The application of Value Improving Practices: team integration pays off!

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Abstract

This paper presents a qualitative study into the application of Value Improving Practices (VIPs) in the Front End Development (FED) phase of five engineering projects. Earlier quantitative research suggested the particular importance of the VIPs Team Design, Goals Setting and Alignment, Goals Monitoring, Risk Management, External Benchmarking and Operations Implementation Planning in improving the chance on project success.

The current qualitative research investigated in-depth how these VIPs were actually applied in 5 projects across different companies. Semi-structured interviews were held with in total 11 project managers and team members.

Results showed a wide variety in the level of application of the VIPs. A formal structure of performing VIPs is a first step in professionalizing project management, but more important is truly applying the VIPs; not applying them as a “tick the boxes” exercise. The solution was found in working with truly integrated teams: involving project owner and contractor, as well as R&D specialists and future users (operations). These integrated teams, in which the parties trust each other, are more open to share knowledge and more alert to anticipate on changes in the highly dynamic project environment.

This research suggests the importance a long term relationship between project owner and project contractors. Further research into particularly this area is recommended: how to establish such long term relationships and how to maintain them.

Keywords: Front End Development, Value Improving Practices, Integrated Teams, Long term relationships, Trust
Introduction

Literature stresses the importance and influence of the early project phases for the project performance (Morris, 1994); (Morris, Crawford, Hodgson, Shepherd, & Thomas, 2006). In the early project phases (called Front-End Development or FED), little has been decided upon and many options are still open. Changes to the project scope can be made easily and with relatively little regret. When the project matures, it becomes more difficult to make changes. Major decisions have been taken and because interdependencies are large, small changes typically lead to a large amount of rework. Therefore, the FED phase needs thorough attention. However, investing too much time in the FED phase might result in spending unnecessary resources and finally could also lead to overruns in schedule or missed opportunities because competitors deliver faster. To conclude, the main goal of the FED phase is to ensure that the owner company obtains sufficient knowledge timely to decide at the moment of the final investment decision (FID) whether or not a project is worth investing in.

What exactly should be done in the FED phase is subject of practical debate. A lot of effort has been spent to identify so called “Best Practices”, or Value Improving Practices for certain industry sectors (IPA, 2009); (CII, 2009); (de Groen, Dhillon, Kerkhoven, Janssen, & Bout, 2003; Oosterhuis, Pang, Oostwegel, & de Kleijn, 2008). A value improving practice, also called best practice, can be thought of as “a repeatable technique or methodology that, through experience and research, has proven to reliably lead to a desired result in a more effective and efficient way than other practices” (van der Weijde, 2008). Typically, VIPs are applied in the framework of a stage gated project management process (Morris et al., 2006), (PMI, 2008). In order to pass a stage gate, the results of applying certain VIPs have to be demonstrated.

How an organization has implemented these practices in practice varies widely over different companies. First of all this is because there are major differences in project
management maturity across companies, but also because there are problems with the implementation of these practices. The first problem related to the implementation is the high number of best practices: there is a list with numerous best practices, which cannot all get equal attention unless considerably more resources are used in the FED phase. The second problem is the fact that all projects are unique and not all practices might be that relevant for all projects. To solve these problems it would help if the value of applying value improving practices would be known: which of the VIPs are particularly relevant for which type of project?

Earlier explorative research (Bosch-Rekveldt, Hermanides, Mooi, Bakker, & Verbraeck, 2010) suggested a number of particularly relevant Value Improving Practices (VIPs) to increase the chance on project success. The current research aimed at an in-depth investigation of these VIPs, specifically for technically complex projects. How are the activities in these VIPs actually implemented in a number of companies? How do they matter for successful project delivery?

This paper addresses the answers on these questions and is structured as follows. First the methodology followed is explained and the 5 investigated cases are introduced. Results are subsequently presented and thoroughly discussed. The paper ends with the conclusions of this research and recommendations in terms of managerial implications as well as suggestions for future research.

Methodology

In previously described explorative research (Bosch-Rekveldt et al., 2010), data on 67 projects was gathered in 2009 by means of an internet survey. These 67 projects came from member companies of the NAP network, the competence network of the Dutch process
Results of that study suggested that for engineering projects, particularly the following VIPs were contributing to project success:

- Team Design,
- Goals (setting, alignment, monitoring),
- Risk management,
- External benchmarking,
- Operations implementation planning.

A brief explanation of these VIPs is provided in Table 1.

<table>
<thead>
<tr>
<th>Value Improving Practice (VIP)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Project Design</td>
<td>A structured process that allows the formation of a “fit-for-purpose” project team</td>
</tr>
<tr>
<td>Operations implementation planning</td>
<td>Up front planning to significantly improve the probability of achieving a flawless start-up and processing at the specified levels of availability</td>
</tr>
<tr>
<td>Goal−setting and alignment</td>
<td>Identifying the goals and opportunities for the project and aligning these with the parties involved</td>
</tr>
<tr>
<td>Risk management</td>
<td>A process that results in the identification and response planning for risks to the project</td>
</tr>
<tr>
<td>External benchmarking</td>
<td>A structured process to add value to a project by comparing it relative to projects of similar characteristics carried out by the industry</td>
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</table>

To find how these VIPs actually were implemented in the projects under investigation and how these could have contributed to the project’s success subsequently qualitative in-depth studies were performed. From the existing dataset, four cases were selected in which the above VIPs were applied, following the case selection procedure in Table 2. Starting with 67 projects from the survey study, those projects were selected in which the interviewee was actively involved in the FED phase (62 projects left). Subsequently, those projects in which the respondents were willing to participate in subsequent research were selected (25 projects left). From these 25 projects, 14 projects applied the VIPs under consideration “little” or
“substantial” in view of the respondents, of which 7 projects were perceived technically complex. From these 7, finally the 4 cases were selected where the contact person acted as the project manager, since the project manager was considered the most relevant person to involve in the in-depth studies.

