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Colophon

Report

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Preface

This thesis presents the research on the capture and storage of performance information for contractors in the water construction industry. This research has been conducted at Van Oord, a major Dutch contractor in the water construction industry, and forms the finalization of the master Construction Management and Engineering at the TU Delft.

Conducting and reporting this research would have been impossible without the help and support of many people. At first I would like to thank my graduation committee for the support and criticism during this period. I want to thank Sicco for your input and challenging feedback. You were always willing to help and to provide substantial feedback. I want to thank Leentje for your guidance and positive attitude. Your expertise and help on academic research and reporting have been of great help during this period. I want to thank Leon for your personal attention and constructive feedback. You challenged me to look at the greater picture, both for this research as personally. Looking back, I can say that the input of the committee has been of great help to conduct and report this research.

From Van Oord I would like to thank Arjan for providing me the opportunity to execute this research at Van Oord and being by company supervisor during this period. Your input and comments have been essential to conduct this research. I would also like to thank Yasin for your contributions and discussions during the last months. I would like to thank the interviewees from Van Oord, Rijkswaterstaat and the Best Value consultant for providing the necessary input to execute this research. I would also like to thank all my colleagues at Van Oord for the positive atmosphere and collegiality.

Finally, I would like to thank my family and friends for their support during the last seven years of education and especially the last months. The support, encouragement and help of my parents, parents-in-law, friends and most of all my wife Mette made all of this possible.

Joost den Hoedt
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Management summary

A new procurement method which is currently used by Dutch authorities to procure water construction projects is Best Value Procurement (BVP). In a tender for projects according BVP, a vendor needs to needs to state performances which prove that he is able to deliver the highest value for the best price. This is done by performance statements that describe the performance to be delivered in the project. To convince the client of the expertise of the vendor, these performance statements must be substantiated by verifiable performance information. Performance information is information that proves that the vendor is capable to deliver the performance. The objective of performance information is to pursue the client of the expertise of the vendor. The performance information is assessed on providing clarity on the promised performance and prescribes dominantly the expertise of the vendor.

Contractors in the Dutch water construction industry are rather unacquainted with the delivery of performance information as a substantiation of tenders. Contractors in the Dutch water construction industry capture information on performances for several purposes, such as own performance management or project specific performance indicators for contractual reasons. Hence, the use of a uniform way to capture performance information is rather low. This leads to the situation where the availability and quality of performance information within contractor's organisations in the Netherlands is diverse.

Because contractors have little experience on presenting performance information, they are unaware which information should be captured during projects. In order for contractors to be recognized as best vendor in a BVP tender, they must capture and store verifiable performance information. This thesis describes how contractors should initiate this process by answering the following research question:

How can a contractor in the water construction industry capture and store performance information to be used in Best Value projects?

This research is divided in three different research questions; at first which performances are relevant for contractors to present in Best Value tenders, secondly how the contractor can capture performance information during projects and thirdly how this performance information should be stored within the contractors' organisation for use during BVP tenders. To come up with an answer on these questions, qualitative research has been executed which combines theoretical and practical views on how a contractor should capture and store performance information. Literature research has been executed by assessing scientific articles, books and other literature on relevance to the topic. The practical input for this research contains an analysis towards project goals for projects in the water construction industry in the Netherlands using BVP, interviews with employees from Rijkswaterstaat, a Best Value consultant and employees from Van Oord and personal observations during the tender phase of the contractor.

Relevant performances to present

Whereas the literature provides multiple categories of performances which determine the success of construction projects, this research displayed that performances regarding time, satisfaction and quality are most relevant to present in tenders for water construction projects. Whereas these categories give an indication, the contractor must come up with specific performances within these categories to present as performance in Best Value tenders. These performances must show the position of the contractor as an expert, using performance indicators to quantify this expertise. This research provides several relevant performances of contractors in the water construction industry. The theory on Best Value though is about the utilization of the expertise of the contractor. This means that the client should let go of managing, steering and controlling the performances in the project. It is therefore important that the contractor does

not come up with performances based on the objectives of the client or theoretical research, but based on its own experiences and expertise within projects.

This research has shown that sometimes clients in the Dutch water construction industry may set up very specific project goals, and thereby reduce the possibility for the contractor to express its expertise. The ability of the contractor to come to the highest value in projects, based on its experience and expertise, requires from the client to provide the freedom to the contractor to do so. Therefore, the project goals should be as abstract as possible.

Capture performance information

To capture performance information which represents the expertise of the organisation, the contractor has to set up a 'performance template'. This template prescribes for the performances of the contractor which information has to be captured, how this information is captured, at what time and who is responsible to capture the information. The IPM managers are responsible to execute the performance measurements and to capture the performance information of performances that are delivered in the project. The performance template gives therein guidance to capture the performance information uniformly. The project manager is responsible to gather the performance information from the IPM managers in the final work reports. The gathering of performance information in the final work reports ensures the traceability of the performance information.

Storage of performance information

The storage of performance information should be done using a web-based relational database, using software which is currently in use by most contractors to store project and organisational data. The use of such a database provides tender teams the possibility to filter all kinds of data to come up with the most relevant performances to achieve the highest value in this project. Therefore, the performances must be related to specific project characteristics. These characteristics, such as process, project type, contract type, contract sum and year gives the tender teams the possibility to specify the search for performances, which increases the relevance of performances towards the current project.

The performance database must be kept up to date by one designated person in the organisation. This person is responsible to gather the performance information from the final work reports of projects and import this data in the database. Restriction of the responsibility for the import of performance information to a limited amount of people ensures the uniformity of the performance information.

Further research

This research and the conclusion focusses on contractors in the Dutch water construction industry. Further research can give insight in how the proposed process can be used for other contractors, e.g. in the road infrastructure industry.

Though this research gives an indication on which performances are relevant for contractors in the water construction industry to present in tenders, the current literature on performances in construction projects provides no clarity on this. Further research can be done towards the role and responsibilities on performances of different parties in construction projects. Further research could also provide insight in the differences between performances in different types of construction projects.

This research gives an overall description on the setup and use of a database to store performance information. Further research within the field of information techniques and information management can be done towards the technical design of such a database.

This research has shown that the setup and interpretation of project goals between different clients may differ. Further research can provide clarity and uniformity in the setup of project goals within the water construction industry.

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List of abbreviations

BVA	Best Value Approach
BVP	Best Value Procurement
IMT	Information Measurement Theory
MDC	Management, Direction and Control
MEAT	Most Economic Advantage Tender
PC	Project Capability
RA	Risk Assessment
RFP	Request for Proposal
VA	Value Added
VPI	Verifiable performance information

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Part A Introduction

This part of the thesis provides the introduction and background of the research. Chapter 1 gives the introduction by providing the context of the problem and research. It describes the background of the problem and provides a problem statement. It concludes with the scientific and practical relevance of this research. Chapter 2 gives a clearer view on the design and execution of the research. It provides an extensive theoretical framework. This chapter describes further the research objective, the research questions, the method used to provide an answer to the research questions and the used material.

1. Introduction

This chapter describes the context and background of the research and defines the problem that initiated this research. The theoretical and practical relevance of the master thesis is explained.

1.1. Research context

In 2002 a parliamentary committee investigated forms of fraud in the Dutch construction industry. This fraud became in Dutch known as 'bouwfraude'. During an extensive research it came forward that contractors in the Netherlands made agreements on prices of biddings in tenders for public construction projects. The parliamentary committee concluded that these practices led to an increase of the costs for authorities on construction projects and a decrease of competition and innovation in the construction industry. This is one of the reasons the Dutch authorities started to procure construction projects more and more based on quality over price. According to the European Guideline 2014/24/EU and the Dutch Procurement Law, every public tender must be done based on the principle to be most economically advantageous. In practice this principle gives three possibilities for procurement. Firstly procurement based on the ratio of price and quality, before the introduction of the new Dutch Procurement Act at 1 July 2016 this principle was known as Most Economically Advantageous Tender (MEAT), secondly procurement based on cost efficiency, and thirdly procurement based on the principle of lowest price. The Dutch Procurement Act states that the procurement of public projects and services should be based on the ratio of price and quality as much as possible. (Booij, 2013; Rijkswaterstaat, 2017a)

One procurement method which is currently used by Dutch authorities is Best Value Procurement (BVP). BVP is part of the Best Value Approach (BVA), which is not only a procurement method, but a method to improve cooperation between client and vendor based on transparency and expertise. Best Value is invented to replace the traditional method of decision making and management, direction and control (MDC) of the client by steering on expertise of the vendor. Procurement according BVP assumes that the vendor who is most expert is able to deliver the highest quality for the best price. The procurement of projects and services according to BVP is based on which vendor can persuade the client, using verifiable performance information (VPI), that the vendor is an expert and capable to deliver the highest quality for the best price. VPI is information that proves the expertise of the vendor. (Rijkswaterstaat, 2015)

BVP as a procurement method is also applied in the Dutch water construction industry. Rijkswaterstaat, Water boards, provinces and municipalities use BVP to procure water construction projects. The water construction industry focusses on projects related to water and soil, such as the design, construction and maintenance of dikes, waterways, harbours, dredging activities and so on. The research is specifically requested from the viewpoint of a water contractor. This viewpoint may influence the way BVP is implemented and the requested performances in the projects. The essence of how to capture and store performance information though is relevant for all kind of contractors.

1.2. Problem description

In tenders contractors need to stand out in order to win the contract. Due to the increased use of BVP in water construction projects, performance information has become more important to do so. More traditional procurement methods are used to quantify the quality of a proposal by focussing on the manner how performances are achieved. Therefore, during these procedures the focus of the contractor mainly lies on how high performances are achieved, rather than what these performances actually are. In the situation of BVP, that actual performance has become important. This means that contractors need to get acquainted with the delivery of verifiable performance information as a substantiation for tenders. Contractors in the

Dutch water construction industry may have captured information on performances for several purposes, such as own performance management or project specific performance indicators for contractual reasons. Hence, the use of a uniform way to capture information on achieved performances is rather low. This leads to the situation where the availability and quality of performance information within the water contractors' organisation in the Netherlands is diverse.

The setup of Best Value tenders for contractors that did not actively capture performance information in the past can be rather difficult. Even though organisations may deliver high performances in practice, it can be hard for tender teams to collect enough or the right performance information to substantiate these performances in the tenders. Because water contractors have little experience on presenting performance information, they are unaware which information should be captured during projects. Furthermore, this information needs to be stored within the contractors' organisation to be available to present in Best Value tenders. In order for contractors to be recognized as best vendor in BVP tenders, and thereby creating the highest value in projects, they must create knowledge and awareness on which information to capture and how this information can be stored for presentation in BVP tenders.

In short, the problem which will be handled in this master thesis can be translated in the following problem statement: *“Due to a change in the use of procurement methods, information on achieved performances has become just as important as the level of the performance. Contractors in the water construction industry are not used to this situation yet. Information on performances which are achieved in projects is not captured uniformly. The variety of information on performances is high and the amount of information on actual achieved performances rather diverse. This leads to a situation in which contractors are unaware which information should be presented in the tender phase of Best Value tenders and where to find this information within the own organisation.”*

1.3. Relevance

Scientific relevance

Literature which is currently available on relevant subjects regarding this research consists of the following theories:

- the theory of the BVA and BVP as described by D. T. Kashiwagi (2016) in “Best Value Approach” and applied for the Dutch market by Rijt and Santema (2013) in “Prestatieinkoop”. This literature focusses on the methods of Best Value and the role of the client in a Best Value process;
- theories on which performances define the overall success of construction projects;
- theories within the field of information management regarding the process of saving information within an organisation.

This master thesis focusses on how a commercial organisation, specifically a contractor in the water construction industry, can capture and store performance information within its own organisation. This master thesis combines the literature on performances in the construction industry with the theory of BVP by describing how a contractor should capture and store performance information in order to prove its expertise in Best Value tenders.

