UNIVERSITY OF TWENTE & RIJKSWATERSTAAT

# Impact of Value Management on defining the project scope in the early stages of infrastructure development projects

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## Preface

This document is the end result of my graduation research which concerns the impact of Value Management on defining the project scope in the early stages of infrastructure development projects. This document consists of two parts, a scientific article and a Dutch summary. This graduation research is the final part in order to complete the master Construction Management and Engineering at the University of Twente.

# Impact of Value Management on defining the project scope in the early stages of infrastructure development projects

PAPER

# Impact of Value Management on defining the project scope in the early stages of infrastructure development projects

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**Abstract:** Value Management (VM) is a systematic process to optimize value. Value is defined as the balance between required functionality and corresponding costs. The appropriate balance is determined in a workshop setting with a multidisciplinary team in which various stakeholders work together. The results of the VM workshop are recommendations for value optimizations. These value optimizations are only achieved when recommendations from the VM workshop reach and survive final decision-making, at highest management levels in an organisation. In the US merely 37% of VM recommendations in 2016 were accepted and applied. Rijkswaterstaat (RWS) (the executive organisation of the Dutch Ministry of Infrastructure and Water Management and one of the largest public clients in the Netherlands), applies VM frequently. One of the reasons to apply VM is to determine the scope of projects. Determining the scope is a refined issue for RWS, since the scope has to be articulated in such a way that it provides sufficient direction for development, while at the same time it provides design space for the contractor. Through design space the contractor can implement creative construction ideas and design optimizations. Although RWS applies VM regularly, it is not monitored to what extent VM workshop recommendations reach and survive formal decision-making at management level. Therefore, in this research it is examined to what extent VM recommendations that resulted from the VM workshop are included in formal decisions. This is done by carrying out a multiple case study in which it is studied how VM workshop recommendations are progressed through the different layers of the organisation. It turns out that despite VM workshop success and implementation of VM recommendations in the design process at project level, there is no guarantee that VM workshop recommendations are included in formal decision-making at management level. Formal decision-making is influenced by many factors, of which some have been identified in this study.

*Keywords: Value Management, Critical Success Factors, Implementation, Project scope, Contractor, Formal decision-making, Public client*

## 1. Introduction

Value Management (VM) is a systematic process to provide recommendations on the required functions against the best life cycle costs (LCC), taking into account short- and long- term investments (Heralova, 2016; Shen & Liu, 2003). Important principles of VM are the continuous awareness of what is of value to the organization and having attention to identify objectives and functions, before thinking in solutions (SAVE International, 2007). VM can help to improve the quality of a project or process, reduce costs, meet customer requirements or reduce design time, by which the value-for-money will increase (Lin & Shen, 2007; Stewart, 2005).

When the VM study is applied for a product, process or project, it is done in three stages: the preparation of the VM workshop, the VM workshop itself and the implementation of VM recommendations (Kelly et al., 2004; Male et al., 2007; SAVE International, 2007; Shen & Liu, 2003). In the first stage, the VM workshop is being prepared in terms of selecting a suitable time and participants and preparing the agenda for the VM workshop. In the second stage, the VM workshop is carried out by a multidisciplinary team under control of VM facilitators. In the final stage, the recommendations from the VM workshop are being implemented in the design process at project level. The implementation stage is the responsibility of the project manager, instead of the VM facilitator. This stage is the step where VM often fails (Male et al., 2007). It is often missed as a formal step of the VM study (Kelly et al, 2004). For example, data from the US Federal Highway Administration (Federal Highway Administration, 2018) shows that merely 37% of the VM recommendations made in 2016 in the US have actually been accepted and applied at higher management level and, in later stages, in practice.

In the Netherlands, a public client that applies VM frequently is Rijkswaterstaat (RWS). RWS is the executive organization of the Dutch Ministry of Infrastructure and Water Management (I&W) and one of the largest public clients in the Netherlands. One of the reasons to apply VM is to determine the scope of projects. Scope is a very broad and abstract concept. A project scope comprises the required work and deliverables to accomplish the project objectives (Mirza et al., 2013). In this paper scope is

approached by MOTIQ aspects (Money, Organisation, Time, Information and Quality). For example the project scope includes the budget (Money), stakeholders (Organisation) and project planning (Time).

Every project stage starts and ends with a formal decision (at management level) on the project scope, in this paper defined as the 'formal project scope'. Determining the scope is a refined issue for RWS, since the scope has to be articulated in such a way that it provides adequate and sufficient direction for development, while at the same time provide design space for the contractor. Through design space the contractor can implement creative construction ideas and design optimizations.

Recently, at RWS, a trend can be seen from detailed scope specifications towards functional scope specifications which could result in more design space for the contractor. This trend is the result of both a shrinking government, where multiple tasks had to be outsourced and the demand from the market to get more design space in order to offer the best solution (Rijkswaterstaat, 2016[a]).

Although RWS applies VM regularly, it is not monitored to what extent VM workshop recommendations regarding scope, reach and survive formal decision-making at management level. Therefore, in this research it is examined to what extent VM recommendations regarding scope, that follow from the VM workshop are included in formal decisions at management level. This is done by carrying out a multiple case study, in the early project stages of RWS, in which it is studied how VM workshop recommendations are progressed through the project stage.

In this research, VM is explored as a potential method to determine and define the project scope in the early project stages. Ultimately the goal is to examine the impact of VM on the formal project scope. The formal project scope is captured in the formal decision, at management level, at the end of a project stage. The early project stages of infrastructure development projects are examined, since VM is mostly carried out in these stages (Kelly et al., 2004). Additionally, in these stages the scope is still broad and costs and resistance regarding changes are limited. In the early stages of a project, many decisions are made, with regard to the project scope, for example budget, planning and objectives. These decisions affect the continuation of the project and ultimately the project scope for the contractor (as defined in the contract). In order to achieve more design space for the contractor, it is necessary to consciously determine and define the project scope throughout the entire project process (Lever, 2006), starting from the early stages.

The decision-making process of infrastructure projects at RWS is fragmented and complex. A project includes several stages with changing activities and responsibilities. Moreover, every stage includes activities at multiple organizational levels. At RWS, formal decision-making takes place after implementation of VM workshop recommendations. The link between implementation and formal decision-making for this Dutch public client is displayed in figure 1. Implementation is defined as the acceptance and appliance of VM recommendations in the project- and design process. Formal decision-making includes all decision- related activities that ultimately lead to the formal decision. Implementation and formal decision-making take place at different organizational levels. Implementation is carried out at project team level, while formal decision-making is carried out by decision-makers, at management level. The mandate for the formal decision and therewith the governance, differs per project and project stage. The formal decision-making could consist of multiple layers (Groote et al., 2011). The governance can for example include a support group, steering group and reflection group.

A clear understanding of the impact of VM on the formal project scope includes formal decision-making at management level. This leads to the research question of this research: *What is the impact of Value Management on the formal project scope in the early project stages of infrastructure development projects?*

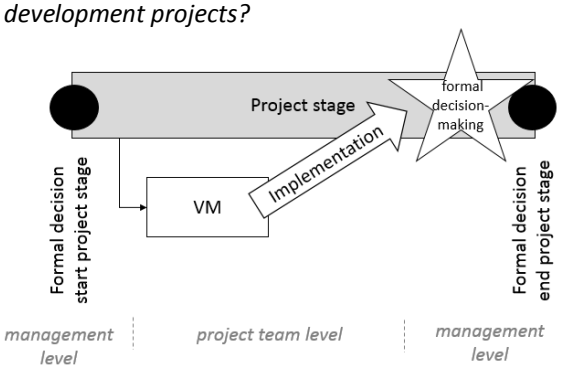


*Figure 1: Link between VM, implementation and formal decision-making (formal decision)*

To the researchers' best knowledge, no research has been done regarding VM related to formal decision-making. The scientific contribution of this research is to examine the impact of VM on formal project scope. Where previous researches end at implementation of VM recommendations at project team level, or focus on the extent of VM recommendations applied in finalised projects, this research also includes formal decision-making at

management level. The practical contribution of this research is to provide insight in factors that influence formal decision-making within RWS. This could lead to improvement of the deployment of VM in the early stages of RWS projects.