From these 4 selected cases, 3 were performed by contractors and only one by an owner organization. Since we expected different opinions between contractors on the one hand and project owners on the other hand, we wanted to include another project which was performed by an owner organization. Therefore we added a 5th case. This case came from a well-established owner company in the process industry, also member of the NAP network. This additional case met all requirements that were defined for the other 4 cases with regard to application of VIPs. In total 11 semi-structured in-depth interviews were conducted across these 5 cases. A summary of the selected cases is given in Table 3.

### Table 2: Case selection procedure

<table>
<thead>
<tr>
<th>Identification step</th>
<th>Criterion</th>
<th>Cases left</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Projects from the NAP survey (Bosch-Rekveldt et al., 2010)</td>
<td>67</td>
</tr>
<tr>
<td>1</td>
<td>Involvement in Front-End Development stage</td>
<td>62</td>
</tr>
<tr>
<td>2</td>
<td>Willingness of respondent to participate in subsequent research</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Score “little” or “substantial” on independent variables (VIPs)</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Being perceived as technically complex</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>Contact person’s role was project manager</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 3: Summary of selected cases

<table>
<thead>
<tr>
<th>Case REF-ID</th>
<th>Role in project</th>
<th>Project success</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Owner</td>
<td>Successful</td>
<td>2; PM and team member (chemical engineer)</td>
</tr>
<tr>
<td>B</td>
<td>Contractor</td>
<td>Successful</td>
<td>3; PM and two team members (electrical engineer and process engineer)</td>
</tr>
<tr>
<td>C</td>
<td>Contractor</td>
<td>Failed</td>
<td>3; PM and two team members (architect and civil engineer)</td>
</tr>
<tr>
<td>D</td>
<td>Contractor</td>
<td>Not successful</td>
<td>1; PM</td>
</tr>
<tr>
<td>E</td>
<td>Additional</td>
<td>Successful</td>
<td>2; PM and team member (mechanical engineer)</td>
</tr>
</tbody>
</table>
The success score mentioned in Table 3 was based on three aspects: schedule overrun, budget overrun and perceived quality performance. In case a project was delivered with sufficient quality within 10% budget and schedule overrun, the project was called “successful”. The project was called “not successful” in case either one of these conditions was not met. The project was called “failed” in case none of these conditions was met. Scoring on these criteria, the five selected cases included 3 successful cases, one unsuccessful case and one failed case. So although these five cases scored similarly on the application of VIP activities (e.g. the independent variables), this resulted in very different success scores (e.g. the dependent variable), based on the survey results. Figure 1 shows the overview of the selected cases and their success scores on the three different aspects.

Figure 1: Overview of selected cases: scores on project success. Legend for perceived quality is shown next to the graphical representation

The cases were analyzed qualitatively: case by case as well as across the different cases, focusing on the actual implementation and application of the VIPs. A case study protocol was developed and included the following activities:

- In-depth study of survey results for the specific cases, resulting in a case summary based on the survey results as a starting point for the interviews
• Contacting the identified project managers via e-mail with the invitation to cooperate in this follow-up research.

• Distribution of case summaries and topics to be discussed during the interviews to the interviewees.

• Conducting semi-structured interviews about how the main activities influencing project performance were applied, using the list of questions in Appendix A.

• Asking the project manager to identify two project team members and asking for their participation.

• Distribution of the interview results (narratives) back to the interviewees, asking them for comments and approval to use these narratives in the research.

• Analysis of the interview results, case by case (based on the narratives) and across the cases.

To assess the validity of the research design, the concepts of construct validity, internal validity and reliability are addressed (Yin, 2002), (Blaikie, 2009). To start with the latter, the concept of reliability (the study could be repeated with the same results) was ensured by developing a case study protocol, recording interview data and storing all case study results in a database. The internal validity (are causal relationships found indeed caused by the factors studied) was ensured by thorough analysis of the results, triangulation with literature and careful formulations of the conclusions, stressing the necessity to gather more project data to more firmly underpin the current results. The construct validity (do we use the correct operational measures to study the concept: do measure what we intend to measure?) was ensured by asking the participants in the case study to review and approve the interview reports. Also, company sensitive information was made anonymous thereby enabling other researchers to feedback on the research. In the interviews, the opinion or definition of the
This paper presents the analysis of the in-depth interview results for the five cases as follows. First, each of the 5 cases is presented at glance, summarizing the main characteristics of the project (the objective, why the project was undertaken, who was involved, whether or not cost- and schedule estimates were met). Next, the application of the VIPs is discussed (Team Design, Goals, Risk Management, External Benchmarking, Operations Implementation Planning) followed by a reflective case summary. In the subsequent cross-case analysis, the five cases are compared by focusing on each of the VIPs and their application across these cases as well as by comparing the level of success of each of the cases and how the application of VIPs contributed to the success (or failure).

**Results: the 5 cases at first glance**

*Case A: A successful construction project by an owner organization*

The key objective of this project was to increase the production capacity of an existing production facility and to improve its cost efficiency by building a new plant. This construction project was undertaken for operational necessity and to comply with legislation. It was an own investment: the project was completely paid by the owner company where the interviewees were working. The stakeholders in this project were mainly internally oriented. Next to the owner company, (sub)contractors were involved. The cost estimate of 30MEuro was met; the schedule estimate of 30 months was exceeded with 3 months.

The owner project team consisted of 8 persons and managed the engineering contractor in close collaboration. Actually it was an integrated project team, where the project owner allocated specialists (chemical and process engineers) to guide and steer the contractor
onsite. The close collaboration was indicated as one of the project success factors in this project because of the resulting direct and efficient information exchange and knowledge sharing. Another perceived success factor related to the project team composition was the involvement of one of the current team members in the preceding, related R&D project.