Practical relevance

The research for this master thesis is conducted under the guidance of Van Oord Marine Contractors. Van Oord is a major water contractor in the Netherlands, which also executes projects procured by Best Value. This thesis is relevant for the contractor due to the commercial value of the research' results for the contractor. Having clarity in which information to capture and how this information can be captured and stored within the contractors' organisation increases the quality of BVP tenders. The increase on quality of

tenders increases the actual value that is achieved in the project. This has a direct positive effect on the turnover of the contractor.

This research is also relevant regarding the knowledge and performance development of the contractor. This thesis increases the availability and accessibility of information on performances of the own organisation. In terms of the website of Van Oord 'the knowledge, expertise and the teamwork of Van Oord's employees are the engine behind the success' (Van Oord). Increasing the availability of knowledge and information increases the quality of tenders and decreases the costs of tenders.

2. Research design

This chapter provides the framework of the research by a literature study. Following on the research framework the objective of this research is set out, followed by the research questions. Finally the research strategy which is used to answer these research questions is explained and the research material which is used as input for this master thesis is described.

2.1. Research framework

The Best Value Approach and Information Measurement Theory

The BVA is theoretically and rationally based on the Information Measurement Theory (IMT). This theory is based on the Information Theory as discovered by Claude Shannon in 1948. This theory states *that the constraint of communication is the transmission speed of the medium and not the noise of the environment*. The IMT applies this theoretical foundation to the field of understanding information, where the IMT identifies that *“an individual who lacks the ability to perceive, creates the misperception that there is a lack of information. In actuality, all of the information always exists”* (D. Kashiwagi & Kashiwagi, 2016, pp. 2-2). (D. Kashiwagi & Kashiwagi, 2016; D. T. Kashiwagi, 2016)

This definition of information and the speed and understanding of information between individuals is the basis for the BVA. The IMT states that the major obstacles in order to understand information in reality are *decision making* and *bias*. The traditional application of decision making and management, direction and control (MDC) can therefore be recognized as the reason of failure in procurement of projects and services of any kind. The BVA can be seen as a change in paradigm, it replaces the traditional way of decision making and MDC by the client with the utilization of the expertise of experts. In short, the BVA shifts the control and risks of the project toward the expert vendor, because experts have the least risks and most knowledge regarding the topic. (D. Kashiwagi & Kashiwagi, 2016; D. T. Kashiwagi, 2016)

The BVA is founded to create *transparency* and *simplicity*. This is achieved by the procurement procedure known as BVP. This procurement methodology optimizes the delivery of services by hiring experts instead of managing the risks. This changes the role of client from guardian over the contract towards a facilitator of the delivery of the experts' services. BVP though is not only about procurement, but mostly about the behaviour of both parties during and after awarding the contract. BVP is about giving the expert the ability and freedom to deliver its performances. BVP therefore means in practice that *the expert takes responsibility in the project* (Rijt & Santema, 2013, p. 31). The objective of this approach is to reach the *highest value for the best price*. This can only be achieved by cooperation and transparency within the supply chain between clients and vendors. (D. T. Kashiwagi, 2016; Rijkswaterstaat, 2015; Rijt & Santema, 2013)

Best Value Procurement

The process of BVP in practice covers three official phases and a preparation phase. These phases are shown in Figure 1. The preparation phase is called in Figure 1 the pre-qualification phase and regards the preparation of the procurement of the project by the client. In this phase the clients prepares its organisation for the application of BVP, by selecting and educating the project team, set the goals and requirements for the project and inform vendors about the project. The vendors are invited to come up with a tender in a Request For Proposal (RFP) which describes the tender requirements and project goals. The goals of a Best Value project are very important to the vendor, the quality of the tender of the vendor will be assessed on meeting the project goals. (I. Kashiwagi; Rijt & Santema, 2013)

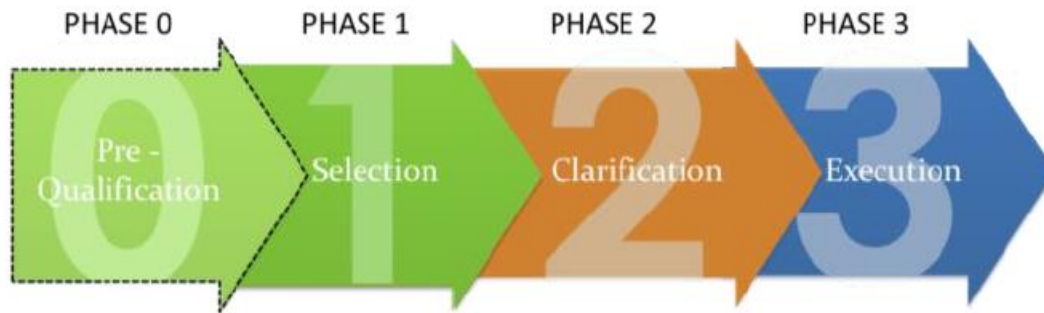


Figure 1. Different phases of a Best Value process (I. Kashiwagi)

Phase 1 is the actual selection phase in which the best suitable vendor is selected. This selection is based on different criteria which have been changed over the years. Past performance of both organisation and staff has originally been part of these criteria but is in The Netherlands not used due to practical and legal issues (D. Kashiwagi, 2011; D. Kashiwagi & Kashiwagi, 2011; Leeuwen, 2011; Rijt & Santema, 2012). Instead of past performance, the criterion ‘Project Capability’ is used for vendors to differentiate themselves from other vendors. Rijt and Santema (2013) and I. Kashiwagi describe both the following criteria, which are also used in the Netherlands by Rijkswaterstaat (2015);

1. Project Capability (PC);
2. Risk Assessment Plan (RA);
3. Value Added (VA);
4. Interview;
5. Price.

A vendor in BVP projects needs to deliver so called project capability submittals in order to prove that the vendor is able to deliver the highest value for the best price and manage the risk as best. Beside these documents the client conducts interviews with key members of the project team of the vendor to see to what extend the vendor understands and is capable of handling the risks and realize the project goals. Herein is the interview usually the most important filter, followed by the RA, which shows how the vendor manages risks outside the scope of the vendor. (D. Kashiwagi, 2011; D. T. Kashiwagi, 2016; Rijt & Santema, 2013)

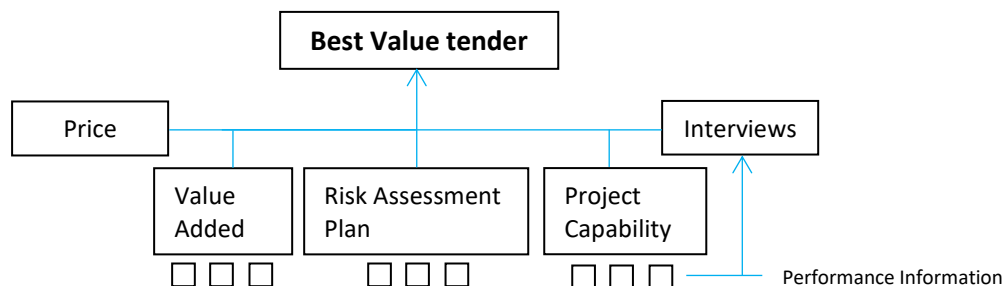


Figure 2. The setup of a Best Value tender (Own ill.)

Phase 2 is the clarification phase, in which only the vendor which is prioritized highest in the selection phase is requested to clarify the offer and plan. In this phase the vendor provides documentation on how the promised performance will be provided which means that the vendor comes with a proposal which includes the scope of the project, a detailed schedule including milestones, a risk management plan, the measured performances to achieve and weekly reports (D. T. Kashiwagi, 2016). In the weekly reports all cost and time deviations are reported, as well as the achieved measured performances. After both parties approve all

documents, the contract is awarded. According to D. T. Kashiwagi (2016) the clarification period is the most important phase of the Best Value process, since in this phase the expectations of client and vendor are aligned in a simplistic way. (Rijt & Santema, 2013)

Phase 3 is the execution and delivery phase of the project. During the execution of the project the vendor keeps up the weekly reports, in order to prove the achieved performances and deliberate and update the risk management. These reports must secure the transparency between the client and the vendor. In this phase it is very important that the contractor is in the lead and takes responsibility (Rijt & Santema, 2013; Rijt & Vries, 2013).

In order to assess the added value of the performance of the contractor in the tender, the contractor describes performance statements. The statements must be related to the project goals which have been set by the client. The vendor must specifically clear out how the performance measures have an impact on the project goals. The tender submittals are assessed based on a blind assessment, which means that the client cannot see any information that reveals the identity of the vendor. The rating of the value of the tender can be done by awarding points to both the quality and price and sum up the total of points. A second method, which is also used by Rijkswaterstaat is to take the price as base and use the value of the interviews and documents as fictive discount on this price. (D. T. Kashiwagi, 2016; I. Kashiwagi; Rijkswaterstaat, 2015; Rijt & Santema, 2013)

The theory, essence and background of Best Value and BVP define the framework of this research because the introduction of BVP in the procurement of water construction projects led to the urgency of contractors to capture and store performance information. For a rightful interpretation of BVP and the use of performance information within BVP, the mind-set of the Best Value theory is essential. This doesn't mean that the use of performance information is restricted procedures related to Best Value, but only that for right application of performance information within BVP, the theory of Best Value is important.

Performance Information

Qualitative performance information should be non-refutable, verifiable, accurate, measurable, show a high performance and be translated or related to the performance in the project. Because transparency and simplicity are the foundations of the Best Value theory, it is very important that the performance information is dominant. Dominant information means that the performance information is easy to read and does not require specific expertise to understand. Performance information is dominant when the information convinces the client of the vendor's expertise. The most dominant form of information is the language of metrics. By using measurable information, the vendor can most dominantly convince the client of its expertise. (D. Kashiwagi & Kashiwagi, 2011; Rijt, 2017; Rijt & Santema, 2013)

Performance information to be used in the tender submittals can come from many sources. The most used source is past performance data from the organization itself. An organization can use old project data to prove that they are able to deliver a certain performance. If past performance data is not available, vendors can use other information such as calculations or research. This is however less dominant information, the performance information serves as information to prove a vendor is capable of performance according the performance statements. (Koreman, 2014)

Chapter 4 will go deeper into the background, setup and requirements of performance information. The essence of performance information is described as framework of the research since this determines the manner which performances are described and how and which information should be captured in projects and stored within the organisation.

Capture and storage of performance information

The capture and storage of performances as performance information is something which is an issue among contractors in the water construction industry in the Netherlands. This may be explained by the fact that the use of performance information in tenders is not required in more traditional procurement methods. Because organisations may have captured information on performances for internal performance management processes or project specific contractual reasons, the applicability of this information for Best Value tenders is rather diverse. The setup of BVP tenders using performance information can therefore be hard for contractors.

The use of BVP as a strategy for water construction projects is expected to grow in the future (Rijt & Santema, 2012). Water construction contractors like Van Oord can expect more tenders for which performance information have to be presented. It is therefore essential that contractors capture and store the right performance information to reuse in Best Value tenders. This thesis describes for contractors in the water construction industry in the Netherlands which and how performance information can be captured and stored in order to reuse this information. Standardization in capturing and storing performance information to reuse in Best Value tenders is an essential step in order to come to efficient qualitative performance information. Having a standardized approach leads to a sufficient amount of performance information and decreases the effort of capturing and storing performance information. (Davies, Gann, & Douglas, 2009)

Though the essence of performance information is to increase the value of projects and use this in the tender phase, this research concentrates on how performance information should be captured and stored. The framework of this research can therefore be set by the technical setup, capture and storage of information, rather than how this performance information can increase the value of projects.

