis is threefold:

- The first is that suggests the identification and inclusion of impacts to the social environment because of the construction activities as important factors in the evaluation of the project's appraisal.
- The second is that through this thesis, a new paradigm of socially sustainable construction mindset is suggested to be employed in the construction industry in order to produce more socially sustainable projects.
- Finally, the last scientific contribution is the utilization of the Analytic Hierarchy Process within a structured model to be employed in the procurement processes for acquisition of added value in the bid documentation.

6.3 Limitations and further research

The most obvious limitation of the proposed model is that cannot be considered as an efficient and effective tool to provide added value to the bid documents by just applying it in the tender. Based on its structure, the model to be effective needs the proper resources in the concept of people working it out and mainly conducting the necessary studies to acquire the social feedback which will be used to feed in the evaluation phase and produce the added value through the value creation phase.

In that respect, it is not expected to have instantly the expected results, but rather provide a support of the setting of the strategy to follow in the initially steps of the tender. In the long-term

and after having applied the model in adequate number of tenders, the model will become more efficient. By employing it in many tenders, a library with social impacts and measures to mitigate them will be created and gradually the model will start yielding its profits. After all, it will be considered as successful after lot of application on tenders which resulted in tender award or triggered the client's perception over the value of employing social concerns as factors of tender's evaluation.

Based on the previous, a further research could be the studying of the model's application in a sufficient number of tenders in order to identify its real effects on the bid documentation and consequently provide the necessary adjustments to make it more efficient.

Finally, another research proposal could be the studying of the available ways to acquire effectively information from the project's environment without coming in contact to the society. Since the client is not permitting the contact with the social environment of the project before the tender award, it is considered as very crucial to identify methods and techniques to collect information which are reliable and solid to be used in the model.

7. Recommendations

Potential benefits for the contractor

- Increase the value of the tender documents by providing solutions which incorporate social impacts to the technical decisions or to the technical solutions.
- Support the tender management, by identifying the competitive advantages of the tender and set socially sustainable strategies to follow iteratively during the tender preparation period, increasing the chances to win the tender.
- Estimate the relation between added value and added costs.
- Justify to the client the added costs as result of the added value through the VCM.

Recommendations to the contractor

- Use of an in-house review team for tender evaluation and score estimation.
- Create libraries with uniform plans for the same usually used evaluation criteria. Combine that library with past evaluations and collective knowledge of the tender managers.

Recommendations to the client

- Apply evaluation meetings instead of just informative meetings where candidates can discuss about the client's perception over the values of the project.
- Examine the costs of the impacts of the construction period in the project's environment so that can be possible in the future to employ evaluation criteria that take into consideration these impacts in the project evaluation and identify measures to compensate them.
- Provide the opportunity to the candidates to get in contact with the project's social environment in order to acquire more valuable information in respect to the impacts in the society and thus produce design solutions that take into account the social context and increase the social responsibility of the client.

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Appendix I: The complete data descriptions of the studied tenders of chapter 4 are presented in the following Tables 4.1 – 4.9.

Table 4.1: The LuVe A12 (Utrecht Lunetten – Veenendaal) tender description

Project 1: LuVe A12. (Utrecht Lunetten – Veenendaal)	1 st Dialogue Phase – Outline Proposal	2 nd & 3 rd Dialogue Phases – Consultation
	N Candidates / 1 Gen. + 2 Individual meetings / 3 Committees	3 Candidates / 6 Individual meetings / 3 Committees
	Assessment on:	Assessment on:
	4 Success Criteria	A. 5 Award Criteria Max EMAT value: €120 million, Scoring: 0-5
	1. Collaboration & Role Distribution – 25% (S)	1. Optimize SC1 - €15 million (S)
	2. Traffic Impediment during Development Period – 40% (S)	2. Minimize SC2 - €20 million (O)
	3. Traffic Impediment during Availability Period – 15% (S)	3. Minimize SC3 - €20 million (O)
	4. Burden on the surroundings during the Development Period – 20% (S)	4. Minimize local disruption during Development & Availability Period:
		4a. Local disruption during Development & Availability period - €13 million (S)
		4b. Local satisfaction during Development & Availability period - €7 million (S)
		5. Sustainability:
		5a. Sustainable business operations:
		5a.1: Component Plan - €4.2 million (S)
		5a.2: Measures - €1.8 million (S)
		5b. Sustainable project execution:
		5b.1: DuBo-Calc - €4.5 million (O)
		5b.2: Measures - €4.5 million (S)
		B. Risk Distribution (O)
	Wins: Lowest Fictitious Tender Price < Ceiling Price - €258 million (F.T.P=Tender price + Risks Increments + EMAT value)	