This paper is structured as follows: in the second section the hypothesis of this research is introduced. In the third section the research methodology is explained, including a brief introduction of the cases. In the fourth section the results of the research are discussed. These are further explained in section five, explaining the findings. This eventually leads to a conclusion in section six, whereafter recommendations are given in section seven. The paper ends with section eight, in which the limitations of the research are appointed.

## 2. Hypothesis

Many research is done on the deployment of VM in the early stages of infrastructure projects (Barton, 2000; Green, 1992; Kelly et al., 2004; Shen et al., 2004; Yu et al., 2006), but none of them considers how VM recommendations progress from the VM workshop, through the design process, until the formal decision at management level of the organisation. Although in the early stages little is known about the project, at the end of these stages a formal scope has to be determined. VM can help to determine objectives and functions of the project and to formulate the project scope.

Moreover, the performance and success of VM studies have been analysed by several researchers (Chen et al., 2010; Fong et al., 2001; Lin et al., 2011; Male et al., 1998, Shen & Liu, 2003). According to Lin et al. (2011) the performance of VM can be measured by Critical Success Factors (CSFs) or Key Performance Indicators (KPIs). KPIs measure past actions while CSFs predict the success of a VM workshop in advance (Chen et al, 2010; Male et al., 1998; Shen & Liu, 2003). Shen & Liu identified fifteen CSFs which are used in the case study analysis to check whether a VM workshop is theoretically a success. The identified CSFs by Shen & Liu were grouped in four clusters: VM team requirements, client's influence, facilitator competence and relevant department's impact. This indicates that VM workshop success requires effort from all parties involved in the VM workshop (Shen & Liu, 2003).

VM workshop success is of importance (Shen & Liu, 2003), since unsuccessful VM studies can lead to losses (Cheah & Ting, 2005) in time and money. However, VM workshop success does not guarantee VM study success. A VM study is more than only the VM workshop, it also includes the implementation of VM recommendations. Regarding the relation between implementation of VM workshop recommendations, not much research is done regarding the causes of limited implementation of VM recommendations. A few researchers examined barriers for VM implementation (Cheah & Ting, 2005; Van der Asdonk, 2014; de Wit, 2015). Cheah & Ting identified factors that limited further implementation of VM results in South- East Asia. Identified factors were: limited time for implementation, limited knowledge about VM, conflict of interests between stakeholders, limited communication and a segmented decision-making process. Van der Asdonk (2014) and de Wit (2015) examined factors that influenced implementation of VM recommendations for Dutch infrastructure projects. Van der Asdonk identified barriers and developed barrier breakers for a local government by means of an observation and reflection framework. Van der Asdonk found implementation barriers based on KPIs (Lin et al., 2011): unclear roles, tasks and responsibilities, limited stakeholder support, insufficient preparation for implementation and a too wide scope for the VM workshop. De Wit identified factors that influence the decision-making process of public clients, as RWS, by means of case study research. These identified factors were: the extent to which VM results are in conflict with the vision of the client, stakeholder support, support from the project team and relation between costs and functionality (value).

If no barriers are present, it is likely that recommendations are implemented and therewith included in the formal decision. This assumption has resulted in the following hypothesis: *VM workshop success and implementation of VM recommendations, at project team level, will lead to inclusion of VM recommendations in the formal project scope, at management level* (figure 2).

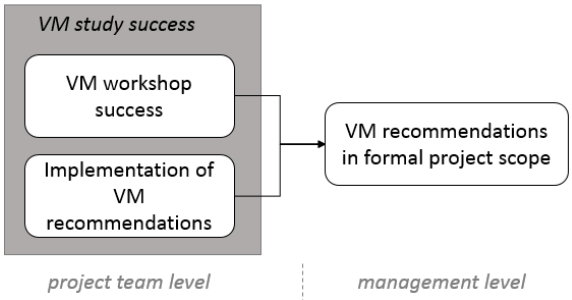


*Figure 2: Hypothesis*

This hypothesis should be analysed to be able to make a statement about the impact of VM on the formal project scope. If the formal decision differs from the accepted and applied VM recommendations, the impact of VM on the formal

project scope is limited. For a high impact, the formal decision should be in line with VM recommendations.

## 3. Research Methodology

Since little is known about the relation between VM and formal decision-making and therewith the impact of VM on the formal project scope, this research is executed with the aid of explorative case studies. Case study research is a form of qualitative research, to discuss complex phenomenon and problems in depth (Moore et al., 2012; Yin, 1994).

The early project stages are analysed, since the deployment of VM is most beneficial in these stages. In addition, in these stages formal decisions are made, with high impact on the project scope.

The project process (MIRT- process[1]) includes five stages: the Initiative (eventually including additional Research), Exploration, Plan development, Realization and Management & Maintenance. The early stages are the first three stages. For every stage, one case is researched (figure 3). The type of this case study research is multiple case studies.

In the Initiative stage the stakeholder objectives, scope and budget of the project are identified (Rijkswaterstaat, 2011). This project stage has a strong political and administrative nature. Since it is the start of a project, the scope should be broad, including the freedom to respond to new developments, risks and chances (Ministerie van Infrastructuur en Milieu, 2016).

In the Exploration stage strategic choices regarding objectives, organisation and involvement of contractors in the process are made (Rijkswaterstaat, 2011). The goal of the Exploration stage is to define smart, integral, sustainable and climate- proof solutions by doing broad research to the project, concretize objectives and problem analysis and make a transparent trade- off between options (Ministerie van Infrastructuur en Milieu, 2016). In the Exploration stage several solutions will be funnelled into three best solutions. Eventually at the end of this stage one preferred solution is be chosen.

In the Plan development stage the project is prepared for construction. The preferred solution is developed into concrete and financially feasible actions and measures (Rijkswaterstaat, 2011; Ministerie van Infrastructuur en Milieu, 2016). The stage ends with financial clearness about for instance budget and realization period.

Information for the case studies is collected by documentation, interviews and observations (case 1). Documents include VM study documentation as well as project documentation and formal decisions. The interviews are semi- structured to be able to respond to project specific elements and give the opportunity to share personal experiences. The structured part is included to compare findings across the cases. The interview protocol has been added as Appendix 1. The interviews are recorded and directly transcribed by the researcher. The interviews are validated by sharing summaries of the interviews with the interviewees and asking for feedback[2]. One of the cases is executed during the lead time of this research, which allowed the researcher to be present at the executed VM workshops as an observer. The role of the researcher is analytical, neutral and non-participatory. By triangulation of data collection methods the accuracy of the interpretation and credibility of findings is increased (table 1).

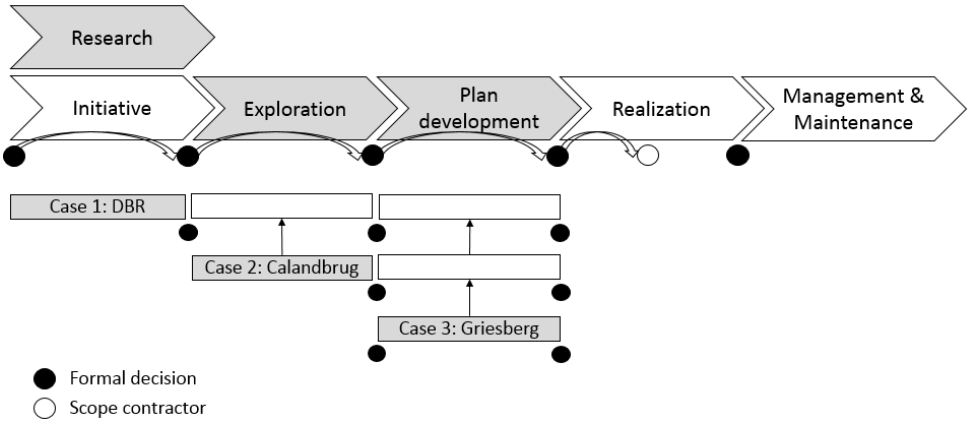


*Figure 3: Analysed cases in MIRT- process*

[1] The MIRT- process (of the Dutch Ministry of Infrastructure and Water and Rijkswaterstaat) focusses on financial investments of spatial programs and projects of the State, provinces and municipalities. In the early stages (Initiative till Plan development) the project is started, determined and prepared to make the realization of legally and financially possible.