2.2. Research objective

As came forward from the problem statement, there is a need for contractors in the water construction industry to uniformly capture and store verifiable performance information. For contractors to capture and store performance information there must be understanding on which information to capture and how information can be stored for efficient use. In order to come efficiently to substantive, qualitative performance information, contractors should have a standardized process of capturing and storing this performance information. The objective of this research can be defined as:

To develop a process how contractors in the water construction industry can capture and store verifiable performance information by analysing which performances are relevant, how performance information can be captured in projects and how this information should be stored within a contractors' organisation.

2.3. Research questions

As mentioned by Verschuren and Doorewaard (2010, p. 97) the main research question follows from the question which information would realize the research' objective. Following the research objective as described in paragraph 2.2, the information to realize this objective relates to an approach of capturing and storing information and theories and experiences on performance information in Best Value projects. From this viewpoint, the main research question of this research is:

How can a contractor in the water construction industry capture and store performance information to be used in Best Value projects?

According to Verschuren and Doorewaard (2010, p. 97), the knowledge that is necessary to answer the main research question should be gathered from two or more sub-questions. Following from the main research question, this knowledge relates to which performances can be represented by the performance information, how data from projects effectively can be captured as performance information to represent these performances and how this performance information efficiently can be stored within the organisation, in order to reuse in Best Value tenders. To gather all required knowledge, the following research questions (RQ) need to be answered;

- RQ1. Which performances are relevant for contractors in the water construction industry to present in Best Value tenders?
- RQ2. How can a contractor capture data during projects to serve as performance information in future Best Value tenders?
- RQ3. How can information be stored within a contractors' organisation to reuse this as performance information in Best Value tenders?

2.4. Research methodology

Research approach

This research is a qualitative research which aims at combining both theoretical and practical insights in the role of performance information to use in Best Value tenders in the water construction industry. This research aims at three different viewpoints required for contractors to capture and store performance information within the organisation. The first viewpoint is the role of performances of a contractor in the water construction industry. The second viewpoint is the role of performance information within Best Value tenders and how to capture performance information during projects. The third viewpoint is on how performance information can be stored within the contractor's organisation. These three viewpoints together provide a framework on how an organisation can capture and store performance information to use in Best Value tenders. Therein the organisation will be given guidance on what performances to focus, how data which is essential to come to qualitative performance information can be captured during projects and how this performance information can effectively be stored within the organisation. The setup of this research approach can be followed in Figure 3 and follows the chapters in this report.

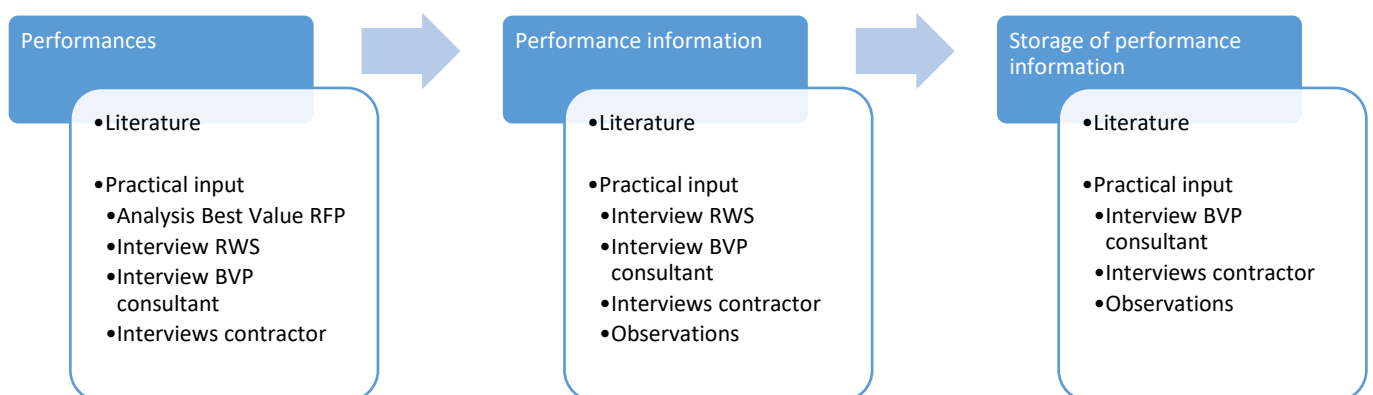


Figure 3. Research setup and material (Own ill.)

Research material

The essence of this research is to investigate relevant literature and assess and combine this information with relevant practical input to come up with a solution on how in practice a contractor can capture and store performance information. For each part of the research a literature research has been performed. In this literature research relevant scientific articles, books and other literature has been assessed on relevance to the topic. The literature research gives insight in the current scientific views on performances in the construction industry, the theoretical role and requirements of performance information and what aspects should make good performance information. Other literature is assessed on how organisations could capture and store information and what requirements the literature provides on information systems to store information.

The practical input for this research contains at first an analysis towards the project goals in 12 RFP's for projects in the water construction industry in the Netherland using BVP. The objective of this analysis is to investigate which performances are relevant for contractors in the water construction industry to present in Best Value tenders. An interview has been held with two employees from Rijkswaterstaat. The objective of this interview is to investigate how the client assesses the presented performance and what aspects regarding performance information increase the value of the tender and thereby projects for clients. Another interview has been held with a Best Value Consultant. The objective of this interview is to map his experiences on when performances are relevant for contractors to capture, how an organisation can capture performance information efficiently and how this can be stored within the organisation. Interviews have been held with five employees of Van Oord, all these employees had at least some experience with BVP. The objective of these interviews is to investigate whether the contractor understands which performances and performance information is relevant and how this efficiently could be captured and stored during projects. Finally, observations have been made during the tender phase for a water construction project of Van Oord. These observations map how the contractor currently sets up a Best Value tender and searches for performance information. The objective of these observations is to identify which aspects in the process of capturing and storing performance information are essential to improve.

Part B Input

This part of the research gives the theoretical and practical input for the realization of a process to capture and store performance information within a contractors' organisation. This part is divided in three different chapters which each represent a research question. Each chapter contains a literature research and a practical research, after which a conclusion in the form of an answer on the research question is provided. Chapter three focusses on the performances which are delivered by contractors in water construction projects. It goes in on which performances are important in construction projects and how the contractor can deliver performances that contribute to the clients objectives. It concludes with an answer on the question which performances are relevant for a contractor in the water construction industry to present in Best Value tenders.

Chapter four focusses on the role of performance information. It describes the aspects and requirements of performance information and it provides practical information on how contractors can capture data to compose qualitative performance information. The chapter concludes with an answer on how a contractor can capture information in projects to use as performance information.

Chapter five focusses on how the performance information can be stored within an organisation. It describes the theoretical aspects of storage of information and how a contractor could set up a system to effectively store performance information. It concludes with an answer on how a contractor can store information within the organisation to use as performance information in Best Value tenders.

3. Performances

Whereas the Best Value theory is about the delivery of performances, this chapter describes which performances are mentioned in the literature as performances that indicate the success of projects, specifically in the construction industry. It describes how these performances should be indicated and measured by contractors in order to gain performance information. The chapter continues with the practical input which includes an analysis on performances requested by clients for construction projects specifically in the water construction industry. This part also includes interviews with Rijkswaterstaat, a Best Value consultant and employees of Van Oord. The chapter concludes by providing an answer on research question 1.

3.1. Literature

Performances as success criteria

The literature on performances in the construction industry considers performances as indicators for project success. The extent to which a performance has been realized can thus be considered as a benchmark for the project success. The core of the project success factors as mentioned in the literature is the so called 'Iron Triangle'. The Iron Triangle is set up by Atkinson (1999) and covers the *costs, time and quality* of a project. These three performances are recognized by most literature as the main performance indicators in the construction industry.

The use of solely these three indicators to measure the project success however, is denied in most literature. Toor and Ogunlana (2009) reason that these three aspects are not solely applicable to measure the performance of project teams in large public sector projects due to the increase of importance of factors as safety, efficiency, and satisfaction of stakeholders. They reason that success in time, costs and quality can only be achieved when supporting performance indicators are monitored. Figure 4 shows that the Key Performance Indicators (KPIs) of projects are build up by supporting performance indicators.

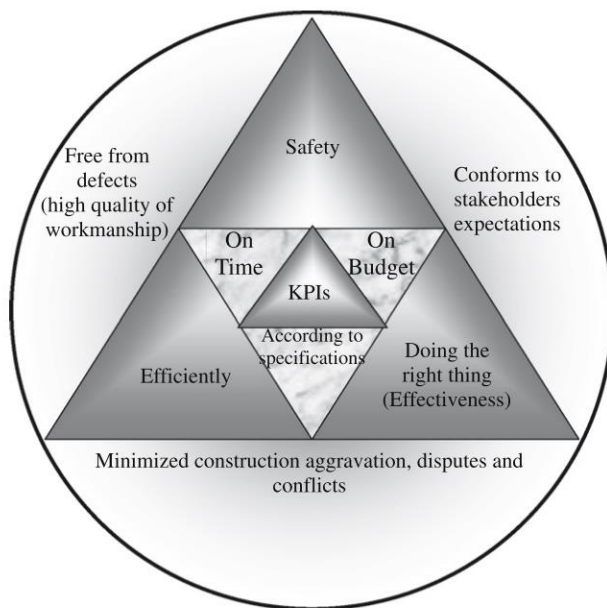


Figure 4. Performance measurement criteria for mega projects (Toor & Ogunlana, 2009)

Many authors have written on which performance indicators have an effect on the project success (Ali, Al-Sulaihi, & Al-Gahtani, 2013; Babu & Sudhakar, 2015; Bassioni, S.M.ASCE, Price, & Hassan, 2004; Chan & Chan, 2004; Cox, Issa, M.ASCE, & Ahrens, 2003; Kagioglou, Cooper, & Aouad, 2001; The KPI Working Group, 2000; Toor & Ogunlana, 2009). An overview of most cited authors on which performances indicate project success is given below in Table 1. Whereas the authors all give different performances, a quick analysis leads to in seven main categories in performances which are important in construction projects, namely the costs, time, satisfaction of stakeholders, health, safety and environment, technical quality and cooperation between the client and contractor.

Category	(Albert P. C. Chan, 2001)	(Xiao & Proverbs, 2003)	(Albert P.C. Chan & Chan, 2004)	(Toor & Ogunlana, 2009)	(Babu & Sudhakar, 2015)
Costs	Costs Commercially profitable Effectiveness/Value	Costs Profitability	Costs Value and profit	Budget Efficient use of resources	Budget Return on investment
Time	Time	Time	Time	Time	Time
Satisfaction	<i>Satisfaction</i> - Client - PM/PM-team - Contractor - Architect - User Meet user expectation	Client satisfaction	User expectation and satisfaction	Meet stakeholders expectation	Satisfaction - Client - Stakeholders Expected result
HSE	Safety Environmental friendliness	Health and safety Environment protection	Health and safety Environmental performance	Safety	Safety
Quality	Quality Meet technical specifications Functionality	Quality	Quality Functionality	Defects Meet specifications	Function for use Quality Aesthetics Construction problems
Cooperation	No legal claim Reduce modification changes	Partnership	Participants' satisfaction	Aggravation, disputes, conflicts	Disputes, conflicts
Other		R&D and training		Effectiveness	

Table 1. Performances in the construction industry

The importance of any of these performances as indicators of the success of a project differs per project. Babu and Sudhakar (2015) argue that it is impossible to generate an universal list of performance indicators which is applicable as project success criteria for all projects, because the success criteria differ per project due to differences in participants, scope, technical applications and other factors. In order to describe which performances are important to a specific project, the reason and scope of the project should give guidelines.

