Key Performance Indicators
Measuring Performance in the Oil & Gas EPC Industry
“If you don’t know where you are, then you can’t know where you’re going and you certainly can’t get to where you want to be. It’s akin to traveling in unknown territory without a compass or a map. You’re totally lost.”

Mark Graham Brown (Performance Measurement Expert)
PREFACE

This is the final report, intended for my Master Thesis, which is carried out at CB&I Lummus (former ABB Lummus Global) in The Hague. This final Thesis represents the end of my Masters at the faculty Technology, Policy and Management of the Delft University of Technology.

First, I want to thank all members of the graduation committee for their assistance in carrying out my Master Thesis. I owe a large debt of gratitude to Jako Kruidenier for offering me the opportunity of fulfilling my Masters at the company and for the advice and guidance during the execution of this Thesis. Finally, I want to thank the respondents at CB&I Lummus for their valuable input.

The members of the graduation committee are:

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The Hague, May 2009
Rishi Chandi
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EXECUTIVE SUMMARY

In order to sustain a competitive advantage and therefore to survive as an organization, companies should be capable of continuously improving their performance. This has never been more applicable than in today’s complex, dynamic and confusing business environment which requires better decisions and improved execution. Managing business performance effectively firstly requires measurement of the current performance and from that point on, the company can make decisions in order to improve its performance in those areas where needed.

Some years ago, CB&I Lummus, an Engineering, Procurement and Construction (EPC) contractor, acknowledged this and decided on measuring their performance. However, performance measurement was not sufficient as it did not lead to making decisions which increased business performance. Therefore, the research in this thesis is aimed at the design of a method that ensures continuous performance measurement at company level for Engineering, Procurement and Construction Contractors in order to continually improve their performance.

As many other companies, CB&I Lummus used Key Performance Indicators (KPI’s) to measure their performance. Literature study shows that there is nothing wrong with using KPI’s to measure organizational performance, as long as they are designed and used correctly. Imagine an airplane’s instrument panel (dashboard) consisting of instrument dials and gauges. Like pilots are able to process information from a large number of indicators to navigate their airplane, organizations need instrumentation (KPI’s) about many aspects of their environment to keep track of their journey towards excellent performance.

Theoretically, using KPI’s correctly can be approached from different point of views. Firstly, KPI’s are directly related to the organization’s strategy and/or directly contribute to the organization’s strategic objectives. This requirement enables KPI’s both on company and project level. The company’s ‘dashboard’ consists of several KPI’s. When determining these KPI’s it is of importance that there is an appropriate mix with respect to the way KPI’s can be viewed in organizations. This will enable the determination of KPI’s which represent different aspects of business processes. In this KPI determination process, KPI’s also need to be ‘good’ and designed in a structured way.

In measuring performance, organizations need to approach KPI’s from a broader point of view where many factors are related, e.g. KPI’s are not isolated measurements. Just like dials and gauges are instrumentation which make up a whole, namely the airplane’s dashboard, every KPI is part of a whole, namely the company’s performance measurement dashboard (can you imagine boarding an airplane of which the pilot is only interested in the speed and does not pay attention to the amount of fuel, the altitude, etc.?). This holistic approach argues for the use of a framework which functions as a basis in organizational performance measurement. There are several frameworks available in the literature. Deciding on which framework to apply should not be done by analyzing which framework fits best to a specific Industry, because frameworks approach organizations from a high abstraction level. Therefore a framework needs to be determined on the basis of theoretically valid criteria. Enhanced by a comparison of the frameworks amongst each other, this study argues to use the Strategy Map of Kaplan & Norton, regardless of the Industry an organization is active in.

One of the main characteristic of the Strategy Map is the approach of organizations from perspectives. Kaplan & Norton argue that these perspectives should be in balance. However, an important conclusion of this study is that this balance is not as important as the fact that the Strategy Map should represent a balance between the needs and requirements vital to the success of the company. These needs and requirements are represented by the Critical Success Factors (CSF’s). Basically, the perspectives are only used to sort CSF’s and to make sure you do not leave out any important ones. So, it is not a requirement of the Strategy Map that all perspectives contain the same number of CSF’s, as long as important ones are not left out. After determining which CSF’s are the most business critical and measurable, one or more KPI’s have been allocated to the CSF’s. These KPI’s are designed in such a way that they comply with the theoretical requirements. CB&I Lummus and other companies in the EPC contracting business are advised to implement these KPI’s, which all together will function as the dashboard for their journey towards excellent performance.
Reflecting on the KPI’s used by CB&I Lummus up till now, it can be concluded that these KPI’s are hardly linked to the strategy and do not make up an integrated whole. Also, the KPI’s provide only a partial picture of performance that reflects what is easy to measure in stead of what is important to measure. This resulted in KPI’s which were used reactively: checking whether targets on project level were achieved. The concept of KPI’s is broader than only monitoring, it needs to enable company management to enrich their decision making process.

In order to use the dashboard for management purposes, in stead of only as a monitoring tool, this study emphasizes on cause-and-effect relationships between all KPI’s of the dashboard (by using System Dynamics modeling techniques). These relationships indicate how KPI’s influence each other. Imagine again the airplane’s dashboard: if for whatever reason the travel time needs to be shortened, the pilot can decide to increase speed, which will decrease the fuel amount faster, increase environmental impact, increase the rotation speed, etc. In this thesis, potential relationships are given, which are subject to be tested thoroughly in additional research. But these relationships are not sufficient to understand why certain changes may have occurred in KPI’s and to analyze areas for improvement in more detail. An answer given in this study is to acknowledge different levels of KPI’s, where the big picture should be bare in mind first and then the focus can be concentrated on the pieces that fit into that picture. Advised is to implement KPI’s of all levels in a System Dynamics model in order to understand the changes in the KPI’s due to change in policies and actions. An additional advantage of modeling is that ‘what if’ scenarios can be tested.

Another shortcoming in the current KPI concept is the lack of a direct link between (not) meeting KPI targets and incentives/ penalties. This study recommends a proactive accountability policy which is based on incentives. Awarding incentives needs to be part of a continual process: this study recommends an ongoing process which takes into account all iterative steps to be taken in the performance measurement and improvement journey of companies. An important note is that this ongoing process has an adaptive character; it needs to be reviewed regularly on validity.

Because any concept can still fail in the implementation phase (or even in an earlier phase when it is not clear who needs to do what and when), a pragmatic plan has been designed in this study specifically for CB&I Lummus. This plan indicates what needs to be done stepwise in order to increase the probability of the KPI-concept to succeed. Also (for companies in general), based on the knowledge gained in this study, the development process of performance measurement and improvement is given.

“Like pilots are able to process information from a large number of indicators to navigate their airplane, organizations need instrumentation (KPI’s) about many aspects of their environment to keep track of their journey towards excellent performance.”

“...can you imagine boarding an airplane of which the pilot is only interested in the speed and does not pay attention to the amount of fuel, the altitude, etc.?..."
1 INTRODUCTION

This chapter is an introduction of this master thesis and can be considered to be the guideline of this research. First, brief background information is given of the company where the master thesis is executed, CB&I Lummus BV. The second section includes the context of this research to discuss why this research is necessary, followed by the scope of the research in the third section. The scope description makes sure that all involved parties have the same understanding with regard to this thesis. The fourth section describes the steps that are taken during the research and the fifth section discusses how the steps will be taken. Section 6 will elaborate on the two main tools that have been used to retrieve valuable information. Finally, the last section gives the structure for the following chapters of this research.

1.1 CB&I Lummus BV

CB&I Lummus is an international Engineering, Procurement and Construction (EPC) Contractor, providing a full range of services to the oil and gas, petroleum refining and petrochemical industries worldwide (both onshore and offshore). CB&I Lummus is a 100% owned CB&I company with headquarters in Texas. CB&I Lummus’ headquarter is located in The Hague, CB&I Lummus Netherlands (CLN), and shares work with other CB&I Lummus companies in order to execute multiple large projects concurrently. Presently the Home Office in The Hague has a staff of approx. 800 employees and together with the other offices, approx. 2700 employees. In 2007 the revenue was approx. USD 105 million (CB&I Annual Report, 2007). CB&I Lummus’ main focus is on executing EPC projects. In addition to the EPC work CB&I Lummus also provides other engineering related services, such as:

1. Project Management Contractor,
2. Front End Engineering Design,
3. Basic Design and Engineering Package,
4. Feasibility studies,
5. Technology development,
6. Authority coordination,

Chapter 2 will elaborate more on business specific features of CB&I Lummus.

1.2 Project Context

The Master Thesis is executed within the Project Services department at CLN. This department provides services to projects, containing the following disciplines: Estimating, Cost Control, Planning & Scheduling, Material Control and Project Engineering Management and counts approx. 80 employees. The director Project Services is a member of the Company Management Team (CMT) and reports directly to the General Manager.

Faced with the increasingly competitive and dynamic business environment, both nationally and internationally, the Company Management of CB&I Lummus agreed upon a set of Key Performance Indicators\(^1\) (KPI’s) to help them manage more effectively. This decision has been included as part of the values in the Company Management Manual (2007), being “a systematic planned and controlled approach towards executing work and measuring performance to improve consistency and efficiency”.

Hence, now approximately 6 years ago, KPI’s were defined to measure company performance based on the Project Management Triangle. The Project Management Triangle measures performance on quality in terms of time, cost and scope. As mentioned above the KPI’s were defined to measure the company performance. The aim of Company Management was to use the outcomes of the measurements to manage business processes in order to improve business effectiveness. However, this aim of using the measurements to improve business effectiveness by Company Management is not being fully accomplished, primarily caused by the fact that the current KPI’s do not capture all aspects related to the business strategy:

\(^1\) See section 4.1 for a definition of Key Performance Indicators.
The KPI's are only used to measure the performance of a single entity and therefore do not meet the requirements to measure the performance in a multi office project environment. Sieval (2006) notes that due to the Multi Office Project Execution (MOPEX)\(^2\) strategy, firstly the managerial control can be seen from various stakeholder perspectives. Secondly, the dependencies across various business units increase and finally due to the various stakeholders, each manager acts to its own strategy, which gives rise to sub-optimization and unfortunately conflict of interest. To cope with these plural strategies one of the advices given is to define strategic metrics on corporate level.

The KPI's are mainly based on cost driven measures, while an adequate business strategy contains more aspects to create future value through investment in customers, suppliers, employees, processes, technology and innovation (Kaplan and Norton, 1996).

The KPI's are an ad hoc collection of measures, whereas they should describe a coherent business strategy (Kaplan and Norton, 2000).

The KPI's measure the performance in the past to date, whereas the measurement of value drivers for long-term (strategic) competitive performance in the future is even more important.

Failing to base strategic business decisions on the retrieved data.

The KPI's are outcomes of what happened in a business process. They cannot fully explain what happened in the process in order to form a basis for strategic decisions.

KPI's are designed on project level; in case of deviation from the standards the explanation is given in terms of project related issues, what therefore do not enable management to use the KPI's for decision making. The KPI's should be on a higher business level, related to the strategy.

Another dimension of the strategy is that the current complexity and size of projects require a Joint Venture approach; hence alliances with other companies are also significant for realizing organizational goals and its measurement.

The consequence is that, in the cycle of continual improvement, the identification and prioritization of opportunities for performance improvement are partly being missed by CB&I Lummus. This has also been included in the Company Management Manual (2007) as a value, being “a culture of continual improvement recognizing that suggestions and learnings are opportunities towards excellence and improved competitiveness”. This value complies with the ISO 9001 certification of CB&I Lummus, according to which the company is required to facilitate continual improvement by monitoring, measuring and analyzing performance and by implementing necessary actions.

Although ad hoc initiatives to improve the performance have been initiated, the KPI's are lacking a structured process towards concrete performance improvement (lack of a continual process of performance measurement and performance improvement). It is also not possible to determine what the effects are of the ad hoc initiatives up till now. Considering the (international) competitive business environment of CB&I Lummus, this lack of not improving to the full extent will have far-reaching consequences. Especially due to the fact that low cost competitors imitate the services and are penetrating into the markets of CB&I Lummus. Also, the function of the KPI’s to identify and track progress against organizational goals is not being realized adequate. Hence, Company Management can not determine to what extent the company strategy is sufficient for the organizational goals. And the benchmarking aspect, comparing performance against both internal and external standards is also not achieved to its full extent. Using lessons from incomplete, incorrect or disputable measures will not lead to (targeted) improvements.

1.3 Project Scope & Limitations

The scope of the Master Thesis is primarily to re-design the KPI package to enable performance measurement on corporate level and secondly on the criteria for effective use of these KPI’s. The study is limited to one company, namely CB&I Lummus. This limitation is firstly due to the need of Company Management, as discussed in the project context above. The second reason is a practical one: Company Management has agreed on time availability for interviews and surveys, both for the respondents and the

\(^2\) The purpose of multi-office execution is to achieve optimum synergism of project activities executed across multiple internal and external offices while maintaining cost, schedule and quality of the project as a whole (ABB Lummus Global – Best Practice, 2006).
author. Consequently, the study is also limited to a single Industry, namely the Industry where CB&I Lummus is active in: Engineering, Procurement and Construction Contracting. Despite of the focus on one company, the results can be assumed to be representative for this business and therefore the results of this research can be implemented for all contractors competing in this business (this also stimulates the benchmark of performance in this Industry). The justification can be found in the extensive (theoretical) literature studies conducted. Also, the line of business CB&I Lummus operates in, is limited to a few companies with the same main characteristics and processes. It is not a strange phenomenon that employees rotate every few years from one company to the other in this Industry and even return to one of the earlier companies (‘it is a small world’).