[2] Validated interviews can be acquired at the researcher.

*Table 1: Data collection case study*

| Cases | DBR (case 1) | Calandbrug (case 2) | Griesberg |
|---|---|---|---|
| Documents | Assignment form start project<br>Problem analysis and scope<br>Workshop plan VM<br>End document VM<br>End document long- term<br>End document short- term<br>Start- decision | Start- decision<br>Project plan Calandbrug<br>VE plan<br>End document VM1<br>End document VM2<br>End document VM3<br>Environmental impact report<br>Structural vision | Assignment letter<br>Scope form<br>VM plan<br>End document VM1<br>End document VM2<br>Advice note for decision |
| Interviews | Project manager<br>Substitute project manager<br>VM facilitator | Project manager<br>VM facilitator | Project manager<br>Project manager subsequent stage<br>VM facilitator<br>Advice decision-maker |
| Observations | Observations by researcher during five VM workshops | Not applicable | Not applicable |

***Introduction of cases***

Since this research focussed on the early project stages, in every early stage one case was selected (figure 3). In this research it was examined to what extent VM recommendations that follow from the VM workshop were included in formal decisions at management level. The goal was to examine the impact of VM on the formal project scope.

Case 1 is called 'Duurzame Bodemligging Rijntakken' (DBR), executed in the Initiative (Research) stage. Project DBR is a research on issues at the Rhine river branches as a result of soil erosion and sedimentation. VM has been deployed to discuss these issues together with stakeholders. The goal was to find short- term as well as long- term measures, including management and maintenance measures.

Case 2 is called 'Calandbrug', executed in the Exploration stage. This bridge over the Caland canal in the Rotterdam port area, is a steel lift bridge for train-, road- and slow traffic. The bridge will reach the end of its technical lifespan in 2020, which requires extensive renovation. In addition, a foreseen increase of train traffic capacity, restricts the growth opportunities of the port. Three VM studies were executed. VM has been deployed to find the best solution, in terms of savings concerning hindrance and money. Contractors were involved to share their specific knowledge on hindrance and execution.

Case 3 is called 'Griesberg', executed in the Plan development stage. 'Gries' is a residual product (no waste) from soda production that was unloaded in the river Eems, near Delfzijl. The residue does not belong in the river and needs to be dredged and processed. Since no contractor offers the combination of dredging and processing, VM was deployed to see if it was possible to find potential partnerships between contractors and solutions for the problems.

The results of the cases were analysed and summarized in a confrontation matrix (table 2). All elements of the hypothesis (figure 2) were scored. With regard to VM workshop success a '+' means minimal 80% workshop success, reviewed as success of the VM workshop. A '0' means 50% - 80% VM workshop success, reviewed as partly a success of the VM workshop. A '-' means less than 50% VM workshop success, reviewed as no success of the VM workshop. With regard to implementation of VM recommendations a '+' means complete implementation in the project, a '0' means partial implementation in the project and a '-' means no implementation in the project. With regard to inclusion of VM recommendations in the formal project scope a '+' means complete inclusion in the formal project scope, a '0' means partial inclusion in the formal project scope and a '-' means no inclusion in the formal project scope.

***Data collection***

Data was collected in three steps. First, VM workshop success was examined by the CSFs of Shen & Liu (2003). By analysing documents and an interview with the VM facilitator, it was examined to what extent the CSFs were present in the cases (Appendix 2). Per CSF it was assessed whether the factor was present in the case. This resulted in a percentage of present CSFs per case. A percentage of below 50% resulted in a review of a '-', a percentage in between 50% and 80% resulted in a review of a '0' and a percentage of present CSFs above 80% resulted in a review of a '+'.

Second, VM implementation was analysed by a variant check. The variant check consisted of a comparison between the variants in VM recommendations and variants in project documentation. This check was used to determine the extent to which VM recommendations regarding the variants have been implemented in

the design process, by the project team (whether or not in other definitions). Through analysis of project documentation and an interview with the project manager, it was examined if VM recommendations were implemented in the project scope (Appendix 3). Per variant check was reviewed if the recommended variant in the VM recommendations corresponded with the recommended variant in the project document. If both documents recommended the same variant, the implementation was reviewed with a '+'. If the documents recommended the same variant, but it differs in detail, the implementation was reviewed with a '0' (for example the VM study recommended variant A inclusive pilots and in the project document variant A exclusive pilots was recommended). If the variants did not correspond, the implementation was reviewed with a '-'.

Third, inclusion of VM recommendations in final decision making was also analysed by a variant check. Though, this variant check included a comparison between recommended variants of the VM workshop and the variant(s) in the formal decision. This check was used to determine the extent to which VM recommendations regarding the variants have been included in the formal decision, at management level (whether or not in other definitions) (Appendix 4). The analysis included document analysis and interviews with the project manager and decision-maker, which operates at management level. Per variant check was reviewed if variants in the VM recommendations corresponded with the variants in the formal decision. If the variants corresponded completely, the inclusion in the formal project scope was reviewed with a '+'. If the variants corresponded partly, the inclusion in the formal project scope was reviewed with a '0' (for example the VM study recommended a combination of measures with a follow-up of a standalone program and in the formal decision a combination of measures with a follow-up in an existing program was recommended). If the variants did not correspond, the inclusion in the formal project scope was reviewed with a '-'.

## 4. Results

The results of the case analysis are displayed in table 2. Background data regarding the scores can be found in the appointed Appendices.

For case DBR 71% of the CSFs were present (10 out of 14 factors). The other four factors were partly present. With this, VM workshop success is reviewed with a '0'. Since VM was integrated in the project process, there were direct lines between the VM workshops and development and design activities. The variant check shows that VM recommendations for the short- and long-term measures, as well possible follow- up, have been completely implemented in the project (reviewed with a '+'). The project team had frequent meetings with the steering group (formal decision-makers), support group and reflection group. To gain support at management level, members of the support group were invited to participate in the VM workshops. The variant check shows that the formal project scope differs partially from the recommended variant in the VM workshop. Due to deviant interests of decision-makers, the formal project scope was partial in line with VM recommendations and preferences of the project team (reviewed with a '0').

*Table 2: confrontation matrix*

| Case | VM workshop success | VM Imple-mentation | VM inclusion in formal decision-making |
|---|---|---|---|
| DBR | 0 | + | 0 |
| Calandbrug | + | + | + |
| Griesberg | + | 0 | - |

For case Calandbrug 86% of the CSFs were present (12 out of 14 factors). The other two factors were partly present. With this, VM workshop success is reviewed with a '+'. The three VM studies were integrated in the project process. The variant check shows that VM recommendations were completely implemented in the project scope (reviewed with a '+'). In the first VM study four solutions were developed. The best two solutions were separately examined in detail with regard to optimisations of hindrance and money, in the second and third VM studies. Out of these two, the best solution was chosen. The variant check shows that the chosen variant in the formal decision was equal to the recommended variant in the VM workshop. The formal project scope was completely in line with VM recommendation (reviewed with a '+').

For case Griesberg 87% of the CSFs were present (13 out of 15 factors). The other two factors were partly present. With this, VM workshop success is reviewed with a '+'. The variant check shows that the project team had developed some of the VM recommendations in the project scope. VM recommendations were partly implemented (reviewed with a '0'). However, the variant check shows that the formal decision mentioned a different solution as recommended in the VM workshop. VM workshop recommendations were not included in the formal decision (reviewed with

a '-'. The chosen solution in the formal project scope was not in line with the VM recommendations.