Performance measurement

The literature mentions the use of performance indicators as a means to measure the performance in projects. Performance indicators are variables or standard to measure the status of an organisation on a certain performance. Performance indicators can be used in all types of organisations and serve mainly two

reasons; as a means to prove the performance of organisations to clients and as a means for the organisations own performance management. (Leansixsigmatools, 2017)

How these performance indicators are set up and what the used measure is for the specific performance is dependent on the organisations. The literature on performance indicators argue that the setup of performance indicators should be done hierarchically. This implies that first more abstract performance indicators, based on the organisations’ strategy, should be established, before specifying these in operational performance indicators. This way, the lower level operational performance indicators help in achieving the higher level performance indicators. This substantiates the idea of the use of more specific performances as a means to establish the key performances in projects. Mcgee, Wilson, and Thomas (2005) recognize the importance that performance indicators which are implemented by organisation should reconcile the strategy of the organisation. Furthermore the operational performance indicators should be measurable in terms of the organisations operations. This setup of performance indicators is also recognized by Jonge (2015) who suggest the use of a ‘Plan for KPI Measurement’ as a means for contractors to capture performances. He suggests that this plan should contain both the most common performances in the construction industry as specific performances which are easily for project managers to capture. (Evans & Richardson, 2009; Mcgee et al., 2005; Slack, Chambers, & Johnston, 2007)

Table 2 below gives an indication of performances indicators and performances measurement for these indicators for the different categories mentioned earlier. It shows that in order for organisations to prove a certain performance, a specific performance indicator is used. The relationship between the performance indicator and the overall performance must be clear. Next, a performance measurement is given which provides the possibility to measure the performance indicator in projects. (Ali et al., 2013; The KPI Working Group, 2000)

Performance	Performance indicator	Performance measurement
Costs	Cost predictability	$\text{Predictability Cost} = \frac{\text{Actual cost} - \text{Anticipated cost}}{\text{Anticipated cost}}$
Time	Time predictability	$\text{Predictability Time} = \frac{\text{Actual time} - \text{Anticipated time}}{\text{Anticipated time}}$
Satisfaction	Client satisfaction (Product, service etc.)	Survey client satisfaction
HSE	Accidents	# Lost time accidents
Quality	Defects	# Defects
Cooperation	Change orders	# Change orders from contractor

Table 2. Performance indicators for different performances (Ali et al., 2013; The KPI Working Group, 2000)

Using performance indicators to measure performances in construction projects, Evans and Richardson (2009) argue that it is important that the performance measurements are time-related. This way performance measurement can be compared between different periods and emerging trends can be found. Evans and Richardson (2009) also argue that performance measurements should not be assessed in isolation. One performance may have a clear inter-relationship with other performances or the context of the project.

To increase the persuasiveness of performance information, the use of benchmarks is emphasized. This means that the performances are measured in comparison to competitive organisations or previous performances. Capturing performances using benchmarks increases the visibility of the impact of the contractor’s measures. (Evans & Richardson, 2009)

3.2. Practical input

Tender document analysis

A document analysis is made towards the performances which are requested in the project goals by Rijkswaterstaat, Water boards and municipalities in RFP's of 12 different water construction projects in the Netherlands. These RFP's were for projects for which the methodology of BVP is applied. Table 3 shows what types of performances were requested and how many times.

Performances	Requests in BV tenders
Costs (1)	Costs (1)
Time (12)	Planning (8) Transfer (4)
Satisfaction (13)	Satisfaction residents (10) Satisfaction users (5) Satisfaction client (1)
HSE (4)	Safety design (1) Ecology design (2) Ecology execution (1)
Quality (22)	Quality (5) Quality design (14) Quality execution (3)
Cooperation (2)	Insight (1) Changes (1)

Table 3. Performances in RFP of construction projects in the Netherlands

The reduction of the costs of the project as a performance is requested once, due to specific project conditions. Usually the costs of a project are a separate criterion in the procurement of Best Value projects and therefore not taken in considerations in the project goals.

Planning can be recognized as a many requested performance in construction projects in the Netherlands. The examples of project goals below illustrate that clients ask for both specific aspects regarding the planning and more abstract requests regarding the overall planning of the project. The transfer towards the user at the end of the project is an activity which is requested as performance multiple times. This performance relates to a smooth and efficient transfer of the project to the users.

“Deliver optimal planning to realize project.”
Delivery harbour services – Rijkswaterstaat

“Acceptance of project plan with minimum delay and costs.”
Dike reinforcement – Waterboard De Stichtse Rijnlanden

The satisfaction of stakeholders is also an often requested performance for construction projects in the Netherlands. Satisfaction of stakeholders is a very broad performance which can relate to different stakeholders, such as the client, users or residents, and different kinds of satisfaction. The examples below illustrate that whereas the first project goal is a broad goal regarding overall satisfaction of client and residents, the second project goal is a specific performance indicator regarding the number of complaints on the activities. The examples illustrate that the satisfaction of stakeholders is very diverse regarding different stakeholders. The difference in specification narrows or broadens the possibilities for vendors to present the best solution.

“Satisfied client and satisfied residents”

Dredging activities – Waterboard Noorderzijlvest

“Minimize complaints on activities.”

Maintenance waterways – Rijkswaterstaat

Performances regarding health, safety and environment are rarely requested in construction projects. The project goals do not directly relate to health and safety issues during the project but more regarding the design of the project. Contractors are requested to optimize the safety and sustainability of projects in the design. For contractors this implies that the actual performance is delivered in the preparation phase of the project. Contractors should therefore be aware that the performance is delivered early in the project and regards mostly the quality of supporting project documents such as the project plan or design.

Performances regarding to the quality of projects is most requested performance in construction project. Therein performances related to the quality of the design of projects are most requested. Contractors are asked to increase specific aspects of the design such as the robustness, maintainability or sustainability. The requested performances also relate to the overall quality or very specific qualities. Finally the clients can ask for specific quality of execution, mostly related to impact on the current situation. As well as performances related to satisfaction, the diversity in request is rather high. Clients can ask for very abstract quality or very specific aspects, as the project goals below illustrate.

“Realize futureproof dikes.”

Design, execute and maintain dike – Waterboard Vallei en Veluwe

“Minimize damage by muskrats.”

Dike reinforcement – Waterboard De Stichtse Rijnlanden

Interviews Rijkswaterstaat and Best Value consultant

Both the employees from Rijkswaterstaat and the Best Value consultant argue that the requested performances for Best Value tenders in construction projects are very much dependent on the project itself rather than the client. The project goals are based on the motive, problem and context of the project and the different interests of the stakeholders. These aspects may differ for each project and therefore the requested performances differ as well. As an overall aspect the employees mention that the added value of the presented performances on the project goals must be clear and measurable.

“It is important that the vendor offers performances that realize an added value on the project goals. It must be clear for the client that the presented performance offers an added value to the project.”

Employee Rijkswaterstaat

The employees of Rijkswaterstaat argue that the project goals may not be too specific. They mention that the setup of the project goals should be as abstract and functional as possible, in order for the vending contractor to come up with its own performance measures, based on its expertise. As a counter they reason that the project goals should give clarity on the expected result to give opportunities for both clients as contractors to steer on performances. The Best Value consultant mentions that the project goals must realistic from a contractors' perspective, it should give the contractor the ability to fulfil its expertise. He also mentions that the project goals should be translatable to measureable performances.

“A client should set up realistic project goals. This implies that it should be able for contractors to meet these goals. The project goals should be translatable to metrics.”

Best Value consultant

The Best Value consultant reasons that performances which repeatedly return in projects of the organisation should be captured in order to present in future Best Value tenders. He argues that these performances, due to the repetitive character, emphasizes the role of the contractor as an expert and increase the quality of performance information. Next to these performances he argues that an organisation should save performances which have a high distinctive character towards other contractors. This is also mentioned by the employees of Rijkswaterstaat whom argue that a contractor should distinguish itself from other contractors by the dominance of the performance information. They argue that more specific performance information increases the persuasiveness of the performance information to achieve the project goals.

The impact of the processes of the contractor on the actual performances in the project is emphasized by both the employees of Rijkswaterstaat as the Best Value consultant. Both argue that the processes of construction project can be used as performance information in Best Value tenders. The Best Value consultant argues that the quality of the processes within the projects define the quality of the organisation. The employees of Rijkswaterstaat mention that these processes do have influence on the quality of the project, but the impact of the processes on the project goals and the relation between the process and the performance should be clear.

Interviews contractor

The interviewees of the contractor are asked to performances of the organisations which they consider as performances which should be captured to use for Best Value tenders. Table 4 gives the different performances which are mentioned by the interviewees of the contractor.

The costs of a project are in a Best Value tender separated from the performances in the project capability submittals. The costs are therefore not relevant and not mentioned by the interviewees.

The planning and the reliability of the planning is mentioned by one interviewee as specific performance. He reasons that planning is an important performance for clients and therefore should be captured as performance for Best Value tenders. He mentions that the progress planning can be used to retrieve specific performance measurements, such as the reliability of the contractor regarding achieving milestones and proceeding on planning.

Performances	Mentions by interviewees
Costs	-
Time	Planning (1) Reliability (1) Transfer to user (1)
Satisfaction	Satisfaction - Stakeholders (5) - Client (1) - User (1) Settling complaints (2)
HSE	Ecology (1)
Quality	Verification & Validation (3) Efficiency design/execution (2) Meet requirements (1) Risk management (1)
Cooperation	Reputation (1) Communication (1) Cooperation (1)
Other	Expertise (2) Risk measures (1) EMVI measures (1)

Table 4. Performances mentioned by the interviewees

Satisfaction of the stakeholders is mentioned by the interviewees, but mostly as a performance measurement for other performances. The interviewees mention that the measured satisfaction of stakeholders should be related to specific performance measures. This way the performance of these specific measures is made quantifiable and verifiable by the satisfaction of the stakeholders. This supposes that the satisfaction of stakeholders on its own is not a special performance, but can be used to quantify a different performance, e.g. *‘stakeholders evaluate the communication measures by*

9 on a scale of 10'. In this example, the satisfaction of the stakeholders is used as performance information to substantiate the performance of communication with the stakeholders.

Because the satisfaction of stakeholders can be used as performance information for many different performances, all interviewees emphasize the importance of the satisfaction of stakeholders as performance indicator. A survey is mentioned by several interviewees as a means to measure the satisfaction of stakeholders. They mention that this survey should thus be set up for different kind of performances.

"There is a need for a standardized survey to collect the satisfaction ratio of the stakeholders as a measurement for different specific performance indicators."

Employee Van Oord

Registration and settling of complaints during the project is mentioned specifically as separate performance. This can be explained by the fact that prevention, registration and settling of complaints is specifically requested in current Best Value tenders for construction projects in the Netherlands.

Efficiency between the design of a project and the execution of a project is mentioned by the interviewees as performance. It is mentioned that efficiency between the design and execution of a project is essential to lower the number of scope changes during execution and manage the interfaces with the environment. One interviewee mentions *"efficiency between design and execution can speed up the process of verification and validation"*. This implies that the efficiency between design and execution has impact on other performances such as the planning of the project.

Several interviewees mention the process of verification and validation, which indicates the delivery of qualitative good reports. This may also reflect to the high performance due to the standard processes used by the contractor. Specifically mentioned is the risk management process that is used by the contractor. Measuring the effectiveness of the risk management or the acceptance of documents by the client may indicate the quality of the contractors' processes.

"Acceptance of documents by the client is a performance measurement that shows that the standard process which is followed to setup reports works well".

Employee Van Oord

Finally the interviewees mention that performances regarding specific expertise of the contractor are essential in Best Value tenders. Specific expertises are mentioned as competitive in Best Value tenders due to the distinctive character towards other contractors. The interviewees argue that in order for project managers to recognize these performances, the organisation should design a framework for these performances and how to capture performance information regarding these performances.

"Design a shortlist of performances which are required less, but have high competitive character due to distinctiveness."