In view of the interviewees, the project team was actively involved in the definition of the detailed user requirement specification, after the high level goals were set by higher management. The project manager stressed within the project team the importance of knowing the project driver (in this case cost driven) by all parties involved. The project manager actively monitored project goals by issuing monthly progress reports.

On project level, risk identification, prioritization and allocation of risk ownership was performed when the business case was formulated and when the user requirement specifications were defined by the project team. At that time, the results were reported to the Steering Committee. Subsequent recurrent systematic risk identification and monitoring was not performed in view of the interviewees.

Despite the survey results indicating “little” application of the VIP External benchmarking, this was actually not applied in view of the interviewees, highlighting the difficulties of benchmarking in an industry where patented processes and products are involved.

Operation implementation planning (OIP) was performed by the early involvement of the future owners (operations and maintenance). This early involvement was the key factor in creating acceptance and buy-in of the site owners. Future users were asked for input already in the design phase. Also the facilitation of training sessions for operators and maintenance personnel was contributing to the flawless start-up, in view of the interviewees.

Reflecting on the above analysis, it seems integration and involvement played a prominent role in the success of this project. Integration is in terms of the team composition
(including owner’s specialists and the contractor’s staff), but also by involving the future users already in the design phase as part of OIP. Because of the good team atmosphere and good relation and trust between the owner and EPCM (Engineering Procurement Construction Management) contractor, a potential conflict was solved without escalating, according to the interviewees. Involvement is in terms of involving the team in defining the detailed user requirements and the initial risk analysis.

Case B: A successful turnaround project by a contractor

The key objective of this project was to increase the capacity of a clients’ already functioning plant by 50% by placing additional equipment and replacing current equipment, using partly unproven technology. This design and engineering turnaround project was undertaken on request of the client, for operational necessity. It was a 100% investment of the client. Next to the client, the key stakeholder was the operations manager of the current plant. The cost estimate of 7MEuro was achieved within 10%; the schedule estimate of 22 months was met. The slight cost overrun was caused by late scope changes of the client, in view of the interviewees.

The project team was composed of personnel of both the contracting company and the project owner. The team consisted of about 15 multidisciplinary engineers of the contractor, coordinated by dedicated lead engineers and led by the project manager from the contractor’s side. The owner also appointed a project manager and delivered two process engineers to the integrated project team. According to the contractor’s project manager the team composition (integrated and multidisciplinary) beneficially contributed to the project success as it supported quick communication, sharing and evaluating ideas concerning design and engineering issues. He also indicated that many years of collaboration (20 years) and the six years that they are preferred supplier now (in the form of a Global Framework Agreement)
resulted in trust between them and the project owner, which also contributed to the good working environment and success of the project team.

The goal of this project was to investigate the technical feasibility and subsequently define the technical scope in the early FED phase. Joint effort was undertaken by owner and contractor, resulting in alignment and broad understanding. Goals were also clear amongst the team members, in view of the interviewees. Goal monitoring was actively done by the project manager based on input and reports of all team members (via the lead engineers). All interviewees stated that having clear goals and monitoring the progress was important to keep the project “on track”.

Systematic risk identification was performed several times during the later FED phase and the execution phase. The methods used to identify risks included mind mapping and analysis of simulation models. The subcontractors and engineering disciplines (civil, piping, mechanical, construction), were involved in the reviews. During the reviews, risks, mitigations and actions were identified and appointed to corresponding specialists. In view of the project manager, appointing risk owners influenced the project success positively, because persons, who were best aware, monitored those risks. Even more important, in his view, it prevented having unsafe situations during the turnaround, and hence directly contributed to the good safety performance.

External benchmarking was performed by IPA during the front end phase, simply because benchmarking was a requirement from the client for projects above 5 million US$. During FED, the contractor delivered documentation for benchmarking. The results of the IPA study were used by the client’s decision board as an indication of project fitness. The good IPA score contributed to a positive investment decision. Recommendations from the benchmarking study (effective management of interfaces, involvement of the site and preservation of a strong team set up) were followed up by the project management.
Regarding operations implementation planning, it seems the contractor could not look beyond the current project, which for him was ensuring that all equipment was delivered in time, installed correctly and thoroughly checked. Applying operations implementation planning, however, could have avoided the late scope change that was requested by the client as a result of (too) late consultation with the operations team.

Reflecting on the above analysis, it seems trust amongst the parties played an important role. The trust between the owner and contractor was developed in the 20 years of collaboration of which 6 years under a global framework agreement. Also because of the good long term relationship, integration and involvement are keywords to characterize this successful project. Integration, i.e. the project owner was collaborating closely to the contractor. However, because of the high trust relationship, formal stakeholder involvement was given not enough attention, resulting in unnecessary, late scope changes. Formal risk management was applied and successfully contributed to the safe turnaround in view of the project manager, particularly because the high technological uncertainties faced in this project.

**Case C: A failed public civil engineering and construction project by a contractor**

The key objective of this project was to design and build a new transportation hub. The involved municipality acted as the project owner. The business justification to undertake this project for the contractor was to obtain margin growth, to build a long-term relation with the project owner and the partner company, to gather knowledge and experience in the field and to get introduced in a new market. The key stakeholders were the municipality and a related project that was executed in parallel. The cost estimate of 12MEuro was exceeded by about 20%; the schedule estimate of 120 months was exceeded by more than 20%.
A collaborative project team was formed by members of two companies, both contractors. These contractors were legally bound by forming a joint venture for this project. The project team was multidisciplinary and consisted of more than ten electrical and civil engineers. The roles of the engineers were set by the standard work procedures of the interviewed contractor. The functions and responsibilities per team member were described in the project plan. Based on the tender, the necessary discipline engineers were already selected and once the bid was approved, these engineers were added to the project team. In view of the project manager, a good working environment was created by having clear roles, positive interpersonal relationships and alignment of the different disciplines involved.