With the information from these three cases, the hypothesis: *VM workshop success and implementation of VM recommendations at project team level, will lead to inclusion of VM recommendations in the formal project scope at management level* is partly confirmed. While case Calandbrug confirms the hypothesis, case DBR and Griesberg do not. The confrontation matrix shows that workshop success and implementing VM recommendations in the project do not directly lead to inclusion of VM recommendations in the formal project scope (formal decision). Due to other factors such as political interests and planning formal decision-making deviates from what is recommended in the VM studies.

## 5. Explaining the findings

In project DBR, executed in the Initiative stage, VM was well integrated in the project process. Also, there was frequent consultation between the project team and formal decision-makers (steering group). Herewith, VM recommendations were discussed before the formal decision. Mutual requirements and wishes were expressed, which led to better understanding and support of findings in the VM workshop. Despite a full implementation of VM recommendations, the assumed formal decision was not completely in line with the recommendations of the VM study. The formal decision was taken beyond the duration of this research, but it was already clear which formal decision would be taken. Formal decision-making was highly influenced by political interests. This may be due to the strong political and administrative nature of this project stage. At the end of the project stage, the formal decision-makers changed their interests. While the project team preferred a continuation of project DBR, the formal decision was to add DBR to another program. Also, the steering group included two clients whose culture and mind-set varied, because of different organisational backgrounds and interests. Both clients had to monitor their own budget and risks, which did not led to cooperation. During the project stage, the impact of VM on the project scope was high. However, due to a deviant formal decision, the impact of VM on the formal project scope was limited.

In case Calandbrug, executed in the Exploration stage, the project team had three clients, with different organisational backgrounds and interests. These clients were all represented in the steering group, which formed the formal decision-making. Since the technical lifespan of the bridge ends at 2020 and budget was limited, there was an enormous pressure for the project team to find a feasible solution. The formal decision-making was influenced by factors as administrative pressure, limited budget and differences in culture and mind-set between the steering group members. Administrative support plays a role in 'multiple-client projects', since all clients want the solution which best represent their own interest. One of the clients only saw benefits in one of the solutions, whereby it only wanted to contribute budget for that specific solution. The culture of this client (private organisation) differed from the other two clients (public organisations). After examining the solutions, the best solution was identical to the preferred solution of that client. Despite the fact that formal decision-making was influenced by many factors, the formal project scope was in line with VM recommendations.

In case Griesberg, executed in the Plan development stage, the formal project scope contradicted the VM recommendations, despite the fact that VM recommendations were partly implemented at the project level. Planning related to administrative pressure was the decisive factor to take a formal decision conflicting with VM recommendations. A steering group for the surrounded area of Delfzijl, which was under development and included project Griesberg, created an administrative field of tension for RWS. In cooperation between RWS and other clients of the steering group it was decided to remove the Griesberg. RWS wanted to keep their reputation as professional cooperation partner high and had therefore, in the formal decision, decided to quickly remove the Griesberg. This was contradictory with VM recommendations, which stated to do pilots and research before starting to remove the Griesberg. Planning formed the decisive role in formal decision-making, but was not considered as most important factor in the VM study. This led to a formal project scope which was not in line with VM recommendations.

## 6. Conclusion

VM is a usable method to define the project scope starting from the early stages till the final project scope for the contractor. However, to be sure that the final project scope for the contractor is in line with the project scope defined with VM, formal decisions should be in line with VM recommendations.

From these three cases it can be concluded that VM workshop success and implementing VM recommendations at the project level do not directly lead to inclusion of VM recommendations in formal decision-making at management level. Despite VM workshop success and implementation

of VM recommendations in the project, the formal decisions may deviate. Further research shows that many factors do influence formal decision-making. Given this, the research question can be answered: *What is the impact of Value Management on the formal project scope in the early project stages of infrastructure development projects?* It can be concluded that VM has impact on the formal project scope (case Calandbrug). However, the impact can change and can be limited at the end of a project stage due to deviant formal decisions (cases DBR and Griesberg). The formal decision-making is influenced by many factors, of which some were indicated in the cases: planning, budget, administrative pressure, political interests and culture and mind-set of formal decision-makers. This new information on formal decision-making complements existing literature on implementation of VM recommendations.

## 7. Recommendations

The findings show that when VM is integrated in the design process (case 1 and 2), VM recommendations are completely implemented. Integration in the design process creates direct lines between VM workshops and development and design activities, which can stimulate implementation of VM recommendations. In order to draw a conclusion about this, it is recommended to do further research on this subject.

Several factors that influence formal decision-making were indicated in the cases, however only those factors which clearly affected the formal decision-making were explained in section five. More factors which could influence formal decision-making were indicated in the case studies. Additional factors are: external support, internal support, budget, laws and regulations, contract, risks, fragmentation of the project process, and capacity of employees. No single conclusion can be drawn about which factors influence formal decision-making the most, since these factors vary per project stage and can even vary per project. It may be that formal decision-making in other projects is influenced by other factors. Every project is different in terms of project team, location and time. It is recommended to further investigate the factors that influence formal decision-making.

A deviant formal decision can influence the impact of VM on the formal project scope. It is recommended for the project team to make an inventory of all factors that influence formal decision-making when applying VM.

Case DBR shows that when there is frequent consultation between the project team and formal decision-makers (governance), VM recommendations will be discussed before the formal decision. Mutual requirements and wishes can be expressed, which can lead to better understanding and support. This can influence the impact of VM on the scope. It is recommended to consciously think about the relationship between the project team and the governance.

The case studies show that involving specialists such as contractors, can help a project team to find solutions and optimize value. By involvement of specialists, risks can be better understood, defined and minimized. It is recommended to involve contractors in VM studies to help with specialist issues. For example concerning issues regarding execution optimisations and construction costs.

It is noteworthy that VM is mainly applied during a project stage, while VM could also be a useful method for a stage transition (in which formal decision-making takes place). VM is seen as opportunity to structure the stage transfer by analysing chances, risks and the scope, to check if proposed solutions are in balance with predefined functions and objectives. In addition, VM can be used at the start of a stage to introduce the new project team to the project.

RWS does not structurally monitor the extent to which VM recommendations are actually implemented in projects. Besides, information is fragmented in the organisation. When monitoring the extent to which results are implemented and included in the formal project scope, the deployment of VM can be optimized. It is recommended to monitor and document VM implementations and VM in formal decision-making.

## 8. Limitations

Due to time limitation only three cases were analysed. Results are not validated to other cases. This makes it difficult to generalize outcomes outward to other organizations and even within RWS. Additional case study research is needed to make well- founded statements. Potentially other factors that may influence the formal decision-making process can be discovered in new research.

The cases were executed in different project stages. The nature of a project stage can affect the factors that influence decision-making. As indicated in case DBR, the political and administrative nature of the Initiative stage may have played a role in the fact that formal decision-making has been influenced by political interests. However, in this research it has not clearly emerged that specific factors influence decision-making at a certain project stage. Additional case study research is needed to make well- founded statements if factors that influence formal decision-making are related to a specific project stage.

In this research solely VM is examined as potential method to consciously determine and define the project scope. Several approaches and factors that influence the scope during the project have been left out of consideration in this study. Additionally only cases whereby VM is deployed are analysed. No judgements can be given about the results if VM had not been applied.

The hypothesis suggests a relation between VM study success (VM workshop success and implementation of VM recommendations) and inclusion of VM recommendations in formal decision-making. In the hypothesis, the time between VM workshop and implementation of VM recommendations has not been taken into account. If this is taken into account two relations can be analysed: VM workshop success related to implementation of VM recommendations, and implementation of VM recommendations related to inclusion of VM recommendations in formal decision-making.

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# Appendix 1: Interview protocol

This interview protocol serves as a guide for the researcher for interviewing participants during the research.