Employee Van Oord

Overall the interviewees mention that the choice which performances to capture should be made by the management of the organisation. This is mentioned because the management level of the organisation can by this performance template steer on specific performances which can help to differentiate the organisation from other organisations. The interviewees mention to be aware that the choice of performances is a dynamic process. This implies that the performances should be updated regularly in order

to capture performances that are still relevant for the market. The interviewees mention that the choice for which performances should be captured, should be based at one hand on performances that are relevant for the market and thus are regularly requested in RFP's and on the other hand have a high competitive character.

3.3. Conclusion

This chapter provided the input which is required to answer the following research question;

RQ1. Which performances are relevant for contractors in the water construction industry to present in Best Value tenders?

For construction projects in the Netherlands we can identify the following six categories of performances which define the success in these projects:

- **Costs**
- **Time**
- **Satisfaction**
- **Health, Safety and Environment**
- **Quality**
- **Cooperation**

For contractors in the water construction industry to come to relevant performances to present in tenders and perform in projects, they should follow the theory of Toor and Ogunlana (2009). They describe how overall project performances, such as the quality of a project, can only be achieved by presenting more specific performances. By splitting these abstract performances in more specific performances, contractors are better able to present their contribution to the project success. The process of how a contractor can come to performances that are relevant to present in Best Value tenders can be illustrated by the following steps:

1. **Examine the market and the clients for relevant performances.** These are performances that can be seen as the performance categories that indicate whether or not a project is successful.
2. **Examine the own organisation on specific performances.** These are the specific performances within the categories that show the position of the contractor as an expert. The performance must indicate how the contractor contributes to the success of the project.
3. **Present the performances by performance indicators.** For dominant communication on performances the use of measurable performance indicators is essential. The indicator should be relatable to measurable aspects in the project.

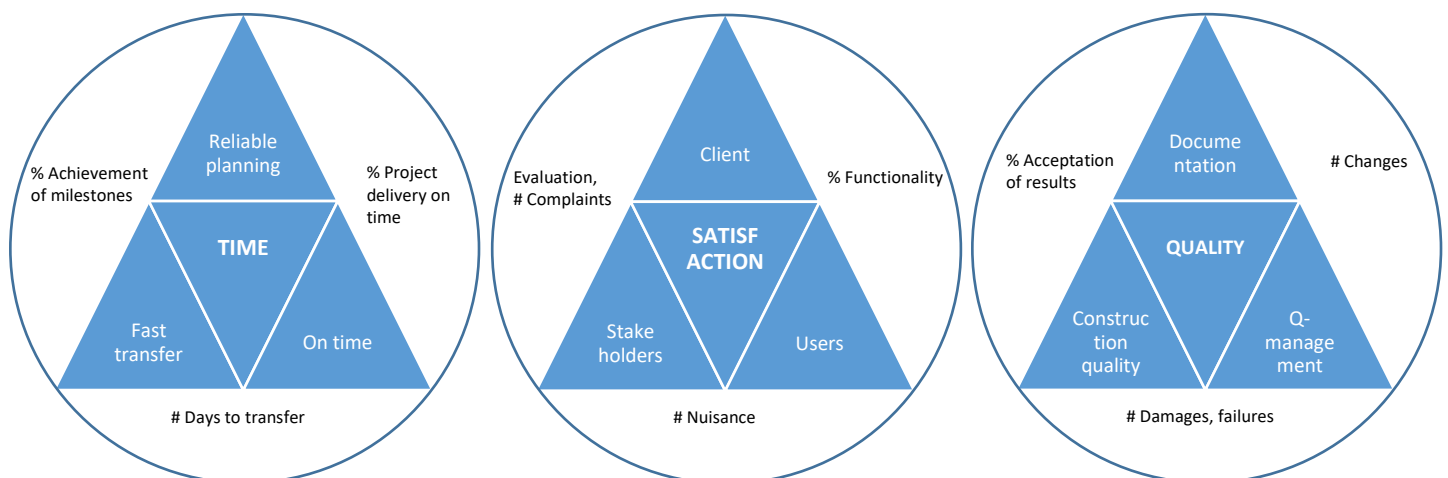


Figure 5. Setup of relevant performances and indicators in water construction projects (Own ill.)

Whereas all the above mentioned categories are relevant in construction projects of any kind, the analysis towards tenders in the water construction industry and the interviews with professionals displayed that

performances regarding time, satisfaction and quality are most relevant in water construction projects. Using the model of Toor and Ogunlana (2009), relevant performances and indicators regarding these categories are setup in Figure 5.

Next to these categories, performances regarding cooperation and health, safety and environment can be relevant in water construction projects. An example of a performance regarding cooperation can be good cooperation with the client, indicated by the number of disputes or by an evaluation of the client. An example of a performance regarding health, safety and environment can be sustainability, indicated by the percentage reuse of material. The costs are mentioned as important aspect to determine the project success, though, the costs are assessed beside the qualitative documents and therefore not relevant to present as a performance in Best Value tenders.

Whereas the examples above provide several relevant performances in the water construction industry, the Best Value theory is all about the utilization of the expertise of the contractor. It is therefore very important that the contractor does not come up with performances based on the objectives of the client or theoretical research, but based on its own experiences and expertise within projects. This requires from the client project goals to be as abstract as possible, to provide the contractor the ability to deliver the highest performance.

4. Capturing performance information

This chapter focusses on how a contractor can capture specific data in projects to come to qualitative performance information. The first part focusses on the literature which describes the function and requirements of performance information and how to capture performance information. The chapter continues with the practical input which provides the interviews with two employees of Rijkswaterstaat, a Best Value consultant and employees of Van Oord and personal observations which have been made during the research at Van Oord. The chapter concludes by providing an answer on research question 2.

4.1. Literature

Performance information in tender submittals

The objective of the project capability submittals is to address a vendor's competence to execute the project, its capacity to identify/mitigate/minimize risks and its ability to increase the value of the project (I. Kashiwagi). In the project capability submittals the vendor must show to be the best party to execute the project. To present the performance to be achieved in the project, the vendor must describe performance statements. These performance statements must be supported by verifiable performance information. The quality of the performance information depends on the following aspects (D. T. Kashiwagi, 2016);

- Match current project requirements and show multiple previous applications;
- Are simple and non-technical (use of metrics);
- Reflect high performance results;
- Reflect direct correlation to relevant key factors of project performance (cost, time, and final product quality);
- Are relevant and in context to current project with supporting experience in previous applications.

The objective of performance information for vendors is to pursue the client of the vendors expertise by differentiating themselves as experts. D. T. Kashiwagi (2016) summarizes that vendors differentiate themselves most by providing information that is *non-technical, relevant and closely related to the client's project requirements*.

Performance information is information that proves that the vendor is able to achieve the performance claim. Theoretically this information can come from many sources such as media publications or relevant academic research. This kind of information can be used when this information supports the performance claims; it is though not very persuasive of the vendor's expertise. In practice the most used source for performance information is data from the vendor itself. This data is persuasive by proving that performances have been delivered in the past and therefore can be delivered again. (Koreman, 2014)

The following example of performance information shows how the performance information substantiates the performance claim (D. T. Kashiwagi, 2016, pp. 11-08):

Risk Assessment Claim:

In 40% of our past 5 projects the connecting software packages were not compatible, the market average is 6 weeks to correct this problem. We as the expert vendor have a mitigation process that identifies the risk quickly and reduces deviations caused by the risk.

Performance Information:

1. # of projects where risk mitigation plan was implemented: 5.
2. # of projects required correctional action: 2.
3. Average discovery of compatibility was 50% earlier than traditional methods.

4. *Minimizes delay to: 0-1 week.*
5. *Customer satisfaction of risk process: 9.8 (out of 10).*

Dominant information

For performance information to be persuasive, the literature refers to the dominance of the performance information as most important factor. D. Kashiwagi and Kashiwagi (2011) describe dominance as a term that means *easy to see, a consensus opinion, or a no brainer that minimizes the need for long justification explanations*. This can thus be seen as an application of one of the foundations of the BVA, namely *simplicity* (D. T. Kashiwagi, 2016).

Performance information which is presented in the project capability submittals of Best Value tenders should be dominant information to easily assess the performance information. Dominance in the context of performance information means that the performance information complies to the following aspects (Rijt & Santema, 2013, p. 70);

1. Non refutable;
2. Verifiable;
3. Accurate;
4. Measurable in terms of numbers, percentages or time;
5. Show a high performance;
6. Translated to the performance in the current project.

In an informal leaflet Rijkswaterstaat (2015) describes dominant performance information as information which is *simple, non-technical and verifiable*. It should be information which can easily be understood by non-experts. In the standard lay-out for the tender- and review document used by Rijkswaterstaat, the following aspects for dominant performance information are mentioned (Rijkswaterstaat);

1. Simple;
2. Easy to verify;
3. Easy to quantify;
4. Does not require specific expertise to understand;
5. Can be seen as logic, common sense or obvious.

To come to dominant performance information it is essential to capture the verifiability of the information. By asking the question 'What is this information based on?' all required information regarding the verifiability, measurability and the relation to the performance in the project can be captured. Kempa (2016) reasons that by doing this again and again this leads to an increase in dominance of the performance as illustrated in the following example;

From 'We start our projects with a project kick off meeting because that works well.'
to 'In the past 3 years we handled the project kick off meeting; this approach led to a time reduction of the project team of 20 hours. Clients evaluate our project planning with 5 on a scale from 1 to 5.' (Kempa, 2016)

"If you can't explain it simply, you don't understand it well enough" Einstein

Metrics

The literature refers to the use of metrics as essential to come to dominant performance information. Metrics are numbers which are used show that a provider of a service or work is good at something. The essence of the use of metrics is that this secures that the performance information is measurable, which increases the persuasiveness of the performance information. According to Rijt (2017) *metrics are the most dominant form of information* which is emphasized by Rijt and Santema (2013, p. 70).

The vendor should illustrate its tender by using metrics, such as performance measurements or performance indicators. The use of metrics is important in Best Value tenders because metrics are supposed to be *non-refutable, simple, verifiable, measurable and time-bounded* (Koreman, 2014). These are also the requirements on performance information which are mentioned earlier by Rijt and Santema (2013). Examples of metrics as dominant performance information in the construction industry are (D. T. Kashiwagi, 2016, pp. 4-2; Koreman, 2014);

- Number of times the solution has performed;
- Customer satisfaction;
- Number of defects;
- Number of projects;
- Length and size of projects;
- Cost and time deviations [# and %].

Performance information as guarantee for future performance

In the eyes of many vendors, procuring based on performance information seems no different than procurement based on *past performance* of the contractor. Performance information however has as objective to substantiate the performance to be delivered in the future. This is done by using past performance information of the contractor while making the relation of the performance to the current project and project objectives. The performance information serves as a means to *promise a certain performance for the future*, based on earlier performances. Procurement based solely on past performance is forbidden by law in the Netherlands. (D. Kashiwagi, 2011; D. Kashiwagi & Kashiwagi, 2011; Leeuwen, 2011; Rijt & Santema, 2012, 2013)

Capturing performance information

In his blog on performance information Koreman (2014) describes 6 steps to capture performance measurements:

1. Determine fundamental performances of the organization. This is done preferably by keeping a brainstorm session, possibly with third parties;
2. Make a distinction between performances which are important to the client and performances which are important for the internal organization;
3. Determine the measurement of the performance. How is the performance visualized or which quantification will be used to express the performance?
4. Operationalise the measurement by determining which performances are already quantified or visualized and which are still required to gather.
5. Determine the way of performance measurement by determining who is responsible for the measurement and which instructions are required.
6. Report the final performance measurements.