**Inclusion**
- Redesigned package with elaborated KPI’s.
- Performance measurement concept (framework) with sufficient basis for strategic purposes.
- Procedure for execution of performance measurement.
- Implementation of the KPI concept as a Management Tool.

**Exclusion**
- Implementation of the new concept throughout the whole CB&I Lummus organization (including CLN).
- Elaborated strategic choices based on performance measurement to implement organizational improvements.

1.3.1 **Research objective**

The relation between continual improvement and KPI’s is illustrated in Figure 1-1. In order to continually improve, the organizational performance needs to be managed effectively by making the correct decisions. In order to make the correct decisions, organizations need to measure their performance which will provide them the necessary input. The widely accepted business tool to measure performance is a set of Key Performance Indicators.

![Figure 1-1 The context of the Research Objective](image)

Following from the project context and the description above, the research objective of this thesis can be given:

To design a method that ensures continuous performance measurement at company level for Engineering, Procurement and Construction Contractors in order to continually improve their performance.
To achieve the research objective, specific research issues are elaborated in this thesis. These specific issues are included in Table 1-1, together with the indication of how the achievement of these specific issues will be evaluated.

<table>
<thead>
<tr>
<th>Specific Issue</th>
<th>To evaluate achievement, these issues should:</th>
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<tr>
<td>To enhance Key Performance Indicators and Performance Measurement knowledge</td>
<td>• Create of a set of basic assumptions to function as reference throughout the thesis</td>
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<td></td>
<td>• Indicate requirements for measuring performance</td>
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<td>• Develop criteria for Key Performance Indicators</td>
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<td>To determine a measurement framework to analyze the company performance of EPC</td>
<td>• Develop criteria for effective measurement frameworks</td>
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<tr>
<td>Contractors with Key Performance Indicators</td>
<td>• Apply the criteria on measurement frameworks</td>
</tr>
<tr>
<td>To define a set of Key Performance Indicators by utilizing the determined</td>
<td>• Indicate specific features of the Industry</td>
</tr>
<tr>
<td>measurement framework for company performance</td>
<td>• Increase the ability to fulfill requirements in line with the organizations policy and objectives</td>
</tr>
<tr>
<td>To design a process/ procedure and an implementation plan for continual</td>
<td>• Be an ongoing process</td>
</tr>
<tr>
<td>performance improvement on the basis of the performance evaluation</td>
<td>• Enrich decision making in order to enhance management</td>
</tr>
<tr>
<td></td>
<td>• Identify possibilities to develop and implement plans for improvement</td>
</tr>
<tr>
<td></td>
<td>• Identify possibilities to evaluate the results and use the findings to develop further improvements</td>
</tr>
<tr>
<td></td>
<td>• Include improvement of the improvement process itself</td>
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<td></td>
<td>• Focus on adopting improvement systemically</td>
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Table 1-1 Specific research issues

1.3.2 Formulation of Research Questions

In order to make the research objective operational, the following central question is posed:

In which configuration and how can Key Performance Indicators contribute to the measurement and improvement of the performance of Engineering, Procurement and Construction Contractors?

The central question can be broken down into the following sub-questions (in line with the specific issues given in Table 1-1):

**Key Performance Indicators and Performance Measurement**
1. “Why do companies need to measure their performance?”
2. “What are the requirements for performance measurement?”
3. “What are Key Performance Indicators?”
4. “What are the views on Key Performance Indicators in performance measurement?”
5. “What are ‘good’ Key Performance Indicators?”

**Reference Framework**
1. “Which frameworks can be used to measure performance?”
2. “Which criteria are important in the measurement of performance when using a framework?”
3. “Which framework is the most effective one for the evaluation of the performance of an EPC Contractor?”

**Development of Key Performance Indicators and the usage for management purposes**
1. “What are important organizational features of EPC contractors, specifically of CB&I Lummus?”
2. “What are the Key Performance Indicators that Company Management needs to use in order to evaluate the company Performance?”
3. “How can the Key Performance Indicators be used effectively for the management of EPC contractors?”
1.4 Research Setup

This research meets the definition that Verschuren and Doorewaard (2005) give for a practically-oriented research, namely the aim to contribute to an intervention which will lead to a change in an existing practice situation. Furthermore, Verschuren and Doorewaard (2005) divide practically-oriented researches in fives phases for problem solving acting. Two of these phases are relevant in this research:

- **Design**: this is the primary focus of this research. In the design-oriented phase the new KPI’s and the use of it will be discussed, based on research material (theoretical and practical).
- **Diagnostic**: this is the secondary focus of this research. The first step in the diagnostic phase is a further analysis of the problem and the context in which it occurs. The second step in the diagnostic phase is the background of KPI’s and the configuration of the current KPI’s.

![Applied Research Framework according to Verschuren and Doorewaard (2005)](image)

**Figure 1-2**  
Applied Research Framework according to Verschuren and Doorewaard (2005)

Figure 1-2 introduces the research framework\(^3\) of this thesis. The 5 columns in this model, (a) – (e), are the steps to be taken in the line of the research project and can be expressed as:

(a) With the elaboration of the problem context and a further analysis of the organization of CB&I Lummus the basis of this thesis will be set. From this basis, research on (b) performance measurement, management and strategy, the information need of Company Management and benchmark information will provide (c) the model/ framework for measuring performance, design criteria’s for KPI’s, success factors in measuring performance and the effective application of the measurements for management purposes. The theoretical frame of reference set in step (c) will be referred to in the (d) determination and design of the revised set of KPI’s and elaboration of the usage of the KPI’s for management purposes, which will lead to (e) recommendations with regard to the performance measurement at CB&I Lummus and other EPC Contractors.

1.5 Research Strategy

Verschuren and Doorewaard (2005) define a research strategy as a whole of coherent decisions with regard to the way by which the research will be executed. The strategy of this research first contains desk research by literature studies of performance measurement and management/ business strategies related to performance measurement. A benchmark of performance measurement is also part of the strategy and will give criteria’s for performance measurement as used in the industry (as far as available). Furthermore, other literature like internal documents and procedures will be analyzed for better insight in business

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\(^3\) Research framework: a schematic representation of the research objective and a broad outline of the steps to be executed in order to achieve this objective (Verschuren and Doorewaard, 2005).
processes of CB&I Lummus. The second part of the research will be an empirical (practical) research by executing surveys for:

1. The analyses of the problem situation and the information need of Company Management.
2. The determination of the KPI's.

The sources of information and the methods applied to gather the information are identified in Appendix B.

1.6 Research Tools

As mentioned in section 1.4 this thesis is practically-oriented. The empirical sources in this part of the thesis are persons/employees of CB&I Lummus. Verschuren and Doorewaard (2005) argue that persons (1) provide a large diversity of information and (2) the information can, compared with other sources, be retrieved quickly. Furthermore, Verschuren and Doorewaard (2005) advise either to use interviews or observations if the sources of the practical research are persons. Observations are advised when the behavior of persons are important and interviews when it is useful to know how people think about certain issues and how they (want to) act with regard to certain subjects. Based on these arguments, the author has chosen for interviews and surveys as research tools for the practical part of this thesis.

1.6.1 Interviews

In the following part of this paragraph the objective and design of the interviews, used to gain knowledge about contextual Critical Success Factors\(^4\) (CSF’s) and KPI’s, will be discussed.

1.6.1.1 Interview Objectives

The main objective of the interviews is to retrieve the important factors in order to design the Strategy Map\(^5\) for EPC contractors operating in the Oil & Gas Industry and specifically for CB&I Lummus. Actually, the Strategy Map as designed by Kaplan and Norton will be challenged thoroughly to check the validity for the business context of CB&I Lummus by utilizing the varied knowledge and perspectives of the interviewees. Therefore, the final framework will not only be based on extensive literature study, but will also be firmly rooted in CB&I Lummus’ business context.

The second objective of the interviews is to collect proposed KPI’s (in relation with CSF’s) that can be taken into account when determining the KPI’s. This will result in KPI’s that will not only have theoretical, but also business specific bases.

1.6.1.2 Interview Design

The Strategy Map contains 4 perspectives (will be discussed in chapter 5). Therefore, questions have been developed for each perspective, which are also considered to be leading in the interviews, see Appendix C. The basis of these questions is the theoretical design of the Strategy Map, complemented with the theories discussed in this thesis. This will ensure that the CSF’s retrieved will be on strategic level.

In order to retrieve balanced feedback with regard to the 4 perspectives, interviews have been executed with interviewees originating from disciplines of which can be expected to deliver valuable information for these perspectives, see Table 1-2. This Table also indicates the extent to which the disciplines are expected to be relevant with regard to the perspectives. Furthermore, the interviewees are considered to be senior in their respective discipline, what should increase the quality of the feedback.

\(^4\) See section 5.1.2.2 for a definition of Critical Success Factors.

\(^5\) The Strategy Map is a performance measurement framework: see section 5.1.2 for a description of the Strategy Map.
All interviewees were interviewed face-to-face on a one-to-one basis. The interviews ranged from an hour to two hours. The interviews are elaborated per Strategy Map perspective in order to retrieve the CSF’s (and KPI’s) for each perspective.

### 1.6.2 The Decision Chart

The decision chart is a bubble chart and has been introduced to visualize the outcome of a survey among key employees in the company. The main objective of this survey is to identify the CSF’s out of the retrieved important factors. A form has been designed (see Appendix F), of which a number of 16 has been posed to a representative population of the company. Unfortunately, 4 out of 16 forms were not completed. However, a score of 12 out of 16 (75%) is sufficient for this exercise. On basis of the (average) evaluations of the respondents, results are plotted in a bubble chart. A more detailed description of this tool is given in chapter 7 together with the results.

An additional, but critical side effect of the interview and the survey is that by involving key persons in this process (as respondents), the basis of support for performance measurement implementation will increase in the company.

### 1.7 Report structure

The figure below gives a description of the upcoming chapters.

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6 See section 2.3 for the distinction between Project and Line organization.
In this chapter the Master thesis has been introduced. The sections describe why this research is necessary, what the projects exactly covers and how it will be executed.

In chapter 2 the line of business where CB&I Lummus is active in as well as the organizational features are discussed. This will enlarge the knowledge of the Oil & Gas EPC Industry. In chapter 3 Performance Measurement is introduced. Several aspects are elaborated to gain knowledge about what exactly performance is, why companies need to measure this and what the requirements are.

With chapter 3 as a basis, the indicators to measure performance (KPI’s) will be discussed in chapter 4. First a clear definition is given of KPI’s, followed by sections which discuss which views on KPI’s exist, what ‘good’ KPI’s are, how to design KPI’s in a structured way and the experiences with KPI’s in the past.

Based on the conclusions of chapter 4 several frameworks will be discussed in chapter 5. This chapter will be concluded with a substantiated choice for a framework in the last section.

Following from the conclusions in chapter 5, the elements for a measurement framework are CSF’s. In order to determine these, first the important factor in this line of business are retrieved, which are potential CSF’s. These factors are retrieved from different sources.

Once the potential CSF’s are retrieved in chapter 6, the final CSF’s are determined in chapter 7. Also, KPI’s will be allocated to these CSF’s in this chapter.

KPI’s are worthless if they are not used to make decisions. This chapter will indicate how the KPI’s, determined in the previous chapters, can be used to improve performance.

Based on the arguments given in this study, conclusions are given in this chapter by answering the posed research questions. This will also be the basis for the recommendations.
2 CB&I LUMMUS

In the previous chapter (section 1.1) a brief description is given of CB&I Lummus (former ABB Lummus Global). In order to gain more knowledge of the internal and external (as part of CB&I) organizational context, this chapter will elaborate more on these aspects. This will be of use in the process of designing the KPI’s and can also function as benchmark for other contractors in the business. Chicago Bridge & Iron Company N.V. (CB&I) is the parent company of CB&I Lummus B.V., which is introduced in the first section. The second section gives a description of the line of business where CB&I Lummus is active in, followed by the organizational features in the third section.

2.1 Chicago Bridge & Iron Company N.V. (CB&I)

CB&I, with headquarters in Woodland, Texas, combines proven process technology with global capabilities in engineering, procurement and construction to deliver comprehensive solutions to customers in the energy and natural resource industries. CB&I is positioned to carry out projects from conceptual design, through technology licensing, engineering and construction and final commissioning. CB&I’s scope of technical capabilities spans the full range of oil & gas projects, from onshore and offshore oilfield development; through gathering, separation and transportation; to refining, downstream processing and petrochemicals; and through to storage and distribution. CB&I is divided in three operating units, (1) CB&I, Inc., (2) Lummus Technology and (3) CB&I Lummus (see Figure 2-1).