INTRODUCTION

| | |
|---|---|
| **Thank for participating** | First of all, I would like to thank you for participating in my research. My name is Sietske Konings, master student Construction Management and Engineering at the University of Twente. I am currently working on my master's thesis at Rijkswaterstaat on Value Management. I would like to interview you because I am carrying out a case study, for which a project you have participated in (as a project manager, VM facilitator or formal decision-maker), has been selected. |
| **Aim of the research** | The aim of my research is an exploration of the impact of VM on consciously defining the scope, related to formal decision-making in the early stages of Rijkswaterstaats MIRT projects. I want to analyse to what extent VM has contributed to consciously define the scope with the view to the project scope for the contractor. |
| **Aim of the interview** | The aim of this interview is to obtain information that could be helpful for this research, no statements will be made about the success of the project itself. My research concerns the relationship between VM and the project scope and VM in relation to formal decision-making. |
| **Length interview** | 60 minutes |

QUESTIONS FOR PROJECT MANAGER

**Questions concerning the project and project process**

- To what extent has the goal of the project been achieved?
  Can you assess this on a 5 point scale? - - - 0 + ++
- As a project manager, what were the obstacles and opportunities in this project to broaden the scope?
- To what extent has been cooperated with the project manager from the previous or successive stage?
- How do you look back on the project process, what went well and what went less well?

**Questions concerning Value Management**

- Why was decided to apply Value Management?
- How did the Value Management process went?
  What went well, what went less well and why?
- How was the relation between Value Management and the project process been designed?
- To what extent have Value Management recommendations been implemented satisfactorily?
  Can you assess this on a 5 point scale? - - - 0 + ++
- What is the cause of implementation or non- implementation of Value Management recommendations?
- To what extent has Value Management influenced the scope? (money, organisation, time, information, quality)
- To what extent have the Value Management goals been achieved?
  Can you assess this on a 5 point scale? - - - 0 + ++

QUESTIONS FOR VALUE ENGINEERING FACILITATOR

**Questions concerning Value Management**

- Why was decided to apply Value Management?
- How did the Value Management process went?
  What went well, what went less and why?
- How was the relation between Value Management and the project process been designed?
- To what extent have Value Management recommendations been implemented satisfactorily?
  Can you assess this on a 5 point scale? - - - 0 + ++
- To what extent have the Value Management goals been achieved?
  Can you assess this on a 5 point scale? - - - 0 + ++

**Questions concerning implementation of Value Management recommendations**

- To what extent have Value Management recommendations been implemented satisfactorily?
  Can you assess this on a 5 point scale? - - - 0 + ++
- What is the cause of implementation or non- implementation of Value Management recommendations?

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QUESTIONS FOR FORMAL (ADVICE) DECISION- MAKER

**Questions concerning the project and project process**

- How did the formal decision-making process go?
  Can you assess this on a 5 point scale? - - - 0 + ++
- Based on what are formal decisions established?
  Which factors influenced formal decision-making in this project?
- Why is the formal decision deviant to VM recommendations?
- How do you, as a formal decision-maker, ensure that a formal decision is actually worked through in the next project stage, when another project team enters the project?
- How do you look back at the project process?
  Can you assess this on a 5 point scale? - - - 0 + ++
  What went well, what went less well and why?

**Questions concerning Value Management**

- What do you know and what do you think of Value Management?
- Were certain factors present in the formal decision-making process which influenced the implementation of Value Management recommendations? If yes, which ones?

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CLOSING

Thank you for participating in my research. A summary of this interview will be sent to you for validation and feedback. The results of this interview will be compared with the results from other interviews and documentation. Lessons learned will emerge from the analysis. If you are interested in the final results of the research, these can of course be shared when I have completed my research.

# Appendix 2: VM workshop success

VM workshop success is in the hypothesis examined, since non-success can be a reason of not implementing VM recommendations in the project scope. VM workshop success is measured by Critical Success Factors (CSFs) of Shen & Liu (2003) (table 2.1, table 2.2 and table 2.3). Firstly, if 80% or more of CSFs were present in the case, the VM workshop of the case was theoretically a success, reviewed with a '+'. Secondly, if 50% - 80% of the CSFs were present in the case, the VM workshop was partly a success, reviewed with a '0'. And thirdly, if less than 50% of the CSFs were present in the case, the VM workshop was no success, reviewed with a '-'.

Table 2.1: VM workshop success case DBR

| CSF's of Shen & Liu (2003) | | Presence | Explanation |
|---|---|---|---|
| 1. VM team requirements | Preparation and understanding of related information | Yes | Case DBR included five VM workshops. Participants of the first three workshops were closely involved in the project. In all workshops, at the start the goal of the workshop and process were explained. |
| | Multidisciplinary composition of VM team | Yes | Many disciplines (from various organisations) were present as: morphology, shipping, cables and pipelines, mobility, legislation, ecology and flood protection. |
| | Professional experience and knowledge of participants in their own disciplines | Yes | The participants were all specialists in their own discipline, they were carefully selected by the project team. |
| | VM knowledge and experience of participants | Partly | An e-mail about VM was sent to the participants of the workshops. Also an introduction was given at the start of the VM study. However, most participants had not participated in a VM workshop before. |
| | Personalities of participants | Yes | Participants were open and inquisitive to other disciplines. |
| 2. Client's influence | Client's support and active participation | Yes | The project manager was emphatically present and started discussions. He had done VM sessions more often. |
| | Clear objective of VM study | Partly | At the start of the VM study the project manager was still looking for a project scope. This has led to confusion among participants. The objective of the VM study was not completely clear from the start. |
| | Timing of VM study | Yes | The timing for carrying out the workshops every other week was good. A long time in between the workshops can cause loss of information and energy. |
| | Adequate time for VM study | Partly | Five workshops were carried out over a period of three months. Five full days is a high claim on the agendas of participants, which can be a cause of many interchanges of participants between the workshops. |
| 3. Facilitator competence | Control of VM workshop | Yes | The VM facilitator had control over the structure and participants during the workshops. |
| | Qualified VM facilitator | Yes | Certified VM facilitator: Practitioner in Value Management. |
| | Function analysis | Partly | This was a bit stiff due to confusion between goals and functions. The idea of function analysis became eventually clear in the workshops. |
| | Interaction among participants | Yes | Interaction among participants was high by means of interactive work methods. A lot of knowledge had been shared. |
| 4. Relevant department's impact | Cooperation from related departments | Yes | The entire project team was present in all VM workshops. There was a variable presence of modellers and employees of RWS and the Ministry. |
| | Plan for implementation | Not applicable | No separate plan for implementation was written. It was included in the final report, since VM was integrated in the project process. |

As displayed in table 2.1, one of the 15 CSFs was not applicable for case DBR. There was no separate plan for VM implementation. VM was integrated in the project process and recommendations were directly documented and processed in project documentation. Out of the remaining 14 CSFs, ten were present in case DBR. From this analysis is concluded that 71% of the factors (10 out of 14) were present, which is reviewed with a '0'. Based on the CSFs, the VM workshop was partly a success.

Table 2.2: VM workshop success case Calandbrug

| CSF's of Shen & Liu (2003) | | Presence | Explanation |
|---|---|---|---|
| 1. VM team requirements | Preparation and understanding of related information | Yes | For case Calandbrug three VM workshops were executed. In the first two VM workshops a presentation about the project was given to bring participants to the same information level. |
| | Multidisciplinary composition of VM team | Yes | There were different disciplines from various organisations. Chief engineering, costs experts and project managers from the clients, consultancy firms and municipalities participated in the VM workshops. |
| | Professional experience and knowledge of participants in their own disciplines | Yes | For all workshops the participants were experts in their discipline. Contractors participated in the last two VM workshops They had experience with execution of similar construction projects. |
| | VM knowledge and experience of participants | Partly | A presentation was given about VM and a small amount of information had been provided in advance of the VM workshops. Actually, prior knowledge of VM is not needed for a successful VM workshop. |
| | Personalities of participants | Yes | Participants were selected on enthusiasm, knowledge, skills and authority. |
| 2. Client's influence | Client's support and active participation | Yes | The project manager understood very well how VM works. |
| | Clear objective VM study | Yes | The purpose of the VM workshop was specifically formulated and clear for the participants. |
| | Timing of study | Partly | The first VM workshop was executed during summer holidays, so things had to be properly coordinated. |
| | Adequate time for VM study | Yes | All three VM workshops were executed in multiple days. The preparation time was short, but it worked out well. |
| 3. Facilitator competence | Control of workshop | Yes | The workshops were led by competent facilitators. Control over workshop and participants was good. |
| | Qualified VM facilitator | Yes | For all workshops certified facilitators were present: Practitioner in Value Management or basic certificate VM. |
| | Function analysis | Yes | A very detailed function analysis was made in the first VM workshop. In the two other VM workshops the function analysis was simple. |
| | Interaction among participants | Yes | Interaction among participants was good. It was very positive that a tender lawyer was present. |
| 4. Relevant department's impact | Cooperation from related departments | Yes | The VM facilitator was also project engineer. The technical manager and project manager also supported VM. The participants were from the project team as well specialists from departments of the multiple client organisations. |
| | Plan for implementation | Not applicable | The VM workshop recommendations resulted in project documents which were fully embedded in the further decision-making process. There was no standalone plan for implementation. |