Project goals and deliverables were set following the contractor's standard work procedures. Subsequently, these were further described in the project plan. The contractor was already involved (in a consultant role) in defining the very early project requirements, which was considered beneficial since it contributed to better understanding of the specific requirements later on in the project. The project goals were monitored by the project manager who compared the project plan and the progress reports of the lead engineers on a monthly basis. Progress was reported and discussed in the project team meetings with the client on a monthly basis. According to the project manager, monitoring the goals by assessing the progress reports and having stage gates beneficially contributed to project success (or, formulated more precisely, prevented an even bigger project failure). It created the opportunity to work together effectively and to keep pace. On request of the client, and as a result of the related parallel project, project requirements changed considerably, resulting in serious project delays.

The project manager indicated that the client was mainly responsible for risk management. On a yearly basis the contractor was involved in a risks analysis workshop together with the client. Besides the yearly risk analysis workshop, the contractor also
identified and monitored risks. This was done on a monthly basis by making it an integral part of their project meetings. The RISMAN method (Well-Stam, 2003) was used which is a method that enables identifying risks, prioritizing risks and coming up with mitigations. During these monthly meetings the risks were updated in a central document. The project manager, assisted by the project management assistant, was responsible for the monthly risk management actions. In his view, risk management as performed by the contractor was a contribution to the project success (at least prevented an even worse project performance). According to the team members, the most serious risk in this project was the influence of various stakeholders (other than the client) as they could stagnate the decision making progress. The mitigation for this risk, early in the project already defined by the contractor, was to make clear agreements with the client and to structure meetings in advance by setting milestones and deliverables in order to stimulate timely delivery. Although clear mitigations were defined, the client could not deliver essential project information in time (because of reluctance of other stakeholders), resulting in project delay.

Neither external benchmarking, nor operations implementation planning were applied by the interviewees. In their view, these practices are unknown in the civil engineering industry.

Reflecting on the above summary, it seems that this project faced interface problems. An integrated project team, in which the client was included, could have overcome such interface problems. Interface problems also resulted in not being able to maintain goal alignment throughout the project. As a result of the long duration and public environment, the project was influenced by a changing political situation after elections which subsequently altered the project scope. Dis-continuity in the project team did not help. Risk management was formally applied, following a structured process, but also here an integrated project team could have overcome serious issues. Owner and contractor applied it both, but separately.
And formally codifying the risks as done by the contractor was not sufficient. More general, it is not about formally applying a FED activity, but about truly investing effort in an activity in order to obtain alertness for the dynamics of the project environment.

Case D: An unsuccessful plant modification project by a contractor

The objective of the project was to modify several of the refinery processes of the project owner in order to make them compliant with European environmental legislation and to reduce capital and operating costs with 20%. New technology was included in the project. The business justification to undertake this project for the contractor was to maintain current margin and to build a long-term relationship with the client. The key stakeholders were the project owner (100% investment in the project) and the contractor. The cost estimate of 36MEuro was met; the schedule estimate of 12 months (for one of the three subprojects) was exceeded by more than 20%. The other two subprojects were delivered in time.

The project team consisted of engineers from both the project owner and the contractor (multidisciplinary: engineering disciplines, procurement and contracting, cost controllers, schedulers). In total 40 team members were involved, of which 15 came from the contractor. In view of the project manager, the integrated team was contributing to project success as it enabled quick communication with lead engineers of the client, which increased the pace of the project. Furthermore the integrated team enabled alignment between contractor and client, which in his view enhanced the client satisfaction. The project manager stated that team performance was heavily dependent upon the different people involved. According to the project manager, the team composition was not only based on the disciplines needed but also on the competencies and soft skills that were required for this project. In his view, this was a very important contribution to the overall project success, as it avoided people functioning in wrong positions.
The project goals were set jointly by the client and the manager of the contractor. Based on the main goal, the goals were divided further on discipline level for the different engineers, the key members of the department procurement and contracting, the cost controllers and the schedulers of the contractor. The joint effort towards defining goals was considered important as it guaranteed the goals were understood correctly by all parties and were in line with present European legislation. The project goals were monitored by evaluating them on a monthly basis by means of a progress report. The various engineers, procurement and contracting staff, cost controllers and schedulers delivered input to the progress report. The project manager indicated that the progress reports were also used to anticipate on opportunities: when steel prices were expected to drop, the planning of the purchase of piping was adjusted.

Only after the FED phase, at start of project execution, the project team and other key players performed a risk management framework session. In this session risks and opportunities were identified, mitigation strategies were explored and responsible people were assigned to monitor these risks or opportunities. The risks, mitigations and risk owners were documented in a risk register. The risks were evaluated every three months. In view of the project manager, investing effort in risk management pays off since a safe project execution was realized without near misses and accidents. However, an extensive identification and deterministic analysis of project schedule risks during the development phases could have reduced the project delay and would have subsequently enabled a more successful project delivery.

On request of the customer, external benchmarking was performed by IPA. According to the project manager the outcome of the external benchmarking study could not be used to leverage the performance of the project.
Operations implementation planning was done according to the project manager, but mainly in terms of checking and testing the new equipment, and system trial runs. According to the project manager these procedures ensured a successful start-up.

Reflecting on the above summary, it seems the lack of systematic risk management in the early project phase contributed to the schedule delay. In this case, there was an integrated project team, but real involvement and integration seems lacking. Results of the IPA benchmarking study were not used to improve the project performance (lack of integration) and although operations implementation planning was done in view of the contractor’s project manager, this seems limited to the technical part whereas involving the operations department early in the project could have prevented schedule delays (again a lack of integration and involvement).