![Organization Chart CB&I (source: intranet)](image)

2.2 CB&I Lummus B.V.

CB&I Lummus – The Netherlands (CLN) is a fully integrated EPC organization which is capable to execute projects in the oil and gas, petroleum refining, petrochemical and chemical industries. It was established in The Hague in 1954 and since its inception, it has changed a few times from owner. The last change of owner was recently, in 2007.

CLN has carried out over 500 major EPC projects throughout the world since its inception. During these years CLN has gained an international reputation in management, conceptual engineering, detail engineering, design, procurement, construction and commissioning of all types of production installations and process plants. To outsource part of the workload, detail engineering and design work, CLN has multi-office project execution (MOPEX) agreements in place with their subsidiary office in Cairo (satellite office) and sister offices in Brno and Singapore (results-accountable offices). The latest development with regard to the organizational transformation (due to the recent change of owner) resulted in more engineering offices throughout the world. In this process, CB&I has acknowledged the “brand” Lummus, which resulted in the operating unit CB&I Lummus, as given in Figure 2-1.

The KPI’s in this thesis are developed for CB&I Lummus - The Netherlands (CLN). After a learning period, the KPI’s can also be applied in the other offices. A consolidation of all offices will then measure the overall performance of CB&I Lummus.

To serve its clients, CB&I Lummus needs to be capable of combining a wide range of project variables in different configurations. Table 2-1 gives an overview of these project variables that the organization has to be capable of when executing in the required configurations.
### Project Element | Range returning in projects
--- | ---
1. Projects | Refineries, Petrochemical Plants, Offshore Platforms, Floating Production
2. Geographical | Europe, Africa, Middle East, Russia, Asia
3. Clients | Oil and gas companies, state oil, gas and power enterprises, (petro)chemical companies
4. Scope | From relatively simple study to full EPC contract including installation, commissioning and Start-Up
5. Size
   - Euro Office manpower | From 7,000 to several billion
   - Construction Manpower | Anywhere between 2 and 500 people
   - Timeframe | Anywhere between 150 and 10,000 people
   - Timeframe | Between a week and 4 years
6. Number of Execution Centers | From 1 to 4 on different continents
7. Alliances | Single or in Joint Ventures with 1, 2 or more partners
8. Contract | From fully reimbursable to Lump Sum Turn Key and may include incentive payments

| Table 2-1 | Project variables for required execution configuration |
--- | ---
CB&I Lummus’ business is the Execution and Management of Capital Investment Projects. The focus is to work with those projects and in those markets where competitive business solutions are presented to the clients from conceptual design and Project Management Contracting (PMC) services through full EPC execution.

#### 2.3 Matrix Organization

CB&I Lummus can be typified as a matrix organization. The key characteristic of these organizations is the column-row structure (de Bruijn and ten Heuvelhof, 1999). The columns, in the case of CB&I Lummus, stand for the different disciplines (the line organization) and the rows for the different projects (the project organization), see Figure 2-2. For each project the line organization provides the resources which make up the project team. In this matrix structure, each project team member is operationally accountable to the Project Manager and functionally accountable to the Department Manager.

![Figure 2-2 CB&I Lummus’ Matrix organization (source: de Bruijn and ten Heuvelhof (1999), modified by author)](image)

#### 2.3.1 Line Organization

This dimension of the organization reflects the hierarchical structure by discipline/ function (see Figure 2-3). The company is lead by the General Manager and is supported by a team of functional directors, together forming the Company Management Team (CMT), which heads up the line organization. Every director is responsible for their scope of disciplines. These disciplines are managed by the department heads. Through the line organization the CMT disseminates policies and strategies to achieve their short and long term goals and objectives.
2.3.2 Project Organization

This dimension reflects the organization with regard to the execution of projects, after all production for CB&I Lummus is carried out in the form of projects. Figure 2-4 represents a typical EPC project. To execute a project, a project team is formed. Depending on the scope of work and size, the composition of the project team will be determined (not every function as indicated in Figure 2-4 is needed for all projects). The Department Heads will nominate the assigned responsible persons. Assignment is subject to the Project Manager’s approval. The Department Heads are responsible for the knowledge and skills (qualification) of the assigned employees.
Figure 2-4  
**Typical EPC project organization (Company Management Manual, 2007)**

Besides the business specific features, an important feature of Contractors operating in the Oil & Gas EPC Industry is that executing projects is the core business, after all projects guarantee production. Therefore in the determination (process) of the KPI’s later in this research there should be considerable notice for the performance on project level besides the performance on corporate level (line organization).
3 PERFORMANCE MEASUREMENT

This chapter outlines the basic assumptions of performance measurement, which will function as a frame of reference during the elaboration of this research. First will be discussed what exactly performance is and secondly why it should be measured. The last section discusses some basic requirements when measuring performance.

3.1 Introduction

The environment within which most organizations operate is changing rapidly: increasing higher users’ requirements, higher customers’ requirements, Safety, Health & Environmental awareness, quality awareness, and limited or merger resources on one side, and increased competition among organizations, the increased risk in contracting and accelerated emergency of new technology on the other side. Organizations failing to adapt and respond to the complexity of the new environment tend to experience survival problems, sooner or later. In this climate of change, EPC Contractors have to be capable of continuously improving their performance in order to sustain a competitive advantage.

‘Performance’ is difficult to define due to the multidimensionality of this term. In dictionaries the following definition is given to performance: “the execution or accomplishment of work” or “the manner in which or the efficiency with which something reacts or fulfills its intended purpose”. Lebas and Euske (2002) also provide a definition of performance: “doing today what will lead to measured value outcomes tomorrow.” Performance Measurement then is concerned with measuring this performance relative to some benchmark, be it a competitor’s performance or a pre-set target. Looking at organizations, the following definition is probably the most relevant: organizational performance is defined in terms of the value that an organization creates using its productive assets in comparison with the value that the owners of these assets expect to obtain (van den Berghe & Verweire, 2004).

To make the comparison mentioned above, the created value (Performance) should be measured. The next section will elaborate more on this need for organizations to measure Performance.

3.2 Need for measuring Performance

Measuring organizational performance can be considered as the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities (Simmons, 2000). Artley and Stroh (2001) provide the following definition for performance measurement: “performance measurement is the ongoing monitoring and reporting of program accomplishments, particularly progress towards pre-established goals.”

Several authors have mentioned what the benefits are of measuring performance of organizations. In order to get a complete view of the benefits, some of these authors will be referred to below:

- A typical performance measurement helps businesses in periodically setting business goals and then providing feedback to managers on progress towards those goals. The time horizon for these goals can typically be about a year or less for short-term goals or span several years for long-term goals (Simmons, 2000).

- The purpose of measuring performance is providing (useful) information that leads to taking (the right) decisions and proper management (van Aken & van Goubergen, 2000). It provides us with the information necessary to make intelligent decisions about what we do.

- Kellen (2003) looks at the organization as a complex organism seeking to survive or thrive in its competitive environment. From this point of view performance measurement serves as a key contributor to the perceptual and coordination/control capabilities of the organization. Organizations use measurements not only to help monitor and control specific activities, but also to predict future

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8 A “program” may be any activity, project, function, or policy that has an identifiable purpose or set of objectives.
internal and external states, to monitor state and behavior relative to its goals, to make decisions within
needed time frames and to alter the firm’s overall orientation and/ or behavior.

- Reviewing the performance of an organization is also an important step when formulating the direction
of the strategic activities. It is important to know where the strengths and weaknesses of the
organization lie, and as part of the ‘Plan –Do – Check – Act’ cycle (Deming’s cycle of continual
improvement), measurement plays a key role\(^9\):
  - Identifying and tracking progress against organizational goals,
  - Comparing performance against both internal and external standards,
  - Identifying and prioritizing opportunities for performance increase.

The main reasons it is needed are:
  - To ensure customer requirements have been met.
  - To be able to set sensible organizational goals and objectives and comply with them.
  - To provide standards for establishing comparisons.
  - To provide visibility and a “scoreboard” for people to monitor their own performance level.
  - To highlight quality problems and determine areas for priority attention.
  - To provide feedback on how well we are doing for driving the improvement effort (Bititci et al.,
    2002).
  - To maximize the effectiveness of the improvement effort.

- In their report, Artley and Stroh (2001) refer to several sources which have provided the need for
  Performance Measurement:
  - One of the benefits is that it provides a structured approach for focusing on a program’s strategic
    plan, goals, and performance. Another benefit is that measurement provides a mechanism for
    reporting on program performance to upper management.
  - Measurement focuses attention on what is to be accomplished and compels organizations to
    concentrate time, resources, and energy on achievement of objectives. Measurement provides
    feedback on progress toward objectives. If results differ from objectives, organizations can analyze
    gaps in performance and make adjustments.
  - Performance measurement improves the management and delivery of products and services. In a
    world of diminishing resources, improving management of programs and services is critical.
  - Performance measurement improves communications internally among employees, as well as
    externally between the organization and its customers and stakeholders. A results-oriented
    organization requires timely and accurate information on programs and supporting services,
    whether at headquarters, field elements, or contractor locations. Collecting and processing
    accurate information depends on the effective communication of mission-critical activities.
  - Performance measurement helps justify programs and their costs.
  - Measurement reduces emotionalism and encourages constructive problem solving. Measurement
    provides concrete data on which to make sound business decisions, thus reducing the urge to
    manage by “gut feeling” or intuition.
  - Measurement increases one’s influence. Measurement identifies areas needing attention and
    enables positive influence in that area. Also, employees “perform to the measurement,” an
    example of how measurement influences employee performance.
  - Improvement is impossible without measurement. If you don’t know where you are, then you can’t
    know where you’re going and you certainly can’t get to where you want to be. It’s akin to traveling
    in unknown territory without a compass or a map. You’re totally lost.

- Performance can be ascribed to corporations, business units, support or functional units, teams and
  workgroups and individuals, both national and international (consequently, measuring performance
  needs to provide insight into different units or levels of analysis). The key benefit of performance
  measurement in this context lies in the ability to help align these different levels of analysis in the firm.
  Many corporations consist of several business units or divisions that compete in different markets with
  differing strategies. Corporate-wide measurement can help articulate the theory of the firm (why
  different business units exist within the corporation) and improve overall performance by exploiting

synergies between the business units (Kaplan and Norton, 2001). At the lowest level of analysis lies measurement of human performance, for which the literature and examples are rich and long. In between the business unit and the individual lay other layers, such as the functional or service group, workgroup or team and the business activity. Performance Measurement often is designed to be a vehicle for strategic dialog within the firms. Therefore, performance measures and scorecards scattered horizontally and vertically across a corporation, need to be coherent so that the conversations between people about the strategy is consistent and all the different measurement units contribute to the performance of the corporation overall (Haas, de & Kleingeld, 1999).

Performance measurement has several benefits as indicated in this section. It is worthwhile to point out the last one mentioned, e.g. performance can not only be ascribed to corporate level and/ or project level, but also to business units and support or functional units. The key benefit of performance measurement in this context lies in the ability to help align the different levels in the global CB&I Lummus company so that the perception of the strategy is consistent and all the different offices contribute to the performance of the corporation overall.

After reviewing these benefits it becomes obvious for companies to measure performance if they want to manage their organization effectively. And when a company decides to measure their performance, it needs to comply with some basic requirements, which are discussed in the next section.

### 3.3 Requirements for Performance Measurement

Performance Measurement should comply with some basic requirements in order to manage companies effectively. The requirements (see Appendix D for the factors per requirement) are (Kellen, 2003):

1. Measuring performance should help the firm accurately perceive relevant internal and external phenomenon. These include threats and opportunities, shortcomings in its ability to perceive phenomenon as well as shortcomings in its ability to control its actions (breadth, depth, coherence and predictability).
2. Measurement information needs to be delivered, processed and acted upon within the time frame needed for market survival (latency: propagation and response).
3. Performance measurement must aid the decision-making process (provability, explainability, believability, communicability).
4. Performance measurement needs to operate self-reflexively and largely below the threshold\(^\text{10}\) of the firm’s awareness (adaptability, measurability, autonomic).

### 3.4 Conclusions

In order to sustain a competitive advantage and therefore to survive as an organization, companies should be capable of continuously improving their performance. If a company wants to improve its performance, it will first have to measure what the current performance is. From that point on, the company can make decisions in order to improve its performance in those areas where needed. So, the information gained needs to be useful and therefore should encourage constructive problem solving and not only to provide feedback to managers on progress towards pre-set goals. Simultaneously, measuring performance has additional benefits (which enhance the need of it) and when a company decides to implement performance measurement, some basic requirements need to be complied with (see section 3.3 above). The concept of ‘measurement frameworks’ will be introduced in chapter 5 in order to comply with the first requirement. The second basic requirement will be divided in 2 parts: (1) the delivery and processing elements and (2) the acting upon element. The first part will be discussed in the next chapter as part of criteria for ‘good’ indicators. The second part will be discussed in chapter 8. Chapter 8 will also cover the third and fourth basic requirement as given in section 3.3.