Table 4.2: The A27-A28 tender description

Project 2: A27 – A28	Registration Phase
	6 Candidates / 1 Gen. + Period for meetings / 1 Committee
	Assessment on:
	2 Award Criteria
	1. Completeness & Quality of Tender Documents
	1a. Project Management
	1a.1: Initial Implementation Plan (O)
	1a.2: Overall Plan (O)
	1b. Technical Management
	1b.1: Phasing Plan (O)
	1b.2: Verification Plan – Use of Rating Table (+/-) (O/S)
	1b.3: Draft Note – Use of Rating Table (+/-) (O/S)
	2. Traffic Regulations (Flow Measures) – Max EMAT value: €94.945.000
	2a. Project Part A27 South - €8.650.000 (S)
	2b. Project Central part A27 - €10.600.000 (S)
	2c. Project Part A27 North - €700.000 (S)
	2d. Project Part A28 South - €32.850.000 (S)
	2e. Project Part A28 North - €42.140.000 (S)
	Wins: Lowest Fictitious Tender Price - No Ceiling Price (F.T.P=Tender price - EMAT value)

Table 4.3: The Zuid – Willemsvaart Maas tender description

Project 3: Zuid – Willemsvaart Maas	1st Dialogue Phase – Plan of Approach	2nd Dialogue Phase – Plan of Action & Tender Plan
	6 Candidates / 1 Gen. + 2 Individual meetings / 2 Committees	3 Candidates / 1 Gen. + 2 Individual meetings / 2 Committees
	Assessment on:	Assessment on:
	4 Success Criteria	4 Award Criteria Max EMAT value: €50 million, Scoring: 6-10
	1. Collaboration & Role Distribution –50%	1. Cooperation between client & contractor - €10 million
	1a. Project Vision – 10% ->2 sub-criteria (S)	1a. Project Vision – 10% ->2 sub-criteria (S)
	1b. Client & Contractor interests – 40% -> 3 sub-criteria (S)	1b. Client & Contractor interests – 40% -> 3 sub-criteria (S)
	1c. Contractor Organization – 40% -> 2 sub-criteria (S)	1c. Contractor Organization – 40% -> 2 sub-criteria (S)
	1d. Risk Management – 10% (S)	1d. Risk Management – 10% (S)
	2. Attitudes & Behaviors during individual meetings – 5% (S)	2. Methods of applying the principles of SE - €10 million
	3. Key staff job description – 5% (S)	2a. Integrated design & realization – 50% (S)
	4. Methods of applying the principles of System Engineering – 40%	2b. Detection & demonstration – 30% (S)
	4a. Integrated design & realization – 50% (S)	2c. Traceability – 20% (S)
	4b. Detection & demonstration – 30% (S)	3. Reduce nuisance - €20 million
	4c. Traceability – 20% (S)	3a. Reduce nuisance during construction - €11 million -> 5 sub-criteria (S)
		3b. Dealing with nuisance - €6 million (S)
		3c. Reduce nuisance during maintenance control - €3 million (S)
		4. Sustainability - €10 million
		4a. Environmental pressure during construction - €3 million (S)
		4b. Energy - €4 million -> 2 sub-criteria (S)
		4c. Sustainable resource management - €2 million -> 2 sub-criteria (S)
		4d. Sustainable contractor organization - €1 million -> 2 sub-criteria (S)
	Wins: Lowest Fictitious Tender Price < Ceiling Price - €206 million (F.T.P=Tender price - EMAT value)	

Table 4.4: The KARGO tender description

Project 4: KARGO	1 st Dialogue Phase – Plan of Approach	2 nd Dialogue Phase – Plan of Action & Tender Plan
	4 Candidates / 1 Gen. + 2 Individual meetings / 1 Committee	3 Candidates / 1 Gen. + 3 Individual meetings / 1 Committee
	Assessment on:	Assessment on:
	6 Success Criteria	5 Award Criteria Max EMAT value: €66.5 million, Scoring: 6-10
	1. Introduction – 10% (S)	A. Quality Criteria - €22.95 million
	2. Project Management & Control (except safety) – 10% (S)	1. Public-oriented Management - €1.95 million -> 3 sub-criteria (S)
	3. Safety – 15% (S)	2. Reliability/Predictability - €15 million -> 2 sub-criteria (S)
	4. Technical Management	3. Sustainable tendering - €6 million -> 2 sub-criteria (S)
	4a. Design – 10% (S)	B. Performance Criteria - €43.55 million
	4b. Implementation – 10% (S)	4. Minimize traffic nuisance in the road - €37.25 million -> 8 sub-criteria (O)
	5. Environmental Management	5. Minimize traffic nuisance in the waterway - €6.3 million -> 8 sub-criteria (O)
	5a. Process to minimize disruption – 25% (S)	
	5b. Communication, conditioning & design – 15% (S)	
	6. Purchasing Management & Other – 5% (S)	
	Wins: Lowest Fictitious Tender Price < Ceiling Price - €95 million (F.T.P=Tender price - EMAT value)	