Case E: A successful Greenfield design and construction project by an owner

The key objective of this project was to build a new factory on a new location to produce an existing product with a new production process. Hence new technology was included in the project. The project needed a total investment of about 100 million Euro (100% by the project owner) and the planned duration was three years. The project was split in two phases. Phase 1 ended during front end development the cost estimate was increased with more than 40%. The project was temporarily stopped and a redefinition of the project scope was made. A new project manager was appointed, a new contract with an engineering contractor was made and phase 2 started. The major challenge of this project was that project execution started while R&D was not ready yet because of business pressure. In total, the project budget was overrun with 10 million and the project was delayed with 3 months and delivered with good quality, which made it a successful project in the definition of the current study.
The project team consisted of members from both the project owner and the contractor. The multidisciplinary, integrated team (piping, mechanical equipment, installation, civil, process engineers and production) was fully dedicated to this project. In total 20 team members were involved. In view of the project manager, this integrated team offered the opportunity to communicate directly with each other when problems arose, for example aligning design adjustments. These design adjustments were communicated efficiently throughout all disciplines in the team. Constructive disagreements such as having different views on design occurred in the team. In view of the project manager these disagreements could have been reduced by composing the project team also based on competencies and personal characters rather than solely on the engineering disciplines needed.

Because of the urgency of the project, the management board put pressure on the initial time schedule. Therefore the conceptual design started while the technology was not completely proven and tested. In phase 1, no clear milestones and deliverables were set for the R&D part of the work, leading to rework once results came available and a temporary stop of the project. The new project manager started with a workshop in which all internal stakeholders were involved in order to define a new business case for the project. The essential deliverables of R&D were defined and ways to obtain savings were discussed. After redefining the business case, the project scope was frozen. The project manager experienced that the joint effort of reframing the project scope provided a new, essential and vital foundation to continue and enhanced the team spirit. The new project goals as defined in the project plan, including schedule and budget realization, were monitored during weekly progress meetings with the lead engineers and the project manager. In the view of the project manager it was important to monitor goals together: it offered the possibility for early problem identification and solving. In case of problems, the contractor had procedures in
place to cope with formal scope changes, which were used by the owner to integrate the changes in the project.

Risk analysis was performed in phase 1 by an external consultant. Before starting phase 2, when reformulating the project goals and scope, risks were identified, mitigations were defined, risk owners were allocated and actions were distributed. During phase 2, no additional risk analysis was performed, nor were formal risk management tools in place. In view of the project manager, risks related to the start-up were foreseen, but could not be fully mitigated because of the strategy to be on the market as soon as possible, hence limiting R&D time.

External benchmarking was applied at the end of the project, as part of the project evaluation. Generally this is done earlier in the project. In this case, external benchmarking was not experienced as very useful, since results were not communicated back to the project team. Results of the benchmarking study indicated that the decision making was a relatively slow process. This could refer to the fact that R&D came with new results, resulting to scope changes over and over again.

According to the project manager, the key to ensure a good start-up was to integrate operations early in the project team. Operations had clear milestones during the Front-End Development phase to ensure that the operators were ready when the factory was commissioned. Operation’s main responsibility was to gather sufficient information in order to write operation manuals, job instructions and maintenance requirements. Furthermore their input was enquired for the design. Still, the targeted production after project delivery was delayed because of start-up problems. Some intended processes could not be executed because of time restrictions (i.e. no 100% practice what you preach…).

Reflecting on the above analysis, it seems a good second start was made for this project resulting in successful project delivery (despite some start-up problems after delivery).
Although the joint effort in reframing the project did not avoid scope changes, it gave a new vital foundation to continue with the project and it enhanced the team spirit. An integrated project team existed, consisting of contractor and owner employees, but the R&D department was formally not integrated in the project team despite their crucial role in the project. However, R&D members were involved in weekly progress meetings, thereby actively contributing to the project (albeit informal). It was a conscious choice to limit the R&D time. In case R&D had been given more time to develop the technology, a number of scope changes could have been avoided and likely a better start-up could have been realised.

**Results: the cross case analysis**

Using the previous within-case analyses, this section presents the cross-case analysis. Table 4 presents an overview of the activities applied in the various cases. First the cross-case analysis is focussed on the application of the separate VIPs across the cases, e.g. discussing the “rows” in Table 4. Subsequently, the similarities and differences between the cases are discussed, e.g. focussing on comparing the “columns” of Table 4. The level of application of the different VIPs in the different cases was determined based on the interview results (i.e. this is an interpretation of the researchers).

**Table 4: Summary of case results**

<table>
<thead>
<tr>
<th>APPLICATION OF VIP?</th>
<th>Case A Owner Successful</th>
<th>Case B Contractor Successful</th>
<th>Case C Contractor Failed</th>
<th>Case D Contractor Unsuccessful</th>
<th>Case E Owner Successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated project team</td>
<td>Yes</td>
<td>Yes</td>
<td>Not</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Goal setting</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Monitoring project goals</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Risk identification and management</td>
<td>Partly</td>
<td>Yes</td>
<td>Partly</td>
<td>Partly</td>
<td>Partly</td>
</tr>
<tr>
<td>External benchmarking</td>
<td>Not</td>
<td>Yes</td>
<td>Not</td>
<td>Partly</td>
<td>Partly</td>
</tr>
<tr>
<td>Planning for start-up</td>
<td>Yes</td>
<td>Not</td>
<td>Not</td>
<td>Partly</td>
<td>Partly</td>
</tr>
</tbody>
</table>
Findings on Team Design

In four cases (A, B, D and E) the project team was consisting of members of both the project owner and the contractor. Concerning these four cases, this team composition beneficially contributed to project success as it increased efficiency. Reasons mentioned were that design adjustments/formal scope changes were integrated faster; the right knowledge was available when crucial data was missing and problems could directly be solved. Therefore, working in integrated project teams likely contributes to a reduction of scope changes and to an increase in client satisfaction. The failed case C (building of the transportation hub) especially illustrates this conclusion. This project did not have an integrated project team. Integrating the client in the contractors’ team likely would have led to better interface management by having a better understanding of the project environment. Supporting our earlier quantitative findings (Bosch-Rekveldt et al., 2010), the importance of integrated project teams, in which the contractor and the project owner closely collaborate, is evident.