Performance is measured by using measures, metrics or indicators; the next chapter will therefore further discuss this by starting with a clear definition.

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\(^{10}\) The point at which something begins to take effect or be noticeable (source: [www.thefreedictionary.com](http://www.thefreedictionary.com)).
4 KEY PERFORMANCE INDICATORS

As stated in the previous chapter, performance is measured by using measures, metrics or indicators. But, what are measures, metrics or indicators? The first section in this chapter will answer this. The second, third and fourth sections will discuss criteria upon which to determine these measures, metrics or indicators and how to design them. The usage of measures, metrics or indicators is not a new phenomenon. So, what are the lessons learned from a historical point of view? The last section will answer this.

4.1 KPI Definition and Composition

Although measures, metrics or indicators are different terms, the usage and the purpose are the same. When being referred to these terms in this thesis, all will have the same meaning. But to avoid any confusion it is needed to set a clear definition. In literature the following definitions are used:

- Performance measures can be defined as a measuring point that gives a good indication of the success or failure of a success determining factor or of the functioning of a process (Ahaus, 1999).
- Simmons (2000) defines a measure as a quantitative value that can be used for purposes of comparison.
- Bititci et al. (2002) define performance measures as measurable characteristics of products, services, processes and operations that an organization uses to track performance. They may address the type or level of program activities conducted (process), the direct products and services delivered by a program (outputs), and/ or the results of those products and services (outcomes).
- On corporate level organizations use Key Performance Indicators (KPI's) or Corporate Performance Measures. Key Performance Indicators are directly related to the organization’s strategy and are critical for its successful execution of its strategy (Kellen, 2003).

The subject of this thesis is on Key Performance Indicators, which means that especially the latter definition is relevant. But also the other definitions should be considered, which leads to the following definition for Key Performance Indicators:

Key Performance Indicators are measurable characteristics of products, services, processes and operations directly related to the organizations’ strategy, that give a good indication of the success (or failure) of success determining factors that are critical for the execution of the organizations’ strategy.

Following Artley and Stroh (2001), KPI’s are composed of a number and a unit of measure:

- The number gives us a magnitude (how much); KPI’s are always tied to a goal or an objective (the target). Since a measure is used for the purpose of comparison, it need not represent an absolute value. For example, in measuring customer profitability, knowing the relative distance in profitability between two customers may be as valuable (and more easily gotten) than knowing the absolute value for a customer’s profitability. Moreover, many measures are normalized into a value that promotes comparison not just with itself, but also with other measures.
- The unit of measure gives the number a meaning (what); KPI’s can be represented by single-dimensional units like hours, meters, dollars, number of errors, number of certified employees, length of design time, etc. They can show the variation in a process or deviation from design specifications. Single-dimensional units of measure usually represent very basic and fundamental measures of some process or product. More often, multidimensional units of measure are used. These measures are expressed as ratios of two or more fundamental units. They may be units such as miles per gallon (a KPI of fuel economy), number of accidents per million hours worked (a KPI or the companies safety program), or number of on-time vendor deliveries per total number of vendor deliveries. KPI’s expressed this way almost always convey more information than the single-dimensional or single-unit KPI’s. Ideally, KPI’s should be expressed in units of measure that are the most meaningful to those who must use or make decisions based on those measures. A specific KPI can be compared to itself over time, compared with a preset target or evaluated along with other measures.
Also, when evaluating organizational performance, the number and unit of measure can apply to a specific element or the relations between elements, see Figure 4-1. Artley and Stroh (2001) describe these relations, based on the transformation within organizations:

- Effectiveness: a process characteristic indicating the degree to which the process output (work product) conforms to requirements/ process outcome: are we doing the right things?
- Efficiency: a process characteristic indicating the degree to which the process produces the required output at minimum resource cost/ process input: are we doing things right?

In this research, performance is measured by means of KPI's and the definition given for KPI's in this section holds throughout the whole thesis. CB&I Lummus already used KPI's to measure their performance. There is nothing wrong with this, as long as the KPI's are designed and used correctly. Imagine an airplane’s instrument panel (dashboard) consisting of instrument dials and gauges. Like pilots are able to process information from a large number of indicators to navigate their airplane, organizations need instrumentation (KPI’s) about many aspects of their environment to keep track of their journey towards excellent performance: the organization’s performance dashboard.

To start with, correctly is taking into account the different point of views from which KPI’s can be approached. These views of KPI’s will be discussed in the next section. With this knowledge a basic set of understanding will be created with regard to KPI’s and their categories.

### 4.2 Views on Key Performance Indicators

The first view on KPI’s is the *Implication* they have. The KPI’s are leading or lagging. Lagging measures give feedback on past performance, such as last month’s profit, and typically do not provide insight into future performance. Leading indicators, in contrast, are designed to measure future performance, and more often than not, future financial performance. Some leading indicators to future performance might include customer defection rate, customer satisfaction scores or changes in consumer confidence. Lagging KPI’s without leading KPI’s do not communicate how the outcomes are to be achieved. They also do not provide an early indication (warning) about whether the strategy is being implemented successfully and whether strategic objectives are achieved. On the other hand, leading KPI’s without lagging KPI’s may enable companies to achieve short-term operational improvements, but will fail to indicate whether the operational improvements have been translated into long-term (strategic) objectives, and, eventually, to enhanced financial performance.

An appropriate mix between lagging and leading KPI’s is necessary to include KPI’s which respectively show outcomes, and KPI’s which show the performance drivers.

The second view is the *Responsiveness* of KPI’s. KPI’s are responsive or not responsive. Individuals can directly influence responsive measures, whereas non-responsive measures are outside the direct influence or control of an individual (such as consumer confidence).

An appropriate mix between responsive and non-responsive KPI’s is necessary to include KPI’s which respectively are manageable internally, and KPI’s which act on the company externally. This represents the actual environment companies operate in.

The third view is the *Nature* of KPI’s. KPI’s can refer to tangible (hard) things, often recorded in the chart of accounts, such as inventory levels, accounts receivable balances, employee headcount, or can refer to intangibles (soft) such as level of skill or knowledge, creativity and innovation.

An appropriate mix between tangible and intangible KPI’s is necessary, because decision-making is often based on both hard and soft factors.

The fourth view is the *Location* in the processes (which are chains of logical arranged activities aimed at achieving results). For CB&I Lummus the distinction can be made between the line organization process and project organization process (actually, there is not a strict separation between these ‘organization’s’,
but the distinction can be used as point of views). Processes in the line organization exist of 7 elements
(Nieuwenhuis, 2003 and Artley and Stroh, 2001), see Figure 4-1:
1. Means (a): used to understand resources consumed to produce the outputs and outcomes (input).
2. Activities: used to understand the intermediate steps in producing a product or service (sub) processes.
3. Performance: used to measure the product or service provided by the system or organization and
delivered to customers (the output meant for the client).
4. Outcome Measures: evaluate the expected, desired, or actual result(s) to which the outputs of the
activities of a service or organization have an intended effect.
5. People: these are actors with certain tasks, competences and responsibilities to execute (a part) the
activities within a process. People are expected to be the main input in the primary processes of CB&L
Lummus (seen the specialist skills and knowledge required for the services to deliver).
6. Means (b): items that independently perform activities within processes or are used by actors to
execute activities. Means are not the same as input. They are different in the way of usage: input
functions as material for transformation into output, while means are not directly being transformed in
the process.
7. Frameworks: pre-conditions, requirements, standards, plans and triggers coming from outside the
process into the process and having an influence on the management of the process.

Figure 4-1 Elements and level of processes (source: Nieuwenhuis, 2003) and the transformation process
within organizations (source: Artley and Stroh, 2001)

Another approach is viewing the elements in Figure 4-1 from a Business Process point of view.
Nieuwenhuis (2003) makes a distinction between the following business processes:
- Management Processes: activities that execute the company policy by planning, checking, evaluation
and control of other business processes.
- Improvement Processes: activities for the control of the business process development itself.
- Primary Processes: the coherent total of activities to realize the product/ service for the client.
- Supporting Processes: activities in order to set up conditions (means and people) for proper
proceeding of the primary processes.

Business Process: it is not necessary to aim for an appropriate mix with regard to the management &
 improvement and supporting processes; it is only relevant for the primary processes to aim for an
appropriate mix. This therefore excludes the elements means (b) and frameworks. The categories of the
primary processes can be elaborated with the elements as given in Figure 4-1. So, there are then already
covered in the Location view. When evaluating the organizational performance, an appropriate mix
according to the location in the process chain is necessary, because information is required for the whole
transformation process (more specifically the primary processes). The performance of a specific part of the
primary processes identifies potential organizational area(s) of concern.
The best way to approach the project organizational processes is the lifetime of a project. Five key stages in the project lifetime cycle have been identified by Blumenthall et al (2000), see also Figure 4-2:

1. Commit to Invest: the point at which the client decides in principle to invest in a project, sets out the requirements in business terms and authorizes the project team (e.g. CB&I Lummus) to proceed with the conceptual design.
2. Commit to Construct: the point at which the client authorizes the project team (e.g. CB&I Lummus) to start the construction of the project.
3. Available for Use: the point at which the project is available for substantial occupancy or use. This may be in advance of the completion of the project.
4. End of Defect Liability Period: the point at which the period within the construction contract during which the contractor (e.g. CB&I Lummus) is obliged to rectify defects ends (often 12 months from point C).
5. End of Lifetime of Project: the point at which the period over which the project is employed in its original or near original purpose ends. As this is usually many years after the project's completion, this is a theoretical point over which concepts such as full life costs can be applied.

In the key stages identified by Blumenthall et al (2000) the emphasis is on execution of the project after it has been awarded. However, a crucial stage prior to project execution is the bidding phase. CB&I Lummus has acknowledged this stage in the work processes and has also elaborated more on the project execution stages in the project lifetime, see Figure 4-3.
I. Strategic: management of those aspects which are crucial for the continuity of the organization.

These levels are:

1. Strategic: management of those aspects which are crucial for the continuity of the organization.
2. Tactical: the total of organizational and structuralizational tasks.
3. Operational: the total of management tasks for proper proceeding of the daily routine.

As mentioned earlier, KPI’s are directly related to the organization’s strategy. The emphasis will therefore be on measurement on (I) strategic level. Although the (II) tactical (departmental) level is important, it will not be taken into account in this research. It should be subjected for additional research or assigned to the departments. On (III) operational level, project execution is crucial. When evaluating the organizational performance, a balance is therefore also necessary according to the location in project execution, because information is required for the whole project lifetime cycle. In order to cover the whole range of the project lifetime cycle, additional research is recommended (except for the ‘Lifetime of Project’ stage, as CB&I Lummus stops at the ‘End of Defects Liability Period’, see Figure 4-2).

A recapitulation of the views on KPI’s which require an appropriate mix is given in Table 4-1.

<table>
<thead>
<tr>
<th>View</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Implication</td>
<td>Leading (future), Lagging (past)</td>
</tr>
<tr>
<td>2. Responsiveness</td>
<td>Responsive, Non-Responsive</td>
</tr>
<tr>
<td>3. Nature</td>
<td>Tangible, Intangible</td>
</tr>
<tr>
<td>4. Location</td>
<td>Input, People, (sub)Process, Output, Outcome</td>
</tr>
</tbody>
</table>

Table 4-1 List of the views on Indicators

 Allocating KPI’s to all categories per view will create a balanced set of KPI’s, which is crucial if an organization aims to cover all important aspects. The categories of these views will be used later in this research for the allocation of KPI’s.
In the designing process of the KPI’s it is also important to obtain knowledge with regard to when a KPI can be considered to be “good”, which will increase the functionality of the KPI’s. This will be discussed in the next section.

4.3 “Good” Indicators

When working with performance indicators, companies should apply well-designed indicators. But what is a well-designed (‘good’) performance indicator? A common used set of criteria is designed by Drucker (1954)\(^\text{11}\), for which he extensively elaborated the concept of Management by Objectives. In this concept the SMART criteria are introduced:

- Specific
- Measurable
- Achievable
- Relevant
- Time framed

Also, Aalberts et al (1999), introduce validity and reliability which can be used complementary to the SMART criteria. They define these 2 criteria as:

- Validity: a performance indicator can be considered valid if it actually represents the reality that it is assumed to measure (do I really measure what I think to measure?)
- Reliability: a performance indicator can be considered reliable if there are sufficient guarantees that the measurement has been executed accurately, objectively and is auditable (could I find out what I think to know now?).

These 7 criteria will be used as a checklist in the process of determining the KPI’s for measuring performance. Besides these criteria, there is also the need for knowledge in order to design these KPI’s pragmatically and in a structured way. For this purpose, the next section will introduce the Performance Measure Record Sheet.

4.4 The Performance Measure Record Sheet

In their working paper, Neely et al. (1997) seek to answer the following question: what are the prescribing criteria for designing effective indicators? In order to discuss this they have introduced the Performance Measure Record Sheet (PMRS) that is based on an extensive review of the performance measurement literature. Also, the PMRS was tested through a series of action research studies and to date has been used successfully implemented by over 200 managers from 50 different types of companies.