Table 4.5: The A15 MaVa (Maasvlakte – Vaanplein) tender description

Project 5: A15 MaVa (Maasvlakte– Vaanplein)	1 st Dialogue Phase – Outline Proposal	2 nd & 3 rd Dialogue Phases – Consultation & Dialogue Phase
	N Candidates / 1 Gen. + 2 Individual meetings / 3 Committees	3 Candidates / 6 Individual meetings / 3 Committees
	Assessment on:	Assessment on:
	3 Success Criteria	A. 5 Award Criteria Max EMAT value: €350 million, Scoring: 0-5
	1. Collaboration & Role distribution – 35% (S)	1. Optimize SC1 - €70 million (S)
	2. Traffic Impediment during Development Period – 50% (S)	2. Minimize SC2 - €100 million -> 1+2 sub-criteria (O)+(S)
	3. Traffic Impediment during Availability Period – 15% (S)	3. Minimize SC3 - €100 million -> 1+2 sub-criteria (O)+(S)
		4. Sustainable Works - €50 million (O)
		5.1 Timely obtainment of building permit/opening permit - €15 million (S)
		5.2 Optimization of interface systems & controls - €15 million (S)
		B. Risk distribution (O)
	Wins: Lowest Fictitious Tender Price < Ceiling Price - €837 million (F.T.P=Tender price + Risk Increments + EMAT value)	

Table 4.6: The Noorwaard tender description

Project 6: Noorwaard	Registration Phase
	5 Candidates / 1 Gen. + Period for meetings / 1 Committee
	Assessment on:
	4 Award Criteria
	Max EMAT value: €46 million, Scoring: -1 to 3
	1. Process Quality
	1a. Project Management - €7 million (S)
	1b. Licensing Management - €3 million (S)
	2. Nuisance during construction
	2a. Transportation nuisance - €5 million (S)
	2b. Construction nuisance - €5 million (S)
	3. Maintenance friendly during Design & Execution
	3.a Embankments - €7 million (S)
	3.b Roads in the river basin - €3 million (S)
	3.c Undesirable willow growth - €3 million (S)
	4. Spatial quality
	4.a Spatial quality management - €3 million (S)
	4.b Ground - €3 million (S)
	4.c Bridges - €7 million (S)
	Wins: Lowest Fictitious Tender Price - No Ceiling Price (F.T.P=Tender price - EMAT value)

Table 4.7: The Wegen Westland tender description

Project 7: Wegen Westland	Registration Phase
	5 Candidates from lottery out of 6 / 2 Individual meetings / 1 Committee
	Assessment on:
	3 Award Criteria
	Max EMAT value: €30 million, Scoring: 0-3
	1. Traffic Management Plan
	1a. Minimize disturbance - €12 million
	1a.1 Less road disturbance
	1a.2 Reroute must be logic & small as possible
	1b. Minimize disturbance to companies (stakeholders) - €6 million (S)
	2. Risk Management Plan - €3 million
	2.a Project management plan (S)
	2.b 10 Risks for the contractor (S)
	3.c 10 Risks for the client (S)
	3. Sustainability - €9 million
	3.a Maintenance & Management - €5 million (S)
	3.b Construction - €3 million (S)
	3.c Sustainable procurement - €1 million (S)
	Wins: Lowest Fictitious Tender Price - No Ceiling Price (F.T.P=Tender price - EMAT value)

Table 4.8: The SAA A1-A10 (Schiphol-Amsterdam-Almere) tender description

Project 8: SAA A1-A10 (Schiphol-Amsterdam-Almere)	Pre-Qualification	Registration Phase
	N Candidates	5 Candidates / 1 Gen. + Period for meetings / 1 Committee
	Assessment on qualitative documents:	Assessment on:
	1. Closed Network Plan	A. 3 Award Criteria Max EMAT value: €44 million
	2. Phasing Plan	1. Limiting traffic nuisance
	3. Descriptive Document Risk Management & Risk File	1a. Traffic nuisance in Vehicle Loss Hours - €30.8 million (O)
	4. Vision Document of Collaboration	1b. Limiting traffic nuisance experience - €4.4 million (S)
		2. Project control / Risk management - €4.4 million (S)
		3. Cooperation & Organization - €4.4 million -> 7 sub-criteria (S)
		B. Closed Network Planning Approval or Not
Wins: Lowest Fictitious Tender Price < Ceiling Price - €100 million (based on interview) (F.T.P=Tender price - EMAT value)		

Table 4.9: The A4 Delft – Schiedam tender description

Project 9: A4 Delft-Schiedam	Pre-Qualification	Registration Phase
	N Candidates	3 Candidates
	Assessment on requirements:	
	1. Financial & Economic capacity	Unknown – No Dialogue Documents available
	2. Technical capacity	
	2a. Experience requirements	
	2b. Critical Processes description	
	2b.1 Analysis of all stakeholders needs	
	2b.2 System Analysis	
	2b.3 Interface Management	
	2b.4 Environmental Management	
	2b.5 Contractor's choice	
	2b.6 Contractor's choice	
	2.c Description of the deployed project organization, organizational chart and resumes	

Appendix II: The Complete Flow-Chart of the tender procedure work instructions