All project teams were multidisciplinary. In two cases (D, E), it was suggested that a team should be composed by looking at competencies rather than solely at which engineering disciplines are needed. In four cases (A, B, D and E) it was suggested that having the right team composition offers the opportunity to engage and manage the stakeholders. The involvement of the future user, as well as the required specialists (R&D staff) stimulated alignment and successful project delivery.

A project team with team members that have collaborated for a long time, likely results in the development of trust. An important benefit mentioned in case B, is that trust results in a good working environment, which favours the motivation of sharing and criticizing ideas. One of the factors that likely contribute to the development of trust is to have a steady composition of the team. Long term relationships between parties enable such steady team compositions.
Our case study results reinforce the suggestion that collaborative project teams are desirable and can help improve teamwork effectiveness (Anderson, Patil, Gibson, & Sullivan, 2004). A good team design will also influence stakeholder management and risk management positively. In conclusion, team design is an important FED activity that needs thorough consideration as it might affect many other elements of delivering a project successfully.

Findings on Goal Setting

Goals were formulated for all the cases by means of joint effort. What this joint effort entailed varied by case. It could be a workshop to set goals with the entire project team and relevant stakeholders. Alternatively, it could involve a joint study to the feasibility of a project or to define the technical scope. Joint effort constituted alignment amongst the stakeholders involved, in view of the interviewees. Although joint effort in goal setting seems to enable alignment, for case C it did not work out very well. Even though goals were framed by the various stakeholders, it seemed that the project environment did not allow keeping alignment on the main project goals, as alterations in requirements and legislation caused changes to the project scope several times. Hence applying joint goal setting does not automatically lead to project success.

Not only joint goal setting, but especially joint effort is important to create alignment and commitment. When joint effort is undertaken for finding an optimal solution and for developing implementation action plans, this likely contributes to an improved understanding of each other’s capabilities and expectations. As a result of such better understanding and involvement, a reduction of major scope changes can be expected, contributing to better client satisfaction. Consequently, undertaking joint effort can be seen as a kind of team building exercise since it enables the development of trust, confirming literature findings (Kadefors,
In a project environment with many stakeholders, which have a high possibility to influence a project's scope, it is important to keep sufficient attention to (joint) Goal Setting.

**Findings on Monitoring Project Goals**

The case results confirm the benefit of monitoring project goals. This activity was applied in all cases, and the interviewees seemed very much aware of the importance of this activity. In their view, it is, amongst others, a means to make people aware of abnormalities in schedule and/or budget and hence to keep on track.

All cases, both successful and unsuccessful, had structured procedures to check project progress and take action to overcome any deviation from achieving the project goals. Hence, applying this FED activity does not automatically lead to a successful project. In case C, the major problem of continuous scope changes was not overcome by Monitoring Project Goals and also case D was not successful although Monitoring Project Goals was applied, according to the interviewee. Just applying this activity does not necessarily suffice; it is essential to choose the right monitoring means and to take appropriate action, if needed.

The right amount and type of effort to invest in Project Goals Monitoring obviously relates to the project environment and should be treated differently for each project. The more the project environment is dynamic, the more effort is needed to monitor the project goals. In monitoring project goals, the challenge is to limit the scope changes. Limiting scope changes can be supported by the use of integrated teams and thorough interface management.

**Findings on Risk Management**

The case studies suggest that risk management beneficially contributed to the project as it offered the opportunity to identify deficiencies in early stages, thereby avoiding rework. But even more important, it contributed to an increase in safety performance during execution, in
view of the interviewees. Risks were identified when defining the business case and the user requirements. Techniques used to identify the risks were brainstorming and mind mapping sessions. Later on in the project, more technical risks were identified and assessed.

The case results indicate only partly applications of risk management in practice. Often actions and owners were allocated to the identified risks, but risk registers or formal risk monitoring were not generally applied. Becoming alert for the most important risks seems to get priority over formally codifying and, particularly, monitoring. In a very stable project environment this could work, but in more dynamic project environments (…like we normally face…) using formal procedures (or at least more continuous attention) for risk management could be beneficial in view of the authors.

Based on the distinction between successful and unsuccessful projects in this case study, it seems that applying risk management does not automatically result in project success. Moreover, the unsuccessful projects (case C and D) were the only cases that had risk registers in place. The successful cases more implicitly implemented risk management practices in the management of the project. Thorough risk identification was followed by allocation of actions and (implicit) identification of risk owners. Formal risk monitoring, reassessment or risk registers were not used in two of the three successful cases. The success of these projects, still, can be explained by the fact that the risk identification was done by integrated teams, including technical experts. Those risks that were identified likely were “the risks that mattered” for those projects. Hence the quality of the risk management seems more important than the quantity. And maybe more important are the people involved: integrated teams likely are more alert for the “risks that matter” that might appear in a project.

The application of risk management seems to be contingent with the project environment. This is confirming our earlier work (Bosch-Rekveldt et al., 2010) in which a moderated relationship was found between risk management and project success with project
complexity as the moderator. Increasing technical complexity was shown to coincide with the need for more (better?) risk management, resulting in a higher chance of project success. Also earlier literature suggests that risk management techniques are more helpful for high-risk projects (Raz, Shenhar, & Dvir, 2002).