He emphasizes the importance of preparation of the organisation on how to capture performances before actually starting to capture performance information. The steps as mentioned above can be divided in three objectives, namely the choice of performances, the capture of performance measurements and the reporting of performances. Koreman (2014) emphasizes the choice of which performances to capture in advance of the projects. The choice for performances has been discussed in chapter 3. The second objective is the capture of performance measurements. Koreman (2014) mentions the use of standard measurements for performances, which also has been discussed in chapter 3. Furthermore he emphasizes the importance of having a plan how to capture these performance measurements in projects. The organisation should come up with a plan on how capture the performance measurements in projects and who is responsible for doing so. Finally the performance measurements should be reported within the organisation. This will be discussed in chapter 5.

When an organisations starts to capture performance information, the literature emphasizes the responsibility of the management of the organisation, especially in the choice and setup of performance measurements. The management should be responsible to examine the performance indicators on relating to the organisations' strategy and watch for emerging trends in the performances. Based on these emerging trends, the usefulness of the performances should regularly be assessed and adapted. The management also needs to assure that the measurements are in balance in order to keep the focus on the actual performance. (Evans & Richardson, 2009; Slack et al., 2007)

4.2. Practical input

Interviews Rijkswaterstaat and Best Value consultant

Both the Best Value consultant and the employees of Rijkswaterstaat emphasize the importance of the relationship between performance measures and actual performance. The consultant argues that presenting this relationship is important for the assessment of the Best Value tender due to the high persuasiveness of information that explains how performance measures lead to a certain performance.

Both the employees of Rijkswaterstaat and the consultant argue that the presented performance should have a measurable impact on the project goals. The employees of Rijkswaterstaat reason that the objective of using BVP during the procurement of projects is to maximize the added value on the project goals. Presenting a measurable impact on the project goals gives the client a clear understanding of the performance and convinces the client of the expertise of the vendor.

“It is important that the performance is related to the project goals. This increases the simplicity for the client and increases the clarity of the added value of a performance for the client.”

Employee Rijkswaterstaat

The Best Value consultant emphasizes the importance of an incentive within the organisation to capture performance information and mentions that the management of the organisation should steer on capturing performance information. He reasons that the organisation should make decisions on which performances to capture and therein focus on what performances display the quality of the organisation. He argues that in order to gain structure and a clear overview on the captured performance information, the organisation should use a uniform method and language to capture performance information.

“It is essential that the management of an organisation recognizes the importance and utility of capturing performance information. The management of an organisation should monitor and steer the process of capturing the right performance information.”

Best Value consultant

Interviews contractor

The interviewees of the contractor are asked for aspects to take in consideration for capturing performance information in projects. Table 5 provides the responds regarding these aspects.

Collecting performance information	
Performance framework	Performance template (3)
Performance measurement	Uniform measurement (3)
	Base measurement (2)
	Effectiveness measures (2)
Responsibility	IPM roles (4)
	BV mind-set (4)

Table 5. Collecting performance information

Multiple interviewees mention a performance template should help the managers in projects to understand which performances should be saved and which information to capture as performance information. This template is thus an extract of the list of performances mentioned in chapter 3. For compatibility the interviewees mention that the performances should fit in the current project processes which are set up in the work breakdown structure in projects.

“There is a need to a standard template regarding to which performances should be saved. By this template, all managers know which performances should be saved and all performance information is built up the same way.”

Employee Van Oord

The interviewees mention that the performance template should be used to describe how specific performances should be captured and saved. A prescribed way of measuring and capturing performances leads to uniform performance information from different projects. Uniform performance information is mentioned as essential to use multiple projects as performance information in tenders. Furthermore the interviewees mention that uniform performance measurement gives opportunities to compare performances over different projects and increase the learning curve of the organisation.

The interviewees mention the importance of proper measurement of the performances in order to use as performance information. They mention two specific aspects to capture namely a base measurement and the relation of the performance to the performance measures. They reason that a base measurement gives material to compare future performances and picture the increase in performance during the project. The relation between performance measures and the actual performance can be recognized as the effectiveness of performance measures. The interviewees argue that this should be captured as persuasive performance information since this proves that the contractor is able to deliver a performance due to its expertise. As the quote below illustrates, this information can also be used for internal performance management purposes.

“For the risk management it is important that the effectivity of specific risk measures is measured and verifiable. On the basis of this effectivity better choices can be made regarding effective risk measures.”

Employee Van Oord

The interviewees recognize the roles of the IPM managers¹ as most applicable to divide the responsibility for capturing the performance information. These different managers could extract different types of performance information from the projects. Some interviewees argue that, even though the actual performance information could be extracted from the IPM managers, one person should be made responsible for gathering the performance information in a central place.

“The IPM model is most used and therefore best applicable as a means to divide responsibility regarding the capturing of performance information. The different IPM roles can capture different kind of performances, the processes of the organisation, such as the work breakdown structure, are adjusted to these roles.”

Employee Van Oord

The interviewees also argue that it is very important that the people who are responsible for capturing the performance information have knowledge of the Best Value theory and the application and requirements of

¹ To improve the cooperation between Rijkswaterstaat and contractors, Rijkswaterstaat implemented the Integral Project Management (IPM) model. This model makes a clear separation in processes and responsibilities within a project team. The IPM model knows the following roles and tasks (Rijkswaterstaat, 2017b):

- Project management: Overall responsibility for project outcome.
- Project control: Responsibility for identification and control of risks.
- Environment management: Responsibility for environment and stakeholders.
- Technical management: Responsibility for technical input.
- Contract management: Responsibility for all contracts.

Most contractors, including Van Oord, apply the same roles in project management teams. For Van Oord the role of project control is the responsibility of the process manager.

performance information. This is mentioned since it should help the responsible manager to recognize performances. The interviewees emphasize the knowledge and mind-set of Best Value and performance information because people who understand the application of performance information should have an understanding which information increases the usefulness of performance information.

Observations

During the research observations have been made towards the setup of the project capability submittals for a Best Value tender of the contractor. During these observations, the following aspects were noticed with regard to performance information in the organisation.

Observed is there are no uniform performance measurements available in the organisation. Performance measurements which have been executed in projects in the past have been executed for external incentives, such as the verification of specific requirements by the client. Therefore performance measurements for as far as they are available, don't have a uniform measurement. This leads to the situation where the amount of useful performance information is limited.

Another observed aspect regarding the use of performance information is the relation of performances to performance measures. Due to the lack of performance information, the tender team started to capture performance information during execution or after projects. It was observed that it was hard for the tender team to make clear that the performance was a result of specific performance measures, due to the lack of base measurements and specific effect measurements.

4.3. Conclusion

This chapter provides the input for the answer on the following research question;

RQ2. How can a contractor capture data during projects to serve as performance information in future Best Value tenders?

To capture the right data to use as performance information, the contractor should design a so-called '**performance template**'. This is a checklist for project teams that describes how and which data has to be captured. This list is based on the performances chosen by the organisation as mentioned in chapter 3. The presence of a performance template is essential in order to capture performance information on a uniform manner over different projects. Before the start of the project, the project team decide which performances are to be delivered in the project and based on that decide which performance information has to be captured in the project. It is important that the people whom are responsible for capturing performance information are informed on their responsibility. A first setup of such a template to be used by Van Oord is added in the appendices.

The performance template describes the following data to capture:

1. **Performance.** Based on the project characteristics and processes, the management of the organisation and the project team decide which performances are to be delivered and therefore should be captured in the project.
2. **Performance measurement.** This gives a guideline on how the performance is measured, as indicated by the performance indicators in chapter 3. For most performances it is recommended to capture a base measurement to visualize the improvement on the performance during the project.
3. **Verification.** This prescribes what documentation should be used to verify the performance.
4. **Planning.** To indicate performances, a planning is essential. The performance template should prescribe per performance at which time and interval the performance is measured.
5. **Responsibility.** The responsibility to capture the different performances should be divided according the different processes to the IPM managers. The IPM managers are responsible to execute the performance measurements and to capture the performance data and verification documents.
6. **Actions.** The performance template can prescribe what actions to take to achieve performances. More importantly the performance template should give the IPM managers the incentive to capture any information on the performance actions that led to the achieved performance.

It is the responsibility of the project manager to gather the performance information of the IPM managers at a central location. It is recommended to use the final work reports to collect all performance information. This way the performance information is traceable within the contractors' organisation. After completion of the project all performance information is transferred to the contractors' organisation for central storage within the organisation. The contractor designates a responsible person within the organisation to transfer the performance information to a central storage.

To increase the relevance of the performance information for future projects and tenders, the performance information should be set into context. This means that the performance information should be related to project and process specifications. For future applicability of performance information, the following data is related to the performance information:

- **Project type** (Dredging, Dike reinforcement, Land creation etc.)
- **Contract type**
- **Contract sum**
- **Year**

- **Process** (Project management, Project control, Environment management, Technical management, Contract management).

5. Storage of performance information

This chapter describes how the captured performance information as described in chapter 4 can be stored within the contractors' organisation. The chapter first describes the literature on the requirements of information and the storage of data in order to come to useful information. It continues with the practical input which provides the interviews with Rijkswaterstaat, a Best Value consultant and employees of Van Oord and personal observations which have been made during the research at Van Oord. The chapter concludes by providing an answer on research question 3.

5.1. Literature

Data vs. Information

Literature on information management makes a clear distinction between data, information and knowledge. It is essential to make this distinction because considering these words as synonyms frustrates the ability to develop requirements for their capture and storage (Collins, 1998).

Data refers to a textual representation, either numbers or words, as they are provided by a computer or can be stored in the form of reals, integers or strings. Data can be considered as numbers or words which represent a measure such as a quantity. (Hicks, Culley, Allen, & Mullineux, 2002; Tolman, Beheshti, & Dado, 2009)

Information is defined as data that is provided within a certain structure or framework (Tolman et al., 2009). This framework provides that the given data is *accurate and timely, specific and organized for a purpose and presented within a context that gives it meaning and relevance* (Business Dictionary).

Data can be thus seen as raw, unorganized facts whereas information can be seen as data which is processed, organized, structured or presented in a given context ("Data vs. Information," 2017). It can be said that "*information consists of a number of related data*" (Tolman et al., 2009).

Storage of information

Storage of information generally results in a representation in an electronic format using computer software. To correctly interpret and regenerate the captured information, the proprietary software is required. There are many different formats available to fulfil this function, which has as a consequence that access to information is limited to users which can access the used electronic format. Therefore, the applicability and usability of the used software to store information within an organisation is of high importance for the availability of the information. (Hicks et al., 2002)

The proprietary software must provide structure for data to organise the information within the repository. This is essential in order to replicate relations, networks or hierarchies between the different data elements. Replicating relation, networks and hierarchies between different data elements is required in order for data to be interpreted as information. The repository should include any type of relation or dependencies between the data which is required in order for a proper interpretation of the information. (Elmasri & Navathe, 1994; Hicks et al., 2002)

Information systems have become more and more complicated. Advanced technology led to the development of elaborate models which have brought high levels of confusion and disorientation. Simple, straightforward information systems mostly produce greater result than more complex systems. Zachman (1987) argues that smaller, suboptimal information systems architecture leads to quick implementation and is easier to design and manage. (Sullivan et al., 2006; Zachman, 1987)

Systems architecture

Several studies have been performed on database systems to capture knowledge or information within construction companies (Chassiakos & Sakellaropoulos, 2008; Eken, Bilgin, Dikmen, & Birgonul, 2015; Ozorhon, Karatas, & Demirkesen, 2014). These studies emphasize the use of web-based information systems since these are currently in use by most construction companies and avoid issues related to spatial dispersion of construction sites.