As displayed in table 2.2, one of the 15 factors was not applicable. There was no plan for VM implementation. VM was integrated in the project process and recommendations were directly documented and processed in project documentation. Out of the remaining 14 factors, twelve were present for case Calandbrug. From this analysis is concluded that 86% of the factors (12 out of 14) were present which is reviewed with a '+'. Based on the CSFs, the VM workshop was a success.

Table 2.3: VM workshop success case Griesberg

| CSF's of Shen & Liu (2003) | | Presence | Explanation |
|---|---|---|---|
| 1. VM team requirements | Preparation and understanding of related information | Yes | For case Griesberg two VM workshops were executed. Before the start of the first VM workshop, information was sent to the participants. Most participants knew project Griesberg beforehand. |
| | Multidisciplinary composition of VM team | Yes | Various disciplines were present: ecology, policy, biochemistry, cost engineering, dredging technology and water quality. |
| | Professional experience and knowledge of participants in their own disciplines | Yes | Participants were selected based on knowledge and competences. Participants were selected after a long selection process. |
| | VM knowledge and experience of participants | Partly | Some of the participants had knowledge of VM, some did not. The principles of VM were explained at the start of the VM workshop. |
| | Personalities of participants | Yes | Prior to the VM workshops there were discussions with the participants to discuss the usefulness and necessity of the VM workshops, so they were willing to enter the VM process. |
| 2. Client's influence | Client's support and active participation | Yes | The project manager intended VM. In addition, intensive discussions were held with stakeholders to create support for VM. The project manager participated in the workshops. |
| | Clear objective of VM study | Partly | It was not entirely clear for the participants if it was already decided to remove the Griesberg or if 'out of the box' ideas were preferred. |
| | Timing of VM study | Yes | The time in between the VM workshops was about two months, which was just enough to properly prepare the second VM workshop. The timing of the VM workshops was good. |
| | Adequate time for VM study | Yes | Both workshops were executed in two days. This time has been optimally utilized by also speaking internally with participants in advance. |
| 3. Facilitator competence | Control of VM workshop | Yes | The VM process went well. The VM workshop was reviewed as 'very good' by the participants. |
| | Qualified VM facilitator | Yes | Certified VM facilitator: Practitioner in Value Management. |
| | Function analysis | Yes | A simple function analysis was executed based on goals, this went well. |
| | Interaction among participants | Yes | The interaction went well. It helped to invite all participants for the complete two- days of the VM workshops. |
| 4. Relevant department's impact | Cooperation from related departments | Yes | Participants from related working fields were present. The project manager linked internal as well external experts to the VM study. |
| | Plan for implementation | Yes | After the VM workshops there was an 'action-day' to fine-tune conclusions and jointly define follow-up actions. |

As displayed in table 2.3, out of the 15 CSFs, 13 were present in case Griesberg. From this analysis it is concluded that 87% of the factors (13 out of 15) were present, which is reviewed with a '+'. Based on the CSFs, the VM workshop was a success.

# Appendix 3: Implementation of VM recommendations

Implementation of VM recommendations is in this study examined, since a VM study consists of a VM workshop as well implementation of the results of the VM workshop. By means of a variant check it was examined to what extent VM recommendations correspond with the final project reports on project level, whether or not in other words. Variant checks for the cases are shown in table 3.1.1, 3.1.2, 3.2 and 3.3. If the recommended variants in the project documents were in line with recommended variants in the VM study, it was reviewed as complete implementation of VM recommendations, reviewed with a '+'. If the recommended variants were partly in line with VM recommendations, it was reviewed as partly implementation of VM recommendations in the project, reviewed with a '0'. If recommended variants in project documents differed from VM recommendations, it was indicated as no implementation of VM recommendations, reviewed with a '-'.

Table 3.1.1: Variant check measures case DBR

| Variants measures | VM recommendations | Project documents | Comments |
|---|---|---|---|
| Do nothing | In this strategy, current management is stopped. This is not been seen as a solution for the problem. | Doing nothing increases existing problems, this ultimately leads to higher costs due to damage | Discouraged in both documents. |
| Current management | This strategy is used as reference and is not indicated as solution for the problem. | Current practice is dredging of seized sediment. | Discouraged in both documents. |
| Soft measures | Continuation of dredging and maintenance, including implementation of successful pilots (replenishments). Sustainability of replenishments is doubted in the VM study. | Soft measures are reversible which makes it adaptive. It does not solve the problems on short-term, but ensures that the situation will not deteriorate. | |
| Hard measures | Continuation of current management, supplemented with hard constructions in the river such as longitudinal dams (including pilots). | Many stakeholders are against hard measures, these measures are not adaptive and have not (yet) proved their effectiveness. | |
| Combination of hard and soft measures | Combination of hard and soft measures, including pilots. | A combination of hard and soft measures is clearly preferred by stakeholders. | Preferred variant. |
| | | | |
| **Recommended variant** | **Combination of measures** | **Combination of measures** | In both documents a combination of measures is recommended. Complete implementation of recommended measure, reviewed with a '+'. |

Table 3.1.2: Variant check follow-up case DBR

| Variants follow-up | VM recommendations | Project documents | Comments |
|---|---|---|---|
| No Regret package | Only a short- term solution, not taking into account a long-term solution. The soil subsidence is remedied locally, but the cause (soil erosion) is not addressed. | A combination with other follow-up projects is always necessary. | Not recommended, or combined with a long-term package. |
| MIRT Exploration | Exploration with a broad approach. This requires 75% financing. | Not opportune, financing is not yet clear and available. | No detailed cost estimate available. |
| Standalone program | In line with desired approach. Prevents the exclusion of problems that are still insufficient visible and leaves space for uncertainties in the future. | A program is flexible and adaptive. Preferred: A program aimed at sustainable management and maintenance of the river bed. | Preferred by the project team. |

| | | | |
|---|---|---|---|
| Part of an existing program | For this variant it must be clear how the problem can be solved. The control on the project will be lost. | The scope of the existing project will be considerably increased. An advantage is that an existing program is already organized. | |
| | | | |
| **Recommended variant** | **Standalone program** | **Standalone program** | In both documents a standalone program is recommended. Complete implementation of recommended follow- up, reviewed with a '+'. |
| | | | |
| Total | | | Both variant checks were reviewed with a '+', which gives a total review, regarding implementation of VM recommendations, of a '+'. |

For case DBR there were two variant checks executed. Firstly, it has been analysed to what extent VM study recommendations regarding measures have been implemented. Secondly, it has been analysed to what extent VM study recommendations with regard to the follow-up have been implemented. In the VM study is ensued that, when dealing flexibly and adaptively with the river bed, the most suitable measure variant consist of a combination of hard and soft measures. The variant check regarding measures shows that for both documents (VM recommendations and project documents) the variant 'combination of measures' was recommended. The variant check regarding the follow-up shows that for both documents (VM recommendations and project documents) the variant standalone program was recommended. Based on the variant checks, both VM recommendations were completely implemented, which is reviewed in total with a '+'.