Reflecting on the above analysis, it seems it is not about applying risk management with a “tick the boxes” mentality, but it is about truly investing effort, in order to obtain alertness of the (integrated) project team. A means to improve risk management is to have the right people incorporated in the project team who are alert and able to cope with the technical risks and the dynamics of the project environment. And it doesn’t stop with a good start. A thorough risk identification session, including the appointing of risk owners, should be followed by serious risk monitoring in order to take the appropriate actions to achieve the project goals.

Findings on External Benchmarking

Although some companies see external benchmarking as an important way to improve themselves, it was substantially applied in only three of the five cases. And from these three cases, only in one case (B) it was contributing to improving the project results, in view of the interviewees. In this case, the outcomes of the benchmarking study were beneficially used to prepare optimally for execution in the later FED phases. In view of the interviewees, the external party, objectively assessing the project fitness, contributed to the development of trust in this truly integrated project team. The project, seen as the result of joint effort of contractor and owner, was objectively evaluated on its performance by this external party. Another project (case D) illustrated a more traditional owner – contractor relation. Here the contractor did not see the value of applying external benchmarking; it was just applied because it was requested by the project owner. In case of real integrated teams, more feedback
of the benchmarking results and integration of these results in the project would be expected. The additional case also applied external benchmarking but it seems it was applied simply too late to be effectively included in the project.

The reason why, in the remaining cases, external benchmarking was not substantially applied was either that it was not a common practice in the industry (case C); or it was not desired to benchmark because of the patented and unique products involved (case A), in view of the interviewees. Applying external benchmarking could have enabled early anticipation in the FED phase on the negative developments in case C. For example, an external benchmarking study could have recommended paying more attention to interface and stakeholder management. A study from construction industry also suggests that benchmarking can support project management, by learning from best practices of others and stimulation of continuous improvement within the organization (V.T., Kim, & Huynh, 2008).

Summarizing the above, we conclude that it is likely that external benchmarking has the potential to contribute to the success of projects, despite its poor application (in quantity and quality) in our current case study.

Findings on Operations Implementation Planning

In 1998 the construction industry institute (CII, 1998) stated that the industry did not have sufficient tools to facilitate effective planning for start-up. Apparently a lot has happened in the industry since then, as illustrated by our case study results. Nowadays procedures are operational, for example for the preparation for start-up. Next to these procedures with a technical focus, it was also considered essential that the future user (often the department operations) is integrated in the project team or otherwise involved early in the project. This enabled the inquiry of feedback for the design in order to identify flaws in an early stage. Furthermore the early involvement enabled them to have operation manuals, job instructions
and maintenance requirements operational at the moment of project commissioning. The construction operators organised site visits and trainings to make the future users acquainted with the facility. So the case study indicated the following benefits to the project when applying OIP:

- Reaching start-up time faster,
- Reaching steady state production faster,
- Identifying flaws early,
- Avoiding risks and non-quality.

One case (E) was not prepared sufficiently for start-up, which resulted in a delay in reaching the targeted production yield. A better preparation could have reduced the delay. For the other cases (A, B and D) OIP had a direct positive relation with project success. It is noted that mainly project owners seem to initiate effort in this FED activity and consider this activity vital. The contractor’s horizon seems shorter and limited to the execution phase.

To conclude, operations implementation planning (or preparing for startup) seems an important contribution to project success, not only for the success criteria (i.e. meeting cost and schedule), but more importantly for the success factors (i.e. trust, acceptance). Involving the departments of operations and maintenance early in the FED phases supports the development of trust amongst the parties involved. As a result of that trust, it seems acceptance for (organizational) change is gained.

**Comparing the 5 cases**

According to Table 4, case D and case E applied the VIPs to the same level, more or less. Why then was only one of these cases successful? Similarly, case A did not apply fully all VIPs, but still was successful. Isn’t it useful to work according to Value Improving Practices? Our qualitative study suggests that the way of applying VIPs is crucial. Working according to
VIPS with a “tick the boxes” attitude is not enough: truly integrated teams, truly investing joint effort in VIPS can make the difference. In such an integrated team, there should be integration of the owner staff and the project contractor staff.

Two of the projects were performed by the project owners (case A and E), the other three by contractors. In the contractor cases, two more traditional owner-contractor relations were observed (case C, D) and one successful long term relationship (case B). In cases C and D, there was no “true” integration: there was no integrated team at all (case C) or activities were performed just because “the owner requested” (case B). The poor performance of these projects might therefore be related to the absence of such true integration.

Whereas the earlier quantitative study already suggested the relations between each of the VIPS and project success, the current qualitative study stresses the importance of the interplay between the different VIPS (with a central role for the integrated team!) and how the VIPS are actually applied.

**What does really matter?**

When talking about the application of VIPS in the different projects with the interviewees during the course of this research, it became clear that besides VIPS, the people involved in the project play the crucial role in achieving project success. They are the ones that execute the FED activities. A formal structure of performing VIPS is necessary (e.g. in company work processes), but not necessarily sufficient to achieve project success. Integration and involvement are keywords. With integration we refer to integration of the results of the different VIPS, integration of the different disciplines in a multidisciplinary team and integration of the different parties involved (e.g. close collaboration of contractor and owner). Involvement means that the team members are involved in setting project goals, in risk workshops, etc. And, preferably, the same parties (even better: persons) are involved in the
different project phases, including the technical specialists and the future users. Long term relationships between the project owner and contractors enable team integration.

Taking a helicopter view, it appears that trust (between the team members, but also between the contractor and project owner) and alertness (to anticipate on the changes in the project (-environment)) can influence successful application of the FED activities. Spending joint effort in FED activities seems to support the development of trust within a project team: when working together, interpersonal relations are build which help in solving problems later on. It is not always about the result of applying the VIPs, but also about the fact that joint awareness is created by performing a VIP with a truly integrated project team.