Regarding to web-based database systems the literature mentions two different systems namely a document-based system and a data-based system, also referred to as relational database. Chassiakos and Sakellaropoulos (2008) argue that for right interpretation of the information the use of data-based systems is recommended. Where document-based systems refer to blocks of information (documents) data-based systems directly refer to the data itself. This has as advantage that the information is recognized and therefore can prevent double, conflicting or wrong data. In addition, such a system enables specific data searches. A quick representation of such a database is illustrated in Figure 6. (Chassiakos & Sakellaropoulos, 2008; Eken et al., 2015)

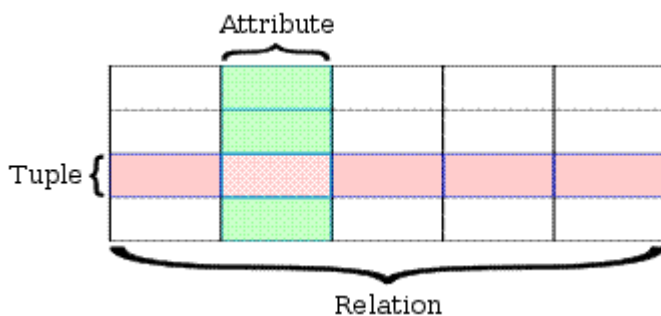


Figure 6. The setup of data in a relational database (Urgenthomework, 2017)

Figure 6 shows how a data-based system ensures the relationship between the different types of data. This enables the users to search for specific attributes while the relationship towards the other data within the performance, here referred to as 'tuple' is kept in place.

Processing information

For a successful capturing and processing of information in an organization it is essential that only the most information is captured. Unstructured information or an overload of information will lead to a lack of clarity in which information should be used and which information is reliable. It is therefore essential that the model used to capture information has strict requirements regarding the information. In the processing of information, Sullivan et al. (2006) suggest that an information model only succeeds when the information is screened using the following criteria:

- Eliminate data and capture information;
- Identify the appropriate and significant information;
- Simplify the information;
- Translate the information into measurements;
- Minimize communication.

For a proper understanding and interpretation of the information it is useful to come to a standardized approach on how to describe the information. Grudzien and Hamrol (2016) describe the following seven attributes as a means to come to a standardized approach on describing process information of organizations on a comprehensive manner;

- *Comprehensiveness;*
- *Accuracy;*
- *Applicability;*
- *Conciseness;*
- *Consistency;*
- *Correctness;*
- *Currency.*

Furthermore, Turner (1978) describes that all information elements used in an organization should comply to the following requirements in order to be useful in the organisation;

- *Available;*
- *Authentic;*
- *Applicable;*
- *Accessible.*

5.2. Practical input

Interview Best Value consultant

The Best Value consultant emphasizes the need for a database to store the performances within an organisation. He mentions that this database can be set up two ways, either an integral system within the current systems of the organisation or a separate system. Whereas an integral, currently used system increases the easiness and synchronisation within project environments, the setup of such a system may be hard. A separate database can be setup easier and faster, though this reduces the opportunities to synchronize the database with project environments. He specifically mentions that during the setup of this system the usability and time to fill the database is essential for project managers.

The Best Value consultant argues that relevant project data is information to be included with the performance information. Whereas some information is useful to search for specific performance information, he specifically warns to be aware for too heavy system with too many types of data. This decreases the usability and increases the time necessary to fill and use this database.

Interviews contractor

The interviewees of the contractor are asked for how performance information can properly be stored within the organisation and which aspects to take in consideration while designing such storage. Table 6 gives the responds regarding these aspects.

Storage of performance information	
Database	Performance library (5) Current IT systems (2)
Selection tools	Project/ construction data (5) Processes (4)
Other	Time/Efficiency (5) Applicability outside BVP (4)

Table 6. Storage of performance information

All interviewees recognize the importance of a performance library as a database to store performances and performance information within the organisation. This performance library should contain all information to substantiate a Best Value tender by performance information. It is mentioned in the interviews that past projects need to be analysed for performance information in order to come to a substantive performance library on the short term. Mentioned is that a well filled performance library gives the organisation insight in the status of the organisation regarding specific performances. This way the performance library could serve as a means for performance management by steering on performances which have less good performance. This insight in performances also provides the opportunity to explicitly search for good performances to provide in Best Value tenders.

“A performance library could serve as a means to bring out the best performances of the organisation, based on the idea of ‘Big Data’”.

Employee Van Oord

In the interviews is mentioned that this performance library should be implemented in the IT systems that are currently in use by the organisation. According to the interviews, new software systems are hard to implement in organisations, especially in larger organisations. They also mention that the use of currently used systems increases the usability of the system for all employees. Since time and efficiency regarding the use of the performance library is mentioned by all interviewees, this is a major point of attention. The use of

current IT systems is also emphasized for the workability and compatibility with project environments using the same software.

“The performance library should be created in the existing database systems of the organisation. The use of new IT tools creates extra work and complications.”

Employee Van Oord

The interviewees mention as an important aspect of this database that different aspects of the information can be selected in order to search during a tender for specific performance information. All interviewees mention the characteristics of the project as data to relate to the performances. These characteristics can be the type of contract, the size of the project, the construction characteristics of the project etc. One interviewee mentions that the contact details of the project manager should be added to the performances in order for the tender manager to gain additional information if necessary. Most interviewees mention the different processes (IPM processes) as a distinction that should be used to categorize the performances. A distinction can be made within these processes on different categories. Whereas the IPM model is widely used and adapted within the organisation, the interviewees mention this to be best applicable for categorization of performances. In the interviews it is mentioned that categorization of the performances on project and process characteristics is not only useful to search for performances, but also increases the specification and therefore the dominance of the performance information.

“During a tender it is useful to search for performances from different perspectives, not only on project characteristics but also on process type.”

Employee Van Oord

All interviewees mention that time and efficiency regarding the use of this database is very important due to the lack of time for administrative tasks by project managers. The interviewees therefore argue that both capturing as storing the information should be efficient and not time consuming. The interviewees also use this as an argument to design the database in IT systems which are already in use by the organisation, since this helps the project managers to quickly understand the setup and easily make relations between different types of information.

In the interviews it is mentioned that a performance library could be used other applications as well. The interviewees mention different tender and procurement applications for the performance information. One aspect that is mentioned is the applicability of the performance library for prequalification applications. In the interviews it is also mentioned that the performance library could be used for tenders based on EMVI criteria. By having insight in the effect of performance measures, the organisation is able to come up with EMVI measures that lead to the highest performance in the project. Therefore the applicability and setup of the information in the performance library should be more general than specifically for Best Value applications. The interviewees mention this as relevant regarding the filtering possibilities in this library.

Observations

During the research observations have been made towards the setup of the project capability submissions for a Best Value tender of the contractor. During these observations, the following aspects were noticed with regard to the storage of performance information in the organisation.

The tender team did not have a clear overview on which performances have been delivered by the organisation in the past. This led to the situation where the tender team had to search for relevant projects where these performances had been delivered and within these projects search for substantiating performance information. As a result the amount of useful performance information is rather low. The

tender team might miss projects where these performances are delivered or within these projects the performance information is hard to find.

Also observed is that during a tender, the contractor comes up with performances measures based on expertise and experience. When performance measures have been chosen the substantiating performance information is been gathered form projects. Performances which are presented in the project capability submittals are thus not presented due to the high performance but for the relevance to the performance measures.

5.3. Conclusion

This chapter provides the input for the answer on the following research question;

RQ3. How can information be stored within a contractors' organisation to reuse this as performance information in Best Value tenders?

The captured performance information has to be stored in a therefore specifically designed web-based relational database. The performance information as gathered by the project managers is transferred to a person in the organisation whom is responsible for a uniform storage of performance information in this database. To maintain uniformity within the data, it is recommended to restrict the amount of person who can import the data in the database.

The database provides the following data, including filter and selection options to search for specific performance information:

1. **Process.** The processes of the contractor follow the IPM structure, therefore to search for performance information the performances are categorized according the IPM processes.
2. **Performance.** This describes the actual performance that is delivered in the project e.g. the delivery of a reliable planning.
3. **Performance indicator and measurement.** This provides the required metrics for the performance to indicate the expertise of the contractor, e.g. 95% milestones achieved.
4. **Construction type** (Dredging, Coastal Engineering, Infra marine, Infra Land).
5. **Contract type.**
6. **Contract sum.**
7. **Date.**
8. **Verification.** This provides the necessary documentation to verify the performance.
9. **Performance actions.** If applicable for the specific performance, actions which are taken to achieve the performance can be stored.
10. **Contact.** To provide tender teams the possibility to gain extra information, the contact information of the project manager is useful.

The use of a relational database is required to maintain the relations between the data and thereby guarantee a uniform interpretation of the information. Furthermore, this database gives tender teams the possibility to filter for specific performances, based on project characteristics and processes. Filtering for specific performances provides the tender teams the possibility to present performances that best represent the expertise of the organisation and are most relevant for the project.

Part C Conclusion

This part of the research provides the final conclusion of the research. Chapter 6 gives the conclusion by providing the answer on the main research question. This chapter further describes several recommendations which are relevant for both the contractor as well as clients of construction projects using BVP. Chapter 7 gives a discussion on this research by providing the limitations this research is subject to. This chapter provides several options for further research.

6. Conclusion

This chapter provides the conclusion of the research by an answer on the main research question. Further, several recommendations are made for practical implementation of this process within water construction projects.

6.1. Answering the research question

This research has been conducted to provide a contractor in the water construction industry clarity on how performance information, which is essential in BVP project, can be captured and stored. Whereas the contractor is rather unacquainted with the delivery of performance information, this research provides clarity on how to come to qualitative performance information and how to capture and store this information. The objective of this research was to describe an approach on how a contractor in the water construction industry can capture and store performance information. The goal of this approach is to increase the efficiency and quality tenders according to BVP and thereby the projects. The main research question for this research is the following:

How can a contractor in the water construction industry capture and store performance information to be used in Best Value projects?

Which performances to capture

Though from the literature multiple performance categories can be recognized as important for the success of construction projects, from the practical input in this research it can be said that performances regarding time, satisfaction and quality are most relevant to present in tenders for water construction projects. Whereas time, satisfaction and quality are just abstract performance categories, it is up to the contractor to come up with specific performances within these categories to present as performance in Best Value tenders. These performances must express the position of the contractor as an expert, using performance indicators to quantify the expertise. Thus, the contractor must come up with measured performance indicators, that quantify a specific performance which relate to a relevant performance category. Figure 7 provides some examples how specific performances and performance indicators relate to the core of abstract performance categories.

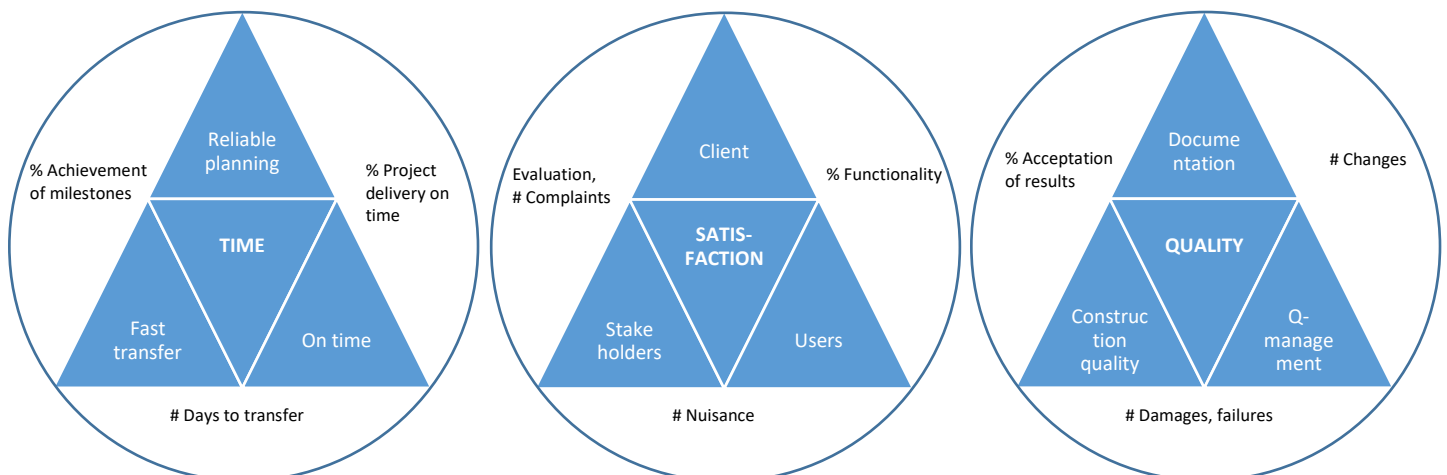


Figure 7. Setup of relevant performances and indicators in water construction projects (Own ill.)