Table 3.2: Variant check case Calandbrug

| Variants | VM recommendations | Project documents | Comments |
|---|---|---|---|
| Renovation+ | Large- scale renovation supplemented with measures to increase the operational capacity for train traffic in the medium to long- term. In the second VM study cost optimisations, concerning budget and hindrance, were indicated. | The alternative does not solve the expected capacity bottlenecks. The accessibility of the port will be limited due to timeframes. | |
| Fixed bridge | A fixed bridge closes the port from maritime shipping. Companies at the port may be able to receive compensation for damage or relocation due to not being able to carry out activities properly. | A fixed bridge closes the port from maritime shipping. This alternative is poorly assessed by stakeholder because of loss of employment and persistent noise pollution by the bridge. | This variant was not indicated as a feasible option, because of closing the port. |
| Shift of the railroad: Theemsweg-tracé | Moving the current railroad to another location. In the second VM workshop costs optimisations of around €50 million were indicated. | External safety is an issue for new railroads. This variant scored high for being future-proof and for development of transport by rail and the port, compared to the reference design (Renovation). | |
| Shift of the railroad: Huntmans-tracé | Moving the current railroad to another location. This location was badly assessed by stakeholders, because of crossing a business park with hazardous substances. | External safety is an issue for new railroads. This variant was badly assessed by stakeholders. The technical feasibility was very complex. Costs were very high and out of budget. | This variant was badly assessed by stakeholders, benefits did not outweigh the costs in any of the growth scenarios. |

| | | | |
|---|---|---|---|
| **Recom-mended variant(s)** | **Renovation+ and Theemswegtracé** | **Theemswegtracé** | After the VM study it was concluded that Theemswegtracé scored higher than variant Renovation+. In both documents Theemswegtracé was recommended. Complete implementation of VM recommendations, reviewed with a '+'. |

For case Calandbrug the variant check shows that VM recommendations were completely implemented in the project scope, which is reviewed with a '+'. VM was integrated in the project process, which stimulated implementation.

Table 3.3: Variant check case Griesberg

| Variants | VM recommendations | Project documents / interview | Comments |
|---|---|---|---|
| Ijsseloog | Transporting 'gries' to Ijsseloog and using the residual as coating. This variant was disapproved, because using 'gries' as coating was not a feasible option. | Removal of 'gries' and processing it for coating of dikes. The original idea, as suggested in the VM study was not feasible. An optional solution could be to use 'gries' in construction of a support bank. However, this requires laboratory tests which entails time and high costs. | Not recommended because of non-feasibility or high costs and needed time for laboratory tests. |
| Quick ahead | Philosophy: there is already enough knowledge available to be able to get started, without doing pilots. High design space for contractors, since little is prescribed. However, this also involves risks, because of needed permits and risks in detail. | Permits must be arranged by the contractor. An option is to sell 'gries' as chalk fertilizer at agricultural companies. The 'gries' can be removed in 2019. | High risks for contractors since they must arrange the permits by themselves. |
| A good start | Before tendering, carrying out researches and doing pilots to minimize risks. Possibilities to remove 'gries' afterwards on full speed after finishing the pilots. However, costs are only known when the business cases are ready. | Removal of 'gries' contains around five years. No pilots will be executed, because of long execution time and high costs. At most a pre-test is possible with accuracy of 40%. Since the variant differed slightly from the original variant A good start, in this document the name of the variant is changed into 'Gradually'. | Recommended by contractors which were involved in the VM study. |
| | | | |
| **Recommended variant** | **A good start** | **Gradually (A good start)** | Both documents recommended variant a good start. However, the variant differs in detail between VM recommendations and project documents. So, partly implementation of VM recommendations, reviewed with a '0'. |

For case Griesberg no specific project end-documentation was available. However, in the interview with the project manager was explained that the project team supported the results of the VM study and further elaborated this in the project stage. Both documents recommended the same variant, however the recommended variant varied in detail and also the name changed, so the variants are not completely similar. The variant check shows that VM recommendations were partly implemented in the project scope, which is reviewed with a '0'.

# Appendix 4: VM in formal project scope

Inclusion of VM recommendations in the formal project scope is examined by means of VM documentation and formal decision-making documentation. By means of a variant check it was examined to what extent VM recommendations correspond with the formal decision. Variant checks for the cases are shown in table 4.1.1, 4.1.2, 4.2 and 4.3. If the recommended variant(s) in the formal decision were in line with recommended variants of the VM study, it was concluded that VM study recommendations were included in the formal project scope, reviewed with a '+'. If the recommended variants were partly in line with VM recommendations, it was indicated as partly inclusion of VM recommendations in the formal project scope, reviewed with a '0'. If recommended variants differed from VM recommendations, it was indicated as no inclusion of VM recommendations in the formal project scope, reviewed with a '-'.

Table 4.1.1: Variant check measures case DBR

| **Variants measures** | **VM recommendations** | **Formal decision** | **Comments** |
|---|---|---|---|
| Do nothing | In this strategy, current management is stopped. This is not a solution to the problem. | | |
| Current management | This strategy is used as reference and is not indicated as solution for the problem. | | |
| Soft measures | Continuation of dredging and maintenance, including implementation of successful pilots (replenishments). Sustainability of replenishments is doubted in the VM study. | | |
| Hard measures | Continuation of current management, supplemented with hard constructions in the river such as longitudinal dams (including pilots) | | |
| Combination of hard and soft measures | Combination of hard and soft measures, including pilots. | Scoring the variants, a combination of measures scored best in total. Assessment points were: shipping, flood protection, cables and pipelines, civil structures, ecology, freshwater supply and technical, legal, social and economic feasibility. | For both short-term (No Regret) and long-term a combination of hard and soft measures is recommended. |
| | | | |
| **Recommended variant** | **Combination of measures** | **Combination of measures** | Both documents recommended a combination of measures. These VM recommendations were completely included in the formal project scope, reviewed with a '+'. |

Table 4.1.2: Variant check follow-up case DBR

| **Variants follow-up** | **VM recommendations** | **Formal decision** | **Comments** |
|---|---|---|---|
| No Regret package | No long-term solution. The soil subsidence is remedied locally, but the cause (soil erosion) is not addressed. | | |
| MIRT Exploration | Exploration with a broad approach. This requires 75% financing. | | |

| | | | |
|---|---|---|---|
| Standalone program | In line with desired approach. Prevents the exclusion of problems that are still insufficient visible and leaves space for uncertainties in the future. | | |
| Part of an existing program | For this variant, it must be clear how the problem can be solved. The control on the project will be lost. | Formal decision-makers concluded that project DBR fits well with an existing program. By including DBR in the existing program multiple goals and benefits will be achieved. | |
| | | | |
| **Recommended variant** | **Standalone program** | **Part of an existing program** | In the formal decision a deviant variant, regarding the follow-up, is recommended (part of an existing program) compared with VM recommendations. These VM recommendations were not included in the formal project scope, reviewed with a '-'. |
| | | | |
| Total | | | The variant check regarding measures is reviewed with a '+', the variant check regarding follow-up is reviewed with a '-', which gives a total review, regarding inclusion of VM recommendations in the formal project scope, of a '0'. |

For case DBR, the formal decision was taken beyond the duration of this research, but during the research it was already clear which formal decision would be chosen. There was frequent consultation between the project team and formal decision-makers (steering group), from which it became clear that preferences of the formal decision-makers deviated partly from the project team. In the VM recommendations the recommended variant regarding measures was a combination of hard and soft measures. The combination variant regarding measures was also recommended by formal decision-makers. This indicates a complete inclusion of these VM recommendations in formal decision-making. However, the recommended variant regarding the follow-up deviated between VM recommendations and formal decision-makers. While in the VM study a standalone program for project DBR was recommended, formal decision-makers recommended the inclusion of project DBR in an existing program. This indicated no inclusion of these VM recommendations in formal decision-making. Based on the variant checks, in only one of the two variant checks the variants corresponded for both documents. It can be concluded that the total VM recommendations (both variant checks) were partly included in the formal project scope. The inclusion of VM recommendations on formal project scope is reviewed with a '0'.