The literature review and implementations has enabled Neely et al. (1997) to summarize 22 recommendations see Appendix E. The PMRS consists of ten elements of which the rationale and their relationship to the recommendations above are explained below:

1. Measure (recommendations 2, 9, 21); the title of the measure should be clear. A good title is one that explains what the measure is and why it is important. It should be self-explanatory and not include functionally specific jargon.
2. Purpose (recommendations 7, 14): if a measure has no purpose then one can question whether it should be introduced. Hence the rationale underlying the measure has to be specified.
3. Relates to (recommendations 1, 6, 7, 11): as with purpose, if the measure being considered does not relate to any of the business objectives then one can question whether the measure should be introduced. Hence the business objectives to which the measure relates should be identified.
4. Target (recommendations 4, 6, 7, 8, 11, 14, 20): the objectives of any business are a function of the requirements of its owners and customers. The levels of performance the business needs to achieve to satisfy these objectives are dependent on how good its competitors are. Without knowledge of how good the competition is, and an explicit target, which specifies the level of performance to be achieved and a time scale for achieving it, it is impossible to assess whether performance is improving rapidly enough and hence whether the business is likely to be able to compete in the medium to long term. An

\(^{11}\) Source: http://www.rapidbi.com.
appropriate target for each measure should therefore be recorded (this enhances the internal and external benchmark function).

5. Formula (recommendations 2, 4, 5, 9, 15, 16, 19, 21, 22): this is one of the most challenging elements to specify because the formula – the way performance is measured – affects how people behave.

6. Frequency (recommendations 3, 12, 13, 18, 20): the frequency with which performance should be recorded and reported is a function of the importance of the measure and the volume of data available.

7. Who measures (recommendations 4, 17): the person who is to collect and report the data should be identified.

8. Source of data (recommendations 15, 16, 17, 18, 19, 21): the source of the raw data should be specified. The importance of this question lies in the fact that a consistent source of data is vital if performance is to be compared over time.

9. Who acts on the data (recommendations 4, 6, 10, 20): the person who is to act on the data should be identified.

10. What do they do (recommendations 4, 6, 10, 20): this is probably the most important element contained on the performance measure record sheet, not because it contains the most important information, but because it makes explicit the fact that unless the management loop is closed, there is no point in having the measure. It is not always possible to detail the action that will be taken if performance proves to be either acceptable or unacceptable, as this is often context specific. It is, however, always possible to define in general the management process that will be followed should performance appear to be either acceptable or unacceptable.

The PMRS is valuable because it facilitates and can function as a practical guide for the design and elaboration of performance indicators. Every KPI will be elaborated by means of this sheet. The record sheet can also be valuable in the learning process as it provides a reference which can be used to explore what constitutes a well-designed performance measure.

KPI’s are already for many years part of organization’s management. As with every concept, lessons are learned throughout the years. The next section will discuss this and also what the path forward will be to measure performance in a more effective way.

4.5 KPI’s: Lessons Learned

Historically, companies applied performance measurement based on financial performance for internal guidance, as the investors of companies (and regulators) emphasized the use of financial measures. They have always measured performance on operational level or, if applied on corporate level, on only traditional financial (accounting) measures of past performance, be this success by profit, failure through liquidation, operating margin or return on investments. On of the most prominent financial KPI is Economic Value Added (EVA). Developed by the Stern Stewart Corporation as an overall measure of financial performance, EVA is both a specific performance measure and the basis for a larger performance measurement framework (Otley, 2002). EVA is a financial performance metric that is most directly linked to the creation of shareholder value, over time (Kellen, 2003). EVA is net operating profit less an appropriate charge for the opportunity cost of all capital invested in an enterprise. In other words, EVA is profit the way shareholders define it. Mathematically it is:

\[ EVA = \text{Net Operating Profit After Taxes} - \text{Capital Charges} \]

EVA helps managers incorporate two basic principles of finance into their decision making. The first is that the primary financial objective of any company should be to maximize the wealth of its shareholders. The second is that the value of a company depends on the extent to which investors expect future profits to exceed or fall short of the cost of capital. By definition, a sustained increase in EVA will bring an increase in the market value of a company.

But in the current business environment, financial performance indicators (solely) are not sufficient. From different sources, the following reasons are given (Neely et al. (1997), Artley and Stroh (2001), Zairi (1994), The Boston Consulting Group (1991) and van Aken & van Goubergen (2000)):
• Provide little information to support organizations on their quality journey, because they do not map process performance and improvements seen by the customer and other stakeholders. Management often wants to focus measurement only on an organization’s internal components and processes. That way they can “command and control” it. However, in an organization that has to maintain competitiveness, it has become evident that performance will be measured by the improvements seen externally by the customer as well as by the results delivered to other stakeholders, such as the shareholders. This has necessitated a shift of emphasis from financial figures to a broader perspective because business competition is now on the basis of product quality, delivery, reliability, after sales services, competitive capabilities and customer satisfaction;

• Are generally outcomes of what happened in a business process, the focus is then on bottom-line results. In this case they cannot fully explain what happened in the process in order to form a basis for future actions. They are not capable of explaining what is happening because they are final outcomes of the business process, nor are they a position of forecasting what the organization is going to do in the future. These traditional measures have not been linked to the process where the value-adding activities take place. A continuous feedback to the process for improvement has been lacking, thus providing little motivation to support attempts to introduce continuous improvement programs because of their inability to map process performance. Many in the performance measurement arena call this “driving through the rear-view mirror.” The focus is not on where you’re going, only on where you have been. And, if you’re driving through the rearview mirror, you won’t see the large hole in the road until you’ve driven right into it. So, the critical things that impact the results should be measured, not just the results themselves;

• Were sufficient in an Industrial environment where investments in long-term capabilities and customer relationships were not critical for success. With the emergence of the Information era and competitive (international) environments, value drivers for long-term competitive performance became necessary.

• Are not manageable, whereas non-financial Indicators are manageable;

• Fail to define performance operationally;

• Fail to expose poor performance which disables the introduction of tighter management controls;

• The absence of approaches to assist decision maker to understand, organize and use the large and complex amount of information to manage organizational performance and guide the measurement process.

• The imbalance with regard to the different aspects of performance of the organization (data tunnel vision). Management and/ or stakeholders focus only on one piece or area of measurement data on which to base their decisions, completely forgetting about the consequences of doing so (sub-optimization). Focusing on only revenue, could lead to compromising employee and public safety, jeopardizing client health, and dissatisfying the client. Also, exceptional financial performance could be disastrous in another and/ or often at the expense of overall business goals.

The main point made in the discussion above is that in measuring performance a broader point of view is needed and that many factors in performance measurement are related. For example, with regard to EVA, this concept can function as part of a larger performance measurement model by including it as a financial indicator.

4.6 Conclusions

The most crucial characteristic of KPI’s is its relation with the organizations’ strategy (and consequently mission and vision). This characteristic needs to be considered throughout the continuation of this research.

Key Performance Indicators can be approached from different point of views. In this chapter the common views used in literature have been reviewed. This knowledge about Key Performance Indicators should be taken into account in the process of determination of KPI’s. Another, at first sight obvious aspect of indicators is that they should be ‘good’. Several authors have discussed this, which resulted in a checklist for ‘good’ by means of criteria. For the guidance of structuring and presenting the KPI’s consistently, the PMRS is assigned. The knowledge of all these design-oriented aspects of KPI’s will be helpful to ensure successful implementation and execution of KPI’s.
The lessons learned discussed in this chapter, enhanced by the arguments in chapter 3, emerge that in measuring performance of organizations several aspects have to be taken into account, which are all related and can not be separated (KPI's are not on them selves, but are part of a broader context). This leads to the conclusion that corporate performance measures should be approached in a more holistic way, in stead of randomly defining KPI's. This holistic approach enables the analysis from a higher abstraction level, of which the next chapter will discuss the possibilities.

12 Emphasizing the importance of the whole and the interdependence of its parts (source: www.thefreedictionary.com) / consisting of entities which can be considered to be autonomously as well as depending parts of even more larger entities (Eijnatten et al., 2002).
5 PERFORMANCE MEASUREMENT FRAMEWORKS

The previous chapter emerged a holistically approach of KPI’s in order to perceive and put a meaning on measuring performance (analysis from a higher abstraction level). Eijnatten et al. (2002) argue that this can be achieved by using an appropriate model, which they define as a simplified representation (a set of assumptions, concepts, values and practices) of a certain aspect of reality that constitutes a way of viewing this reality. An appropriate model will enable analysis from a higher abstraction level by using it as a guideline or framework to indicate how performance measurement should be organized, structured and in what order (prescriptive). A framework also stimulates thoughts about what should be measured.

According to Artley and Stroh (2001) experience has shown that a framework is needed to organize these thoughts, identify common vocabulary and ensure appropriate coverage for the performance area.

In order to determine an appropriate framework to use for the KPI development process, this chapter will first discuss the most prominent frameworks for measuring performance. These frameworks will be analyzed and discussed in separate sections of which the purpose is to present a coherent and complete model for measuring performance. Closely related to organizational performance are Quality Programs due to the self assessment factor, which will therefore also be discussed in the second section. The last topic in this chapter is the one discussing perspectives based on empirical studies, on the contrary of the other perspectives which are based on theoretical concepts. Based on this analysis, a well founded choice will be made with regard to the most appropriate framework.

5.1 Most prominent Frameworks for measuring Performance

The most prominent frameworks for measuring performance are firstly determined by the available relevant literature, as experienced by the author. Furthermore, Marr and Schiuma (2003) have conducted a citation analysis of the Performance Measurement field using papers published in the Performance Measurement and Management conference. Marr and Schiuma (2003) take over Baker and Lancaster’s (1991) argument that citation analysis is a recognized methodology to examine the body of literature influencing a discipline or field of academic research. The underlying assumption is that more frequently cited articles and/or authors have a greater influence on the academic field in comparison to articles cited less frequently. Using frameworks presented by authors who have been cited most frequently will enhance the academic bases of this thesis.

![Most frequently cited authors](source: Marr and Schiuma, 2003)

Figure 5-1 shows that the authors Kaplan, Norton and Neely are not only cited most, but the number of citations of these 3 authors are also growing through the years 1998, 2000 and 2002.
Analyzing the work of Marr and Schiuma (2003) from a slightly different point of view shows that almost 75% of all papers quoted Kaplan and Norton, followed by Neely with a citation percentage of 18% of all papers (see Figure 5-2). The other authors can be neglected in this comparison due to the minor number of citations.

![Most frequently cited authors in 2002](image)

**Figure 5-2** Percentage of most frequently cited authors in 2002 (source: Marr and Schiuma, 2003)

Based on the arguments above (citation analysis) and the author’s literature study, the next sections will discuss works of Kaplan and Norton, the Balanced Scorecard (BSC) and the Strategy Map, and Neely’s Performance Prism.

## 5.1.1 Balanced Scorecard (BSC)

The Balanced Scorecard (BSC), proposed by Kaplan and Norton, translates a company's vision, mission and strategy into a coherent set of performance measures.

Initially focused on finding a way to report on leading indicators (the performance drivers) of a business’s health rather than traditional accounting measures which are lagging indicators (the outcomes), the balanced scorecard was refocused to measure the firm’s strategy. Instead of measuring anything, firms should measure those things that directly relate to the firm’s strategy (Kaplan & Norton, 2001). This thesis is on KPI’s, which are used on corporate level. As mentioned earlier KPI’s are measurable characteristics of products, services, processes and operations directly related to the organizations’ strategy, that gives a good indication of the success (or failure) of success determining factors that are critical for the successful execution of the organizations’ strategy.

The ultimate purpose of KPI’s can be considered to be to check whether what the organization is doing is going well or not, in other words: is the strategy being implemented effectively? Consequently, the framework used to measure performance should be based on the organization’s strategy. Also mentioned in section 1.2, the current KPI’s of CB&I Lummus do not capture all aspects related to the business strategy, consequently Company Management can not determine to what extent the company strategy is sufficient for the organizational goals. This adds weight to the argument that frameworks used to measure performance should be based on the organizations’ strategy.