Whereas the examples in Figure 7 provide several relevant performances in the water construction industry, the Best Value theory is all about the utilization of the expertise of the contractor. It is therefore important that the contractor does not come up with performances based on the objectives of the client or theoretical research, but based on its own experiences and expertise within projects. This approach will lead to performances that really show the position of the contractor as an expert. This implies that contractors come up with different performances and performance indicators to express their expertise on abstract performance categories. For a contractors to know which performances to present in tenders, the own organisation must be examined. The contractor must assess which processes, tasks or investments have an impact on the success of these performance categories and therefore imply that a specific performance is delivered.

This research has shown that for employees of the contractor a change in mind-set is required. The current mind-set of employees at the contractor is to investigate how a high performance can be achieved, rather than what the actual performance is. To notice which performances are relevant to present as an expert, the contractor must focus on what the actual delivered performance is. More than just focussing and describing how specific work methods reduce the nuisance for residents, the actually measured reduction in nuisance, e.g. reduction in noise nuisance measured in decibel, is what shows the expertise of the contractor.

The idea of Best Value to come to the highest value in project is to replace the decision making and MDC of the client by the utilization of expertise of vendors. This research has shown that the level of abstractedness of the project goals in water construction projects differ per client and project. Some clients in the Dutch water construction industry may set up very specific project goals, and thereby reduce the possibility for the contractor to express its expertise. The ability of the contractor to come to the highest value in projects, based on its experience and expertise, requires from the client to provide the freedom to the contractor to do so. This means that the project goals should be as abstract as possible.

Capturing performance information in projects

To capture performance information on these performances uniform over different projects, the contractor has to set up a 'performance template'. This template contains all performances which are chosen by the organisation as performances which represent the expertise of the organisation. The template gives a guideline for project teams how to capture performance information by the following aspects:

1. **Performances.** The template contains all relevant performances of the organisation.
2. **Performance measurement.** This gives a guideline on how the performance is measured, as indicated by the performance indicators.
3. **Verification.** This prescribes what documentation should be used to verify the performance.
4. **Planning.** The performance template prescribes per performance at which time and interval the performance is measured.
5. **Responsibility.** The responsibility to capture the different performances should be divided according the different processes to the IPM managers. The IPM managers are responsible to execute the performance measurements and to capture the performance data and verification documents.
6. **Actions.** The performance template may prescribe what actions to take to achieve performances. More importantly the performance template should give the IPM managers the incentive to capture information on the performance actions that led to the achieved performance, e.g. informing the residents by letter reduced the number of complaints.

Table 7 projects how the performance template provides clarity for project teams to capture performance information. The performances in the first column are the performances which are chosen by the contractor. The performance template gives a guideline for project teams which performance information to capture, though the choice which performances to capture is dependent on characteristics of the project, e.g.

possibilities to reuse a high amount of material can be an incentive to capture this as performance information. The use of a template ensures the uniformity in performances and performance measurements over different projects.

Performance	Performance measurement	Verification	Planning	Responsibility	Actions
Reliable planning	% Achievement of milestones	Planning	At milestones	Process manager	Risk based planning.
Smooth delivery and transfer	# Days of process delivery and transfer	Delivery dossier	At transfer	Project manager	Start process D&T one month early
Maintain functionality	% Maintain functionality road during execution	#,T Road closures	Continuous	Environmental manager	Use of small equipment
Reduction of complaints	# Complaints due to contractor	Complaints register	Continuous	Environmental manager	Inform residents before activities
Maintainable design	Evaluation by operator	Evaluation	Design phase	Technical manager	Question operators during design
Sustainable design	% Reuse of materials	Design	Design phase	Technical manager	Reuse of material in design.

Table 7. A performance template gives clarity which and how performance information is captured

The research has shown that IPM managers should be responsible to execute the performance measurements and to capture the performance information. The project manager should be responsible to gather the performance information from the IPM managers in the project. To transfer the performance information to the organisation to be imported in the performance database, the project manager inserts the captured performance information in the final work reports. This ensures that the performance information of projects is always traceable.

Presenting the expertise of the contractor

The captured performance information has to be stored in a performance database which is designed as a web-based relational database. This is done by using software which is currently in use by most contractors to store project and organisational data, e.g. SharePoint or Relatics. The use of such a database provides tender teams the possibility to filter all kinds of data to come up with the most relevant performances to achieve the highest value in this project.

For tender teams to come up with most relevant performances to present, the performance information must be related to specific project characteristics. These characteristics, such as project type, contract type, contract sum and year gives the tender teams the possibility to specify the search for performances, which increases the relevance of performances towards the current project. One important characteristic to filter the performances is the IPM process. All activities of the contractor are divided according to IPM processes. Structuring the performances according the IPM processes increases the usability of this database. Furthermore, to provide tender teams the possibility to gain extra information, the contact information of the project manager must be available and related to the performance.

The performance database must be kept up to date by one designated person in the organisation. This person is responsible to gather the performance information from the final work reports of projects and import this data in the database. Restriction of the responsibility for the import of performance information to a limited amount of people ensures the uniformity of performance information.

6.2. Recommendations for practical implementation

Beside the approach of capturing and storing performance information as described above, there are several recommendations that can be made. For the contractor these recommendations are relevant to increase the efficiency of this approach or to broaden the effects of capturing and storing performance information. Based on the findings of this research a recommendation can be made towards clients of construction projects as well.

Encouragement of the management

It is essential that the management of the contractor is involved in the capture and storage of performance information. The choice which performances are relevant to capture should be made in consultation with the management of the contractor. It is the responsibility of the management to make the choice which performances reflect the expertise of the organisation and which performances have a distinctive character towards other contractors. The involvement of the management also broadens the support of the organisation to capture these performances.

The use of performance information within Best Value tenders is to express the expertise of the contractor. It is therefore important that the management of the organisation keeps involved in the capture and storage of performances. By regularly evaluating, updating and steering on the captured performances, the management can control how the expertise is expressed and on which performances to focus in projects.

Application further than Best Value tenders

The availability of a database that presents the performances of the organisation in projects provides opportunities for other applications besides the use for Best Value tenders. One application for this database is the use for pre-qualification matters. The database creates an overview of executed project with relevant project information and verification documents. This may increase the efficiency for contractors to search for relevant project and past performance information which is required for pre-qualification matters.

Another useful application for this database is the use for internal performance management and reviews. The management of the organisation could use the performance database as a tool to review the organisation towards specific performances. Based on the results of these performances the organisation could make strategic decisions on which performances to utilize in tenders and projects and which performances to improve in the future.

Setup of realistic project goals by clients

A final recommendation can be made towards clients in the construction industry using BVP. As emerged in the analysis of project goals for construction projects, the setup of project goals is rather diverse. Both abstract as more specific project goals are currently used by clients. From the observations and interviews became clear that for more specific project goals it is hard for the vending contractor to present relevant performance information. Moreover, specific project goals force the contractor to focus on specific performances, whereas the expertise of the contractor should be used to decide which performances to focus on. Best Value is about utilizing the expertise of the vendors. Therefore the client should set abstract project goals. Abstract project goals increase the ability of the contractor to present the highest performance, based on its expertise. It is even more important that the different clients and contractors within the Dutch water construction industry come to an agreement on this. The difference in abstractedness of project goals is recognized between different clients. To provide clarity within the market and fulfil the objective of BVP to utilize the contractors' expertise, the market should come to a uniform implementation of BVP.

7. Discussion

This chapter provides the limitations which must be taken into account for the reliability of this research. Further recommendations are made how these limitations can be solved by further research.

7.1. Limitations

Limited scope

The research has been conducted under the guidance of one specific contractor. This led to the fact that the interviews with employees of a contractor are only held with employees of this contractor, and the observations are biased towards the experiences of this contractor. To increase the variety of the input and thereby the reliability of the conclusions, more practical input has been used such as the interviews with Rijkswaterstaat and the BVP consultant and the analyses towards project goals of water construction projects.

The scope of the research focuses on contractors specifically in the Dutch water construction industry. Though the literature makes little distinction between different contractors, the practical input focussed solely on employees and project goals of Dutch water construction projects. Therefore the conclusions and recommendations are mainly applicable for water construction contractors in the Netherlands. Though the overall process is applicable for contractors of any kind, the interpretation of this process requires more research towards which performances are relevant and which data represents these performances.

Literature on performances

For the literature research on performances in the construction industry the literature only mentions performances that are indicators for the project success of all kind of construction projects. There is no literature available on performances specifically for the water construction industry. Neither is there literature available that describes specifically the role of contractors within these performances. This theoretical input has been nuanced by the practical input, which focusses on the performances that contractors deliver in water construction projects.

Information management

The storage of information and the use of information management tools within organisations is an extensive academic field. Due to personal knowledge, as well as relevance for this research, the research only gives a general description on the design of a relational database to store performance information. For the organisation to construct such a database, the knowledge and expertise of technical staff is required.

7.2. Recommendations for further research

This research gives contractors an insight on how to capture and store performance information to use in Best Value tenders. For the completeness of this research, three different subjects based on three different research questions have been described. Nevertheless, to extend the insight and knowledge towards capturing, storing and the use performance information, the following recommendations give indications for further research.

Applicability for other contractors

The scope of this research has been limited to contractors in the Dutch water construction industry. Though the process to capture and store performance information is applicable for other contractors as well, further research can be done towards the implementation of this process for other types of contractors. This

research may give insight in which performances are relevant for other contractors and how the process of capturing and storing performance information may be implemented.

Relevant performances for contractors

Scientific literature which is currently available gives little clarity on the role and responsibility of the different parties towards the performances to achieve project success. Research in the responsibility of different parties on the performances in project can give guidance for clients and contractors on the distribution of responsibilities and how to increase the overall project success.

Current literature provides performances which are relevant for construction projects, but is limited on the interpretation of these performances for different types of construction projects. Research towards the relevance of performances between different construction industries may give insight in these performances. Research can be done towards specific performances in e.g. water construction projects or infrastructural projects or on the influence of the project environment towards the performances that determine the project success.

Design of a relational database

This thesis gives an abstract description on the design of a relational database to store performance information. Further research within the field of information management and information technology can be done towards the actual design and implementation of a relational database to store performance information within construction industries.

In the recommendations of this research the utilisation of performance information for applications other than BVP tenders is mentioned. One can think of applicability of performance information for matters such as internal performance management or pre-qualification. Further research can give insight on the manner how organisation could create a more integral system to utilize performance information for multiple applications.

Reflection on Best Value in the construction industry

The implementation of BVP for procurement of projects in the water construction industry led to commotion within the construction industry. Many blogs, columns and articles on social media and papers have been written on whether or not the use of BVP is positive for the construction industry. Therefore, a reflective research can be done towards the applicability and results of the use of BVP in construction projects. Based on experiences with BVP in construction projects, can it be said that the use of BVP indeed led to the most expert contractor and the highest value in projects?

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Appendices

- A.I. Analysis performances in in project goals water construction projects
- A.II. Interview Rijkswaterstaat
- A.III. Interview Best Value consultant
- A.IV. Interviews Van Oord
- A.V. Setup of performance template for Van Oord