Turner already stated: “To a large extent people are the key elements and yet so many books concentrate on methods, tools and computing capability” (Turner, 2003). Our research also suggests that people are key elements in projects. Still, formally and truly (e.g. not as “tick the boxes” exercises) applying VIPs is deemed beneficial as they provide the guidance in performing those activities that are relevant for achieving project success. The people factor then plays an important role in how the different VIPs are applied and how results of the VIPs are implemented and integrated in the project.

**Conclusion and recommendations**

The findings of this research support developments in literature in which it is argued that the people in the project play the crucial (but interwoven) role (Lechler, 1998), (Cooke-Davies, 2002), (Baiden & Price, 2011). Nevertheless, the VIPs under investigation do add value: having a formal system in place for applying VIPs is a first necessary step in professionalising project management, in view of the authors. On top of such a formal structure, the people are the ones that “make or break” the project.
In the studied cases, the activities team design (integrated multidisciplinary project teams), goal setting & monitoring and operations implementation planning were implemented according to the best practices known from literature. Integrated teams particularly seem to contribute to project success as it increased efficiency in decision making. Based on the findings of this research it seems likely that trust and the composition of a team, not only in terms of disciplines but also in terms of competences, have to be taken into account when designing a team. Risk management was implemented in the cases under investigation to a lesser extent than described in the literature; it seemed to stop after the risk identification. Appointing risk owners was highly beneficial in view of the interviewees.

From this qualitative study, we suggest the following managerial implications for technically complex projects:

- Work in integrated teams (contractor & owner),
- Involve the operations people early on in the project,
- Try to keep key persons in the team across the different project phases (starting with R&D),
- Perform goal setting with the integrated team, in a joint effort,
- Perform external benchmarking and actively involve the results in the project,
- Actively monitor risks after thorough risk identification and appointing of risk owners.

Of this list of managerial implications, the most important is working in integrated teams. It is about establishing true integration between all parties involved. Long term relations contribute to trust between parties and both support such true integration. Project teams working together for a longer period of time developed effective problem solving skills (de Jong & Elfring, 2010).
In project management, it seems we have all tools available for successful project delivery, but we keep on nailing using pincers. How you apply the VIPs – e.g. the people factor - seems more important than that you apply them.

Limitations of this research concern the limited availability of interviewees in some of the cases under investigation. The strong point of this study is that it shows the qualitative story behind some of the cases from our quantitative dataset, and the results reinforce each other.

This research suggests the importance of integrated teams and long term relationships between project owner and project contractors. Further research into particularly this area is recommended: how to establish such long term relationships and how to maintain them?
References


Appendix A: Initial List of Questions: FED activities relating to project success

Background information project
Company description
Reasons for starting project
Client
Location
Project team size

Team Building
1.1 Can you tell me something about the project team?
1.2 How was the team composed?
   1.2.1 How did you apply team design?
   1.2.2 What exactly has been done during these activities?
   1.2.3 Would you perform these activities again?
   1.2.4 Would you perform these activities in a different situation?
   1.2.5 How did team building influence the project results?
1.3 Which negative impacts of team building on project success can you mention?
1.4 Did any conflicts appear during Front-End Development phase between the team members?
   1.4.1 What conflicts appeared in the Front-End Development phase between the team members?
   1.4.2 How where the initial conflicts between the team members influencing the rest of the project?

Goal-setting
2.1 What were the most important goals in the project?
2.2 How were these goals set?
   2.2.1 Which goal setting activities did you use?
   2.2.2 Which two goal setting activities consider you to be most important?
   2.2.3 What exactly has been done during these activities?
   2.2.4 Would you perform these activities again?
   2.2.5 Would you perform these activities in a different situation?
   2.2.6 How did team building influence the project results?
2.3 By whom were the goals of the project set?
   2.3.1 What are benefits if the goals are self set?
2.4 Were these goals complicated to achieve or do-your-best goals?
   2.4.1 Do you think that difficult goals led to a higher performance?
2.5 Were these goals perceived to be important contributors to the project success?
2.6 Did you monitor the project goals?
   2.6.1 How did you monitor the project goals?

External Benchmarking
3.1 Did you perform benchmarking activities?
   3.1.1 Which benchmarking activities did you use?
   3.1.2 Which two benchmarking activities consider you to be most important?
   3.1.3 What exactly has been done during these activities?
   3.1.4 Would you perform these activities again?
   3.1.5 Would you perform these activities in a different situation?
   3.1.6 How did benchmarking influence the project results?
   3.2 Various benchmarking processes exist. Which process did you use?

Risk Management
4.1 Did you perform risk management?
4.2 When did you apply risk management?
4.3 Who were involved in risk management?
   4.3.1 Which risk management activities did you use?
   4.3.2 Which two risk management activities consider you to be most important?
   4.3.3 What exactly has been done during these activities?
   4.3.4 Would you perform these activities again?
4.3.5 Would you perform these activities in a different situation?
4.3.6 How did risk management influence the project results?
4.4 What systematic risk identification methods were performed during the Front-End Development Phase?
4.5 How did you assess the risk of the project?
4.6 How did you reduce the probability and consequences of adverse risks to an acceptable threshold?
4.7 Were risks actively monitored?
   4.7.1 How were risks actively monitored?
   4.7.2 Was there a person responsible for risk management?

Operations Implementation planning
5.1 Did you perform Operations Implementation Planning?
5.2 When did you perform OIP
5.3 Who were involved in OIP?

Project success
6.1 Who defined the critical success factors?
6.2 How were the critical success factors defined?
6.3 What were the critical success factors of the project?
6.4 How was success measured?
6.5 Were these critical success factors reached?

General questions
7.1 Which FED activities was the most important?
7.2 Which activity had the most attention in your project?
7.3 Which activity was most effective in terms of invested time and results in the project outcome?
7.4 Which FED activity is not dependent on the context it is executed and has a strong relation to project success?