The BSC consists of four perspectives which permit a balance between (1) short- and long-term objectives, between (2) outcomes desired and the performance drivers of those outcomes, and between (3) hard objectives measures and softer, more subjective measures. The balanced scorecard proposes a holistic view of the organization by integrating four perspectives of performance: financial, customer, internal business process, and learning & growth (Kaplan and Norton, 1996). These perspectives are based on four strategies related to corporate performance and provide answers to four basic questions about corporate performance:
### Table 5-1  The 4 perspectives of the BSC including the corresponding strategy and main question

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Strategy</th>
<th>Main Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
<td>Growth, profitability and risk from the shareholder’s perspective</td>
<td>What financial performance must be delivered to investors or the owners to meet their expectations and to survive as ongoing concern?</td>
</tr>
<tr>
<td>Customer</td>
<td>Creating value and differentiation from the perspective of the customer</td>
<td>On which critical factors do customers judge us?</td>
</tr>
<tr>
<td>Internal Business Process</td>
<td>Priorities for various business processes that create customer and shareholder satisfaction</td>
<td>To satisfy our shareholders and customers, what business processes must we excel at?</td>
</tr>
<tr>
<td>Learning and Growth</td>
<td>The priorities to create a climate that supports organizational change, innovation and growth</td>
<td>What do we have to do to continually innovate and add value to the overall operations?</td>
</tr>
</tbody>
</table>

The goals from the financial perspective tend to be the ones that are the most lagged in a cause-and-effect relationship amongst the four perspectives. If one were to monitor strategic goal performance only by evaluating progress against financial goals, it would be too late in the game (these are results of past business activities). The drivers of financial goal achievement are actually the goals from the other three perspectives. Financial goal achievement maybe the ultimate desired outcome, but it is critical that a balanced set of goals is developed that are linked to each other and ultimately the financial goals. Ideally, one should be able to state how each customer, internal process or learning and growth goal will lead, directly or indirectly, to achieving a financial goal. A set of financial goals would typically begin by targeting rates of revenue growth in the company’s product or service lines of business. They would also include long term improvement in profit margins or cost related areas for the lines of business. Establishing and achieving goals in the remaining perspectives (customer, internal process, learning and growth) is where the business game is really won or lost (Kali, 2003). Again, achieving these goals should lead or cause the achievement of the lagged financial goals. Valid measurement is demonstrated by the cause and effect linkage that is established amongst the balanced set of performance measurement goals.

The checklist for goals from the customer perspective concerns current business activities and includes those goals related to improving customer acquisition and retention, increasing market share, understanding customer needs, selling the optimum product mix, improving customer satisfaction and company reputation, and increasing customer profitability.

The typical checklist for goals related to internal process concerns also current business activities and includes improving employee productivity, reducing process cycle times, reducing product or service cost, reducing inventory levels, and increasing service response times.

Goals established for the final perspective, namely learning and growth, are usually the most leading of the four perspectives and possibly the most effective drivers of long term results (business activities aimed at the future). Because they have largely intangible benefits that are not immediately apparent, these goals are the most difficult to justify investing time and money in achieving. These goals have to do with advancing the company’s intellectual assets and may begin with simply better training to upgrade the competency of staff employees. Recognizing and rewarding employees for innovative contributions as well as retention and motivation of key contributors to making the company more competitive are all strategies in this perspective to be considered (Kali, 2003).

Over all, the BSC determines the knowledge, skills and systems that the employees will need (learning and growth) to innovate and build the right strategic capabilities and efficiencies (the internal processes) that deliver specific value to the market (the customers), which will eventually lead to higher shareholder value (the financials). Kaplan and Norton elaborated this concept by introducing the Strategy Map, which is discussed in the next section.

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13 Something that cannot be seen or physically touched (source: [www.investorwords.com](http://www.investorwords.com)).
5.1.2 Strategy Map

According to Kaplan and Norton (1996), strategy is a set of hypothesis about cause-and-effect. As mentioned in section 5.1.1 above, properly constructed scorecards should reveal the business unit’s strategy through such a sequence of cause-and-effect relationships, because measures without linkage are useless and they’re not going anywhere. “Every measure selected for a BSC should be an element of a chain of cause-and-effect relationships that communicates the meaning of the business unit’s strategy to the organization.” Kaplan and Norton (2000) visualize this chain with the Strategy Map.

A Strategy Map is a diagram that describes how an organization will convert its initiatives and resources (including intangible assets), by connecting strategic objectives in explicit cause-and-effect relationship with each other in the four BSC perspectives, into tangible outcomes in order to drive organizational performance. The Strategy Map is the link between the strategy on the one hand and the measurable indicators and tangible actions in line with the strategy on the other hand (Kerklaan, 2006).

The Strategy Map should be built from the top and cascading down into the organization (horizontal and vertical linkage) by starting with the destination and then charting the routes that will lead there. Typically the Strategy Map starts with a financial strategy for increasing shareholder value (Kaplan and Norton, 2000).

Financial Perspective: companies have two basic goals for the financial strategy: (1) revenue growth and (2) productivity/efficiency. Revenue growth generally has two components: (a) value from new markets, new products and new customers and (b) increase value to existing customers by deepening relationships with them through expanded sales. Productivity/efficiency usually also has two parts: (c) improve the company’s cost structure by reducing direct and indirect expenses and (d) use assets more efficiently by reducing the working and fixed capital needed to support a given level of business.

Customer Perspective: this perspective starts with the selection of the customer segments on which the organization wants to aim at (the strategy of the company should contain a description of these specific customer segments). This perspective contains the core of any business strategy, the customer value proposition. The customer value proposition describes the unique mix of product and service attributes, customer relations and corporate image that a company offers. It defines how the organization will differentiate itself from competitors to attract, retain and deepen relationships with targeted customers.

Internal Process Perspective: once an organization has a clear picture of its customer and financial perspectives, it can then determine the means by which it will achieve the differentiated value proposition for customers and the productivity improvements to reach its financial objectives. The internal process perspective captures these critical organizational activities, which fall into four high-level processes: (1) innovation with new products and services and by penetrating new markets and customer segments; (2) increase customer value by deepening relationships with existing customers; (3) achieve operational excellence by improving supply chain management, the cost, quality and cycle time of internal processes, asset utilization and capacity management; (4) become a good corporate citizen by establishing effective relationships with external stakeholders.

Learning & Growth Perspective: the foundation of any Strategy Map is the learning & growth perspective, which defines the core competencies and skills (human capital), the technologies (information capital) and the corporate culture (organization capital) needed to support an organization’s strategy. These objectives enable a company to align its human resources and information technology with its strategy. Specifically, the organization must determine how it will satisfy the requirements from critical internal processes, the differentiated value proposition and customer relationships.

The company’s strategy map should be kept on the strategic level - it is not supposed to illustrate how everyone’s job is linked to the strategy (Markus, 2004). The strategy map can help a company to find out whether there are gaps between the strategy and actions to implement the strategy and strategic goals.
Overall, the financial objectives can only be achieved and sustained through satisfying customers, which can only be achieved through effective and efficient processes. In addition, efficiency of processes also contributes directly towards financial objectives. The efficiency and effectiveness of the internal business processes can only be improved through development of competencies and capabilities of the organizations internal resources.

Literature regarding the Strategy Map clearly describes what the concept of it is and what the main issues are per perspective. However, not much attention is dedicated to the interpretation of these main issues. In other words, literature does not elaborate on how to retrieve and/or define those factors that really matter for individual organizations, e.g. that give a good indication of the success (or failure) of success determining factors that are critical for the execution of that specific organizations’ strategy. Therefore it is not possible to design the Strategy Map for an organization on the level of the possible factors other than indicated in the standard model as presented by Kaplan and Norton. A solution of this shortcoming is making use of Critical Success Factors. Another shortcoming, which is acknowledged by the authors of the Strategy Map, is the content of the Learning & Growth perspective. Both shortcomings are discussed in the next sub-sections.

5.1.2.1 Intangible Assets

This section discusses the first shortcoming, addressed by the author, with regard to the Strategy Map. In Kaplan and Norton’s publication in 2000 they state that the learning & growth perspective defines the core competencies and skills, the technologies and the corporate culture that are needed to support an organization’s strategy. Unfortunately, this definition did not enable organizations to apply the learning & growth perspective successfully, as admitted by Kaplan and Norton (2004). Therefore Kaplan and Norton (2004) state, in their most recent publication, that the learning and growth perspective consists of the following intangible assets: (1) Human Capital, (2) Information Capital and (3) Organization Capital.

But Adams and Marr (2004) state that Kaplan and Norton do not acknowledge the collective wisdom that has been developed and published on the subject of intangible assets. Due to the fact that there are many definitions of what intangible assets are, the author refers to a publication of Marr et al. (2004). They provide, based on extensive literature review, a classification of organizational assets. These assets contain all aspects related to the learning & growth perspective. The organizational assets are included in Table 5-2.

<table>
<thead>
<tr>
<th>Organizational Asset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial assets</td>
<td>Money, as one of the invisible assets of an organization, is in fact a necessary input as well as an output of operations in form of cash flow.</td>
</tr>
<tr>
<td>Physical assets</td>
<td>Comprise all tangible infrastructure assets, such as structural layout and information and communication technology. It includes databases, servers, and physical networks like intranets.</td>
</tr>
<tr>
<td>Relationship assets</td>
<td>The relationship between an organization and its external stakeholders as well as in the exchange of knowledge between them.</td>
</tr>
<tr>
<td>Human assets</td>
<td>Include employee’s skills, competences, commitment, motivation and loyalty.</td>
</tr>
<tr>
<td>Culture assets</td>
<td>Provide employees with a shared framework to interpret events; a framework that encourages individuals to operate both as an autonomous entity and as a team in order to achieve the company’s objectives.</td>
</tr>
<tr>
<td>Practices and routines as assets</td>
<td>Determine how processes are being handled and how work flows through the organization.</td>
</tr>
<tr>
<td>Intellectual property assets</td>
<td>The tools and enablers that allow a company to gain a protected competitive advantage.</td>
</tr>
</tbody>
</table>

Table 5-2 Description of the organizational assets according to Marr et al. (2004)
To cope with the shortcoming in this sub-section, the author has adjusted the Learning & Growth perspective in the Strategy Map as included in Figure 5-3. Also, taking into account that the EPC Contracting business is based on service, rather than products, the Human assets should be emphasized within this perspective. The Human assets have been emphasized by firstly treating it as a separate topic in the interviews (see Appendix C) and secondly by elaborating on possible aspects which are valued by the employees of CB&I Lummus in section 6.3.

Figure 5-3   The Strategy Map (source: Kaplan and Norton (2000/2004), modified by author)

5.1.2.2 **Critical Success Factors (CSF’s)**

As already stated, the second shortcoming is the translation of the main issues of the Strategy Map into company specific factors. These company specific factors should determine whether the strategy is effective by (not) realizing the set objectives. This information is provided by Critical Success Factors (CSF’s). CSF’s define key areas of performance that are essential for the organization to accomplish its mission (Caralli, 2004). The CSF’s are therefore essential for the achievement of the set objectives, derived from the strategy. They are a limited number of factors that, if evaluated with satisfactory results, will ensure a successful competitive performance for the organization (factors that really can make the difference between business success and failure). Related to organizational goals, these factors are the few key areas of activity in which favorable results are absolutely necessary for managers to reach their goals. They are also factors on the bases of which an organization can distinguish itself from the competition in order to establish a sustainable, positive relation with the market (Vrisou van Eck, 2003). An example of a CSF is the training of staff, which can be measured with the KPI: average number of training hours per employee.

These factors are also referred to as Value Drivers. Bourne et al. (2003) have evaluated the best practices in performance measurement and state that there is a growing trend towards managing performance improvement through focusing on the value drivers. Marr et al. (2004) state that organizations perform well
and create value when they implement strategies that respond to market opportunities by exploiting their internal resources and capabilities. Therefore, managers need to understand what the key resources and drivers of performance and value in their organizations are.

By defining a few numbers of key areas, CSF’s are limited. But they should not measure too little, because this would disable effective decision making. On the other hand, too much data results in ‘information overload’, what can be so much that managers and employees either will ignore the data or use it ineffectively.

For each CSF’s it is possible to develop one or more KPI’s to inform what the status is of that specific CSF; from this point of view KPI’s are measurable translations of a specific CSF.

Taking CSF’s as a starting point in performance measurement, enables the company to first analyze what they want to measure and then how they want to measure it (by allocating KPI’s to the CSF’s).

Rockart and Bullen (1981) have introduced the concept of CSF’s. They define five specific sources or types of CSF’s for an organization:

1. Industry CSF’s: every organization inherits a particular set of operating conditions and challenges that are inherent to the industry (or segment of the industry) in which it chose to do business. This results in a unique set of CSF’s that organizations in a particular industry must achieve to maintain or increase their competitive positions, achieve their goals, and accomplish their missions.

2. Competitive Position or Peer CSF’s: peer-group CSF’s are a further delineation of industry-based CSF’s. They define those CSF’s that are specific to the organization’s unique position relative to their peer group in the industry in which they operate or compete.

3. Environmental CSF’s: environmental CSF’s reflect the environmental factors over which the organization has very little control or ability to actively manage. By making these factors explicit, the organization can at least be mindful of them and actively monitor their performance relative to them.

4. Temporal CSF’s: temporary conditions or situations can result in temporal CSF’s. These are areas in which the organization must temporarily perform satisfactorily in order to ensure that its ability to accomplish its mission is not impeded.

5. Management Position CSF’s: managers have different focuses and priorities depending on the layer of management in which they operate. This translates into a set of CSF’s that reflect the type of responsibilities required by the manager’s position in the organization. In fact, the CSF’s that are inherent to the level of management may be universal across different organizations in the same industry.