Table 4.2: Variant check case Calandbrug

| Variants | VM recommendations | Formal decision | Comments |
|---|---|---|---|
| Renovation+ | Large- scale renovation supplemented with measures to increase the operational capacity for train traffic in the medium to long-term. In the second VM study cost optimisations, concerning budget and hindrance, were indicated. | | |

| | | | |
|---|---|---|---|
| Fixed bridge | A fixed bridge closes the port from maritime shipping. Companies at the port may be able to receive compensation for damage or relocation due to not being able to carry out activities properly. | | |
| Shift of the railroad: Theemswegtracé | Moving the current railroad to another location. Investment costs were high. In the second VM workshop costs optimisations of around €50 million were indicated. | Train traffic and ocean shipping do not cross each other anymore. The bridge will remain for road traffic and will be renovated. The capacity problem will be resolved with this variant. This variant is within the legal framework for nature and living environment. | Variant Theemswegtracé is the ideal solution in terms of efficient traffic flow, noise hindrance and external safety. Based on the environmental impact report and the social cost-benefit analysis Theemsweg is chosen as preferred variant. |
| Shift of the railroad: Huntmanstracé | Moving the current railroad to another location. This location is badly assessed by stakeholders, because of crossing a business park with hazardous substances. | | |
| | | | |
| **Recommended variant(s)** | **Renovation+ and Theemswegtracé** | **Theemswegtracé** | After the VM study it was concluded that Theemswegtracé scored higher than variant Renovation+. In both documents Theemswegtracé was recommended. This gives a complete inclusion of VM recommendations in the formal project scope, reviewed with a '+'. |

After the VM study, more detailed research was done regarding both recommended variants (Theemswegtracé and Renovation+). From this, it was concluded that Theemswegtracé was the best variant to solve the problems of the Calandbrug. For case Calandbrug the variant check shows that VM recommendations were completely included in the formal project scope. Inclusion of VM recommendations on formal project scope is reviewed with a '+'.

Table 4.3: Variant check case Griesberg

| Variants | VM recommendations | Formal decision | Comments |
|---|---|---|---|
| Ijsseloog | Transporting 'gries' to Ijsseloog, use the residual as coating. This variant is disapproved, because using 'gries' as coating is not a feasible option. | Removal of 'gries' and processing it for coating of dikes. This original idea was not feasible. A discovered new solution could be to use 'gries' in construction of a support bank. However, this requires laboratory tests which entails time and high costs. | Not recommended because of non-feasibility or high costs and needed time for laboratory tests. |
| Quick ahead | Philosophy: there is already enough knowledge available to be able to get started, without doing pilots. High design space for contractors since little is prescribed. However, this also involves risks, because of needed permits and risks in detail. | Permits must be arranged by the contractor. Reimbursement based on tons of re-used product to encourage re-use. Image related to sustainability is good. Option is to sell 'gries' as chalk fertilizer at agricultural companies. The 'gries' can be removed in 2019. | This variant fits with the vision of the client to carry out the project in acceleration. |

| | | | |
|---|---|---|---|
| A good start | Before tendering, carrying out researches and doing pilots to minimize risks. Possibilities to remove 'gries' afterwards on full speed after finishing the pilots. However, costs are only known when the business cases are ready. | Removal of 'gries' contains around five years, also direct deposit to the end-user takes takes place within five years. No pilots will be executed, because of long execution time and high costs. At most a pre-test is possible with accuracy of 40%. Option is to sell 'gries' as chalk fertilizer at agricultural companies. A good start, in this document the name of the variant is changed into 'Gradually'. | Recommended by contractors which were involved in the VM study. |
| | | | |
| **Recom-mended variant** | **A good start** | **Quick ahead** | The variants of the VM study and formal decision were scored on dissimilar factors, which could be an explanation of the difference in preference. In the formal decision variant Quick ahead is recommended while in the VM study variant A good start was recommended. These variants do not correspond, which shows no inclusion of VM recommendations in the formal project scope, reviewed with a '-'. |

The variants for the formal decision were scored on: goal achievement, planning, sustainability, costs, stakeholder support, permits and reputation. From this it was advised by the formal decision makers to continue with variant *Quick ahead*, which conflicts with the recommended variant *A good start* from the VM study. The variants in the VM study were scored on: healthy mud bed, budget, positive image, sustainable solution, planning, regional reprocessing, innovation, combination with other projects and legal feasibility. The preference of gradual removal of 'gries' (variant *A good* start) conflicted with the task of RWS to accelerate project Griesberg. Since in the formal decision a different variant was recommended as in the VM study, the variants in both documents did not correspond. The variant check shows that for case Griesberg, VM recommendations were not included in the formal project scope. Inclusion of VM recommendations on formal project scope is reviewed with a '-'.

# De impact van Value Management op de scope in de vroege fasen van infrastructuur projecten

NEDERLANDSTALIGE SAMENVATTING

## Samenvatting

Value Management (VM) is een systematisch proces om waarde te optimaliseren. Waarde is gedefinieerd als de balans tussen de vereiste functionaliteit en bijbehorende kosten. In een workshop setting wordt in een multidisciplinair team de juiste balans bepaald. De resultaten van een VM workshop zijn aanbevelingen voor waarde optimalisaties. Deze waarde optimalisaties woden echter slechts bereikt wanneer VM aanbevelingen de uiteindelijke besluitvorming, op managemet niveau, bereiken en in de besluiten worden opgenomen.

Rijkswaterstaat, de uitvoerende organisatie van het Ministerie van Infrastructuur en Waterstaat en een van de grootste publieke opdrachtgevers van Nederland, past VM frequent toe. Een van de redenen om VM toe te passen is om de project scope te bepalen. Het bepalen van de scope is een verfijnde taak, omdat de scope een duidelijke richting voor ontwikkeling dient te geven, maar tegelijkertijd oplossingsruimte voor de aannemer dient vrij te laten. Ondanks dat Rijkswaterstaat VM regelmatig toepast, wordt de inzet van VM en de mate waarin VM aanbevelingen de formele besluitvorming bereiken en in besluiten worden opgenomen niet gemonitord. Om deze reden wordt in dit onderzoek geanalyseerd wat de impact van VM op de project scope is. De scope wordt vastgelegd in verschillende documentatie gedurende het projectproces, waaronder besluitvormings documentatie aan het eind van een projectfase. De scope in de formele besluiten is in dit onderzoek gedefiniëerd als de formele project scope. Het onderzoek is uitgevoerd door middel van exploratief case studie onderzoek. In de cases is bestudeeerd hoe VM workshop aanbevelingen zijn doorgevoerd door de verschillende organisatie niveaus (van project team niveau tot management niveau).

Uit de case studies is gebleken dat VM workshop succes en implementatie van VM aanbevelingen in een project niet garanderen dat VM aanbevelingen worden opgenomen in de formele besluitvorming op management niveau. Formele besluitvorming wordt beïnvloed door verschillende factoren. Een afwijkende formele besluitvorming kan de impact van VM op de project scope beperken. Concluderend kan gesteld worden dat de factoren die de besluitvorming beïnvloeden geïnventariseerd dienen te worden voor de start van een VM studie. Hierdoor kan er mogelijk op de factoren ingespeeld worden en kunnen bepaalde factoren worden meegenomen in de VM studie, waardoor de impact van VM op de project scope kan worden vergroot.

Aan de hand van het onderzoek zijn verschillende aanbevelingen geschreven met betrekking tot de inzet van VM in relatie tot de project scope. Naast dat de formele besluitvorming in lijn dient te zijn met VM aanbevelingen dient het doel van de VM studie in relatie tot de project scope voor aanvang van de VM worshop helder geformuleerd te worden. Tevens dient er gekeken te worden of de succesfactoren met betrekking tot de VM workshop aanwezig zijn en kunnen marktpartijen betrokken worden in een VM studie om hulp te bieden bij specialistische vraagstukken. Door daarbij bewust na te denken over de inrichting van de governance structuur en de inrichting van het project proces, kan de impact van VM op de scope beïnvloed worden. Door projecten te monitoren kan de inzet van VM geoptimaliseerd worden.