These 5 sources/types of CSF’s indicated above should be considered as background information when determining the CSF’s. They do not add value to the Strategy Map with regard to the point of view (perspectives); the contribution of CSF’s is the concept that by determining those factors that really matter for individual organizations, a specific interpretation can be given to the Strategy Map for that organization. The CSF’s should primarily comply with the following criteria:

- Both observable and measurable in certain respects such that it would be easier to focus on these factors.
- Actuality, i.e. having the largest impact on an organization’s performance (the criticality of success factors).

The secondary focus of CSF’s should be on the following criteria:

- Essential for the organization to accomplish its mission.
- Essential for the achievement of the set organizational objectives.
- Be the bases of which an organization can distinguish itself from the competition.
- Enabling a sustainable, positive relation with the market.
- Not only aimed at organizational bottlenecks.
- Focused on the future by formulating in results terms (improvement): this is not really a focus of CSF’s, but more a formulation rule which will be taken into account later in this study.
It can be acknowledged that the Strategy Map adds value to the BSC by making the cause-and-effect relationships explicit and by visualization of it in a diagram. In order to increase the effectiveness of the Strategy Map the following issues should be taken into account:

1. Improvement of the Learning & Growth perspective,
2. Introduction of CSF’s in order to elaborate the Strategy Map for a specific organization.

Besides the works of Kaplan and Norton (the BSC and the Strategy Map), Neely’s Performance Prism can be considered to be prominent in the field of Performance Measurement. This framework will be discussed in the next section.

### 5.1.3 Performance Prism

Neely and his colleagues (2002) introduced the Performance Prism in order to satisfy the demand for a multi-faceted, yet highly adaptable framework which will address the needs for performance measurement within the new competitive environment of the 21st century. Where the BSC derives its measures from the company strategy, the Performance Prism is based on the assumption that although the strategy is undoubtedly of value, they are not the end goal. In this framework the first and fundamental perspective on performance is the stakeholder perspective. This measurement framework is built around five interrelated perspectives on performance, see Figure 5-4.

![The 5 dimensions of the Performance Prism (source: Neely, 2002)](image)

The five perspectives all pose specific vital questions, as stated in Table 5-3.

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Vital Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder Satisfaction</td>
<td>Who are the key stakeholders and what do they want and need?</td>
</tr>
<tr>
<td>Strategies</td>
<td>What strategies do we have to put in place to satisfy the wants and needs of these key stakeholders?</td>
</tr>
<tr>
<td>Processes</td>
<td>What critical processes do we require if we are to execute these strategies?</td>
</tr>
<tr>
<td>Capabilities</td>
<td>What capabilities do we need to operate and enhance these processes?</td>
</tr>
<tr>
<td>Stakeholder Contribution</td>
<td>What contributions do we require from our stakeholders if we are to maintain and develop these capabilities?</td>
</tr>
</tbody>
</table>

**Table 5-3 The 5 perspectives of the Performance Prism (Neely, 2002)**
Neely et al. (2002) have identified the following set of stakeholders in the model:

1. Investors
2. Customers
3. Regulators
4. Suppliers
5. Employees

Overall, this framework provides a balanced picture of the business (Neely, 2002) highlighting external (stakeholder) and internal (strategy, process and capability) measures, as well as integrating financial and non-financial measures.

As mentioned above, the fundamental perspective on performance of the Performance Prism is the stakeholder perspective. For the context of EPC Contractors, regulators will not have an influence of significance. The other 4 stakeholders can easily be integrated into the Strategy Map with regard to what they want and need:

- Investors’ wants and needs correspond with the Strategy Map’s financial perspective
- Customers’ wants and needs correspond with the Strategy Map’s customer perspective
- Suppliers’ wants and needs correspond with the Strategy Map’s internal process perspective
- Employees’ wants and needs correspond with the Strategy Map’s Learning & Growth perspective

With regard to the other perspective of the Performance Prism, these do not add value compared to the Strategy Map.

Organizational performance is closely related to Quality Programs due to the self assessment factor of these Programs. This chapter will therefore also discuss in the next section the EFQM Business Excellence Model and the Malcolm Baldrige National Quality Program, self-assessment frameworks related to the way of managing business excellently.

### 5.2 Quality Programs

The BSC, for example, can be best described as a framework directly related to performance (prescriptive\(^{14}\)). However, in the past years several Quality Programs have been developed where the emphasis is on self-assessment related to the way of managing business excellently (non-prescriptive). The most prominent programs are the EFQM Business Excellence Model and the Malcolm Baldrige National Quality Program (MBNQP).

#### 5.2.1 EFQM Business Excellence Model

The Business Excellence Model (BEM), developed by the European Foundation for Quality Management (EFQM), is a non-prescriptive framework based on nine criteria that can be used to assess an organization’s progress towards Business Excellence (see also Figure 5-5).

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\(^{14}\) Related to giving directives or rules (source: [www.thefreedictionary.com](http://www.thefreedictionary.com)) / outlines how reality could be represented (Eijnatten, van et al., 2002).
This model is not designed as a performance measurement framework, but it gives many insights that affect performance measurement (Neely, 2002). The model is a broad management model that explicitly highlights the enablers of performance improvement and indicates result areas that should be measured (Neely, 2002). The Enablers are concerned with how the organization undertakes key activities and the Results are concerned with what results are being achieved (EFQM, 2003). Excellent results with respect to Performance, Customers, People and Society (the Results) are achieved through Leadership driving Policy and Strategy, that is delivered through People, Partnerships and Resources and Processes (the Enablers). A description of these nine criteria is given in Table 5-4.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>How behavior/ actions support a culture of “Excellence”.</td>
</tr>
<tr>
<td>Policy and Strategy</td>
<td>How policy and strategy are formulated and deployed into plans/ actions.</td>
</tr>
<tr>
<td>People</td>
<td>How the organization realizes the potential of its people.</td>
</tr>
<tr>
<td>Partnerships and Resources</td>
<td>How the organization manages resources, including external resources, effectively and efficiently.</td>
</tr>
<tr>
<td>Processes</td>
<td>How the organization manages and improves its processes.</td>
</tr>
<tr>
<td>Customer Results</td>
<td>What is the customers’ perception of the organization and how good are the drivers of customer satisfaction?</td>
</tr>
<tr>
<td>People Results</td>
<td>What are the employees’ perceptions of the organization and how good are the drivers of employee satisfaction?</td>
</tr>
<tr>
<td>Society Results</td>
<td>How does society and the local community perceive the organization and what results have been achieved relating to community and environmental concerns?</td>
</tr>
<tr>
<td>Key Performance Results</td>
<td>What is the organization achieving in relation to its planned performance?</td>
</tr>
</tbody>
</table>

Table 5-4  A description of the 9 EFQM criteria (EFQM, 2003)

By defining performance indicators per Result and subsequently measuring these, enables the feedback of control information to the five Enablers. Through Measurement and analysis the organization will be capable to learn (Bour, 1998). Within the model it is the purpose to determine the objectives per Enabler in line with the chosen strategic direction. For all of these objectives it is indicated what the related activities and the aimed Results are. By linking objective, activity and Result on a consistent manner the possibility will rise to monitor the progress of the organization.

5.2.2 Malcolm Baldrige National Quality Award (MBNQA)

The recognition that total quality management is a broad culture change vehicle with internal and external focus embracing behavioral and service issues, as well as quality assurance and process control,
prompted the USA to develop one of the most famous and now widely used frameworks, the Malcolm Baldrige National Quality Program (MBNQP). Similar to the EFQM, actually being the American counterpart of the EFQM, this framework consists of criteria. The 7 criteria are the basis for conducting organizational self-assessments, for making Awards, and for giving feedback to applicants. The Criteria are designed to help organizations use an integrated approach to organizational performance management that results in (BNQP, 2007):

- Delivery of ever-improving value to customers and stakeholders, contributing to organizational sustainability,
- Improvement of overall organizational effectiveness and capabilities,
- Organizational and personal learning.

The 7 Criteria are built on a set of interrelated Core Values and Concepts, see Figure 5-6.

![Figure 5-6 Core values & concepts and criteria](image)

The overall goal is the delivery of customer satisfaction and market success leading, in turn, to business results.

An opposite approach to the discussed conceptual models is that of KPI groups determined on the bases of empirical research. The next section will elaborate on these empirical groups.

### 5.3 Key Performance Indicators in the Construction Industry

The frameworks presented earlier in this chapter all are theoretical concepts applicable on all kind of organizations. Specifically for the Construction industry, the KPI Working Group and the Construction Products Association also have developed perspectives based on empirical studies. Clients of the construction industry want their projects delivered (Blumenthall et all, 2000): (1) on time, (2) on budget, (3) free from defects, (4) efficiently, (5) right first time, (6) safely, (7) by profitable companies. The purpose of these requirements within the construction industry is on the one hand to enable measurement of project and organizational performance and on the other hand it will be a key component of any organization’s move towards achieving best practice. Blumenthall et all (2000) therefore have introduced the measurement framework, which consists of seven main groups:

15 Contractors’ inability to make a profit has been identified as a major reason for project cost and time overruns (Blumenthall et all, 2000).
1. Time
2. Cost
3. Quality
4. Client Satisfaction
5. Client Changes
6. Business Performance
7. Health and Safety

Within these groups, a range of indicators have been developed to analyze either project or company performance, or both. The indicators are classified in:

- Headline Indicators: provide a measure of the overall, rude state of health of a firm.
- Operational Indicators: bear on specific aspects of a firm’s activities and should enable management to identify and focus on specific areas for improvement.
- Diagnostic Indicators: provide information on why certain changes may have occurred in the headline or operational indicators and are useful in analyzing areas for improvement in more detail.

The indicators are identified as applicable at project and/or company levels. In some cases the company indicator is the average value of that company's project indicators. The indicators are identified as appropriate to the various members of the supply chain to which they could be applied. For all indicators an organization may have to use estimated, predicted or actual data depending on the stage of progress on the project.

The Construction Products Association (2007) makes a distinction between Key Performance Indicators (KPI’s) and Secondary Performance Indicators (SPI’s). KPI's are measures of factors critical to success. SPI's are indicators of the performance of an activity that is of secondary importance to success (an SPI often provides some diagnosis of the result of a KPI). Both KPI's and SPI's were developed following extensive stakeholder dialogue and based on the objective of measuring the performance within areas that were core to the business values. The key areas where performance should be measured easily and without unnecessary administrative burden were identified. The KPI's and SPI's are based on 3 aspects:
1. Customer Satisfaction
2. People
3. Environment

This section discusses main groups of KPI’s used by organizations operating in a project context in the Construction Industry (unfortunately no framework has been developed specifically for the EPC Contracting business). This Industry is not equal to the EPC Contracting business: where the Construction Industry embodies the actual construction work, the EPC Contracting business embodies for example the Engineering of a refinery, the Procurement of equipment and materials for that refinery and the management of subcontractors which construct the refinery. However, the empirical groups could be of use in determining important factors in the operations of the EPC Contracting business. Furthermore, another point of view in measuring performance has been introduced: the distinction between headline, operational and diagnostic indicators and KPI's and SPI's. After determination of the overall status of the organization with the factors critical to success (level 1), it should be possible to zoom in on the details in order to identify and focus on specific areas (level 2) and to provide information on why certain changes may have occurred and what to change on detail level (level 3).

5.4 Recapitulation on Frameworks

Seen the characteristics of the frameworks mentioned above, in general the purpose of a performance measurement framework is to design a consistent approach for systematically collecting, analyzing, utilizing and reporting on the performance of a company. The framework is a tool that will enhance the management of business processes by measuring the organization's level of achievement of results. The discussions have also emerged that, from a theoretical point of view, there are some criteria to which a framework has to comply if it wants to be effective:

- Approach of organizations by perspectives that give a “whole picture” of the health of the organization,
Organizational perspectives are recognizable and applied in balance with regard to the different aspects of performance of the organization,
Enable translation of the strategic plan in one way or another as far as all parts of the organization,
Ability to also map process performance, which means that organizational outcomes desired as well as the performance drivers of these outcomes are required,
Short- and long-term organizational performance should be taken into account,
Not only 'hard' business aspects are important, but also 'softer' issues,
The perspectives are applied in coherence (cause-and-effect linkages),
Basis of the framework is the organizations’ strategy,
The presented KPI’s should be manageable for the responsible manager(s),
Not only the shareholders are important, all relevant stakeholders should be taken into account with regard to their expectations,
The ability, especially seen the organizational set-up of EPC Contractors, to enable the measurement of both project and organization performance,
Enabling different levels of detail,
Prescriptive characteristic,
Not measuring too little data, as well as not measuring too much data.

Deciding on which framework to apply should not be done by analyzing which framework fits best to this specific Industry/ line of business, because the frameworks approach organizations from a high abstraction level. This means that each framework is applicable to every organization regardless of the Industry/ line of business they operate in. The criticality of a measurement framework emerges in its application process: the way it can be elaborated for Industries’ companies. Deciding on a framework will therefore be done by comparing them against the criteria mentioned above. Also, a comparison of the frameworks amongst each other will contribute to the process of deciding on a framework.

Strategy is the starting point of the BSC and the Strategy Map; they enable the translation of the strategic plan as far as all parts of the organization. With regard to the Quality Programs and the Performance Prism, strategy is only a part of these concepts and not the starting point.

The Strategy Map is based on the BSC, but elaborated on the connecting of the strategic objectives in explicit cause-and-effect relationships with each other in the four BSC perspectives. Therefore, the Strategy Map will be preferred above the BSC.

The Performance Prism adopts a seemingly complementing perspective compared to the Strategy Map, namely the stakeholders. Earlier has been indicated that the interests of the stakeholders can be incorporated into the perspectives of the Strategy Map. Also, the Strategy Map has been applied successfully in many organizations (and have proven their validity) and enjoyed worldwide recognition and acceptance, while the Performance Prism is only a theoretical concept. With regard to the Performance Prism, in the literature study executed for this thesis, there is no literature available with proven validity of this model, as also stated by Berrah et al (2004). Furthermore, earlier mentioned is that the usage of frameworks presented by authors who have been cited most frequently will enhance the academic bases of this thesis. With a percentage of citations of almost 75% for Kaplan and Norton against 18% for Neely, enhanced by incorporating Neely’s stakeholders perspective in the Strategy Map and the proven validity of the Strategy Map, it can be concluded that the Strategy Map will be preferred above the Performance Prism.

The Strategy Map and the Quality Programs are complementary frameworks rather than competing. They have the advantage of helping companies to better understand the need to look at activities as well as results. In this view, the Strategy Map could be part of the Quality Programs by emphasizing on measuring performance, but for the purpose of this research the Strategy Map fits best:
- The Strategy Map is primarily concerned with results indicating the performance and goals for each perspective (starting point is (managing) the results of activities/ processes), which is due to the leading and lagging concept. The Quality Programs on the other hand use enablers criteria to determine how a company does what it does and the results criteria to determine what companies
have actually achieved or are achieving (emphasis on (managing) the work processes which lead to results),

- The categories for measurement of the Quality Programs provide a very broad and coherent set of assumptions about what is required for a good organization and its management, limiting the guidance it gives to defining specific areas of measurement (which makes it not easy to measure). Therefore, the Quality Programs are more holistic than the Strategy Map by considering the ‘hows’ rather than just the ‘whats’ (seen the objective of this research, the Quality Programs are too holistic).
- The Strategy Map is more an objective measurement framework (prescriptive) by involving and strictly following a set of rules or standards. The Quality Programs on the other hand are frameworks that recognize that there are many approaches to achieving sustainable excellence (non-prescriptive).
- The Strategy Map is very useful as a high-level strategic measurement framework, but it does not really tell how to improve, what the Quality Programs do on the contrary. In order to handle the lack of the Strategy Map of not telling how to improve, more levels should be built in to zoom in on the details to identify and focus on specific areas and to provide information on why certain changes may have occurred and what to change on detail level. The levels depend on the purpose of the KPI’s,
- Also, the Strategy Map is more forward looking, what means that the Quality Programs tell you where you have come from and where you are now (are regarded as excellent tools for self-assessment), while the Strategy Map emphasizes on what the company needs to achieve if it is to be successful in the (near) future.

5.5 Conclusions

In general multiple, seemingly conflicting, measurement frameworks exist because they all add value; they all provide unique perspectives on performance and approach organizations from a different point of view to cover business activities. These frameworks all have their strengths and weaknesses; as long as it is acknowledged that performance measurement should be executed according to a framework. The traditional way of measuring performance according to a framework had shortcomings in guiding the measurement process. The main shortcoming is that they are based on financial performance measures. These measures provide little information to support organizations on their quality journey, because they do not map process performance and improvements seen by the customer and other stakeholders, they do not capture value drivers for long-term competitive performance and are not manageable.

To cope with these shortcomings the last few years several frameworks and methodologies have been developed of which the most prominent have been discussed in this chapter. When comparing the frameworks against the criteria recapitulated in the previous section, it can be concluded that the Strategy Map complies most. This conclusion is enhanced by the critical comparison of the frameworks amongst each other in the previous section. Secondly ranked is the BSC followed by the Performance Prism and then the Quality Programs.

The main critics received with regard to the Strategy Map are the lack of specific guidelines for successful implementation and not telling how to improve. However, based on the suggestions in this chapter to cope with these shortcomings (application of CSF’s and introduction of levels) and the arguments above, the Strategy Map is the framework that will be used to determine the KPI’s for the EPC Contracting Industry, which will enable specific, customized performance measurement.

Besides the conclusion in this chapter that frameworks are valuable tools for performance measurement, another conclusion is that prior to elaborating any framework, the company needs to have a clear, preferably written, vision, mission and strategy (the strategic plan) in place. If not, the company has to focus on this aspect before applying a performance measurement framework. The next chapter discusses the strategic plan of CB&I Lummus.
This chapter will first discuss CB&I Lummus’ strategic plan. Having a strategic plan is not only a precondition when measuring performance based on a framework, but it will also provide valuable information needed to retrieve important factors. Because these factors are derived from the strategic plan, they can be considered to be potential CSF’s. As concluded in the previous chapter, CSF’s are needed for successful implementation of the Strategy Map. The second section discusses a source that has an empirical point of view on important factors for CB&I Lummus, namely the interviews with employees. The last source for important factors is the perception of employees, which will elaborate on the human assets of the Strategy Map (section 3). Based on these sources, the goal of this chapter is to retrieve all factors that are considered important in this line of business. Section 4 gives the conclusions of this chapter, including the important factors, which are considered to be potential CSF’s.

6.1 Source 1: The Strategic Plan

A company’s strategic plan can be best described according to Figure 6-1. Nieuwenhuis (2003) defines mission (discussed in 6.1.1) as the primary function of the organization. In order to fulfill the mission, an ambitious shared view of the future described with success determining factors is necessary (Nieuwenhuis, 2003): the vision (discussed in 6.1.2). Values (discussed in 6.1.3) provide the basis for judgments about what is important for the organization to succeed in its core business (the success determining factors). In order to achieve the organization’s mission, vision and values, targets that are established (Caralli, 2004): the organizational objectives (discussed in 6.1.4). They are very specific as to what must be achieved, when it is to be achieved, and by whom. The last item of the strategic plan is the company strategy (discussed in 6.1.5). Based on Boonstra et al. (2002), the following description can be given to strategy: the decisions with regard to the way the set objectives can be achieved by allocation of people and means, taking into account the demands/developments from the environment and the choice to act on these demands/developments.

Figure 6-1 Strategic Plan pyramid (source: author)

Figure 6-1 also indicates how CSF’s and KPI’s relate with the strategic plan. After all, the Strategy map should translate the strategic plan into a coherent set of performance measures (the KPI’s arise from the strategic plan).
6.1.1 Mission
Koster & Stolze (2007) make a distinction between 5 aspects regarding a mission:

1. Business Scope
2. Organizational Purpose
3. Meaning for Stakeholders
4. Values and Beliefs
5. Intentions and Ambitions

CB&I Lummus mission has been described as (Company management Manual, 2007): to serve the petrochemical and chemical industries through designing and constructing production facilities, on- and offshore, on an EPC project basis, which includes project management, engineering, procurement, construction and commissioning.

This mission fits within CB&I’s overall mission, which is\(^{16}\): we will be the preferred supplier of process and storage facilities worldwide by:

- Providing innovative and safe solutions through engineering, fabrication and construction
- Recognizing and delivering the products and solutions that our customers value
- Delivering results that repeatedly bring customers back to CB&I
- Creating an ethical, safe and enabling environment for our employees to prosper
- Leveraging the reputation and equity of our brands
- For the purpose of achieving sustainable, profitable revenue growth

Based on the above, the author has broken down the mission into the following important factors:

<table>
<thead>
<tr>
<th>To serve the chosen markets</th>
<th>Aim at EPC projects</th>
<th>Enabling employee prosperity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing innovative and safe solutions</td>
<td>Meeting customer requirements</td>
<td>Leveraging the reputation and equity of the brands</td>
</tr>
<tr>
<td>To be the preferred supplier in the Industry</td>
<td>Delivering results that repeatedly bring customers back</td>
<td>Achieving sustainable, profitable revenue growth</td>
</tr>
</tbody>
</table>

6.1.2 Vision
Koster & Stolze (2007) make a distinction between 3 aspects regarding a vision:

1. Environmental View
2. Corporate Dreams
3. Success Formula

CB&I Lummus’ vision has been described as (Company management Manual, 2007): CB&I Lummus strives to be the global partner of choice to its clients in the hydrocarbon and related industries, by:

- Capturing the energy and creativity of its people to deliver projects that meet its clients’ and stakeholders’ objectives and expectations
- Offering its employees challenging opportunities to develop and grow
- Demonstrating exemplary performance in safety, quality and sustainability as an integral part of its culture

This vision fits within CB&I’s overall vision, which is\(^{16}\): to be the leader in providing innovative and value-added engineering and construction solutions to customers worldwide while creating superior shareholder value.

Based on the above, the author has broken down the vision into the following important factors:

<table>
<thead>
<tr>
<th>To be the global partner of choice to clients in the chosen Industries</th>
<th>Demonstrating exemplary performance in safety, quality and sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capturing the energy and creativity of employees</td>
<td>Creating superior shareholder value</td>
</tr>
</tbody>
</table>

\(^{16}\) Source: intranet CB&I Lummus.
To deliver projects that meet clients’ and stakeholders’ objectives and expectations

Achieving sustainable, profitable revenue growth

Offering employees challenging opportunities to develop and grow

To be the leader in providing innovative and value-added engineering and construction solutions to customers worldwide

### 6.1.3 Values

Values are the embodiment of what an organization stands for and should be the basis for the behavior of its members (Cowings, 2002).

CB&I Lummus’ values are (Company management Manual, 2007):

- Client focus at all stages through understanding client requirements and listening to client satisfaction feedback.
- Leadership and consistency of purpose through clear vision, objectives, policies and strategies.
- A working environment conducive to team working, job satisfaction, achievement of each individual’s potential and providing the opportunity to learn and develop skills.
- Focus and stimulus on key issues such as health, safety, welfare and environmental care.
- A systematic planned and controlled approach towards executing work and measuring performance to improve consistency and efficiency.
- Win-win relationships with sellers and contractors.
- A responsibility to the public in general and an acceptable presence in the community by adopting an ethical and moral approach to concluding business.
- A culture of continual improvement recognizing that suggestions and learnings are opportunities towards excellence and improved competitiveness.
- A culture of continual improvement recognizing that suggestions and learnings are opportunities towards excellence and improved competitiveness.

These values fit within CB&I’s overall values, which are:

- Focus: encompasses our passionate focus on safety, on our employees and on our customers.
- Innovation: drives us to deliver creative solutions, to have empowered leadership and to apply key technologies.
- Accountability: allows us to leverage our culture of individual accountability to achieve profitability, perform with excellence and bind us to ethical behavior.

Based on the above, the author has broken down the values into the following important factors:

<table>
<thead>
<tr>
<th>Client focus</th>
<th>Leadership</th>
<th>To achieve profitability</th>
<th>Measuring performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding client requirements</td>
<td>Client satisfaction feedback</td>
<td>Suggestions and learnings</td>
<td>Deliver creative solutions</td>
</tr>
<tr>
<td>Consistency of purpose through clear vision, objectives, policies and strategies</td>
<td>A working environment conducive to team working, job satisfaction, achievement of each individual’s potential</td>
<td>Focus and stimulus on key issues such as health, safety, welfare and environmental care</td>
<td>An ethical and moral approach to concluding business</td>
</tr>
<tr>
<td>Providing the opportunity to learn and develop skills</td>
<td>A systematic planned and controlled approach towards executing work</td>
<td>Focus on safety, employees and customers</td>
<td>Win-win relationships with sellers and contractors</td>
</tr>
<tr>
<td>A culture of continual improvement</td>
<td>To improve consistency and efficiency</td>
<td>To apply key technologies</td>
<td>To perform with excellence</td>
</tr>
<tr>
<td>Excellence and improved competitiveness</td>
<td>To have empowered leadership</td>
<td>To leverage the culture of individual accountability</td>
<td>To bind employees to ethical behavior</td>
</tr>
</tbody>
</table>
6.1.4 Organizational Objectives

Organizational Objectives are measurable final results that should be achieved within a certain period, typically a timeframe of two to four years, depending on the rapidity of the changes in the environment (Koster & Stolze, 2007).

CB&I Lummus’ prime organizational objective is (Company management Manual, 2007): business continuity in a lead position in the industry, by satisfying the needs of its clients and other stakeholders. Subject to this prime organizational objective are the following objectives:

- Increased Profitability
- Balanced Risk Profile (through a mix of Reimbursable, Lump Sum Turn Key (LSTK) and Partnership contracts)

Based on the above, the author has broken down the organizational objectives into the following important factors:

- Business continuity
- Lead position in the industry
- Satisfying the needs of its clients and other stakeholders
- Increased Profitability
- Balanced Risk Profile

6.1.5 Strategy

CB&I Lummus’ strategy is described as (Company management Manual, 2007):

- Building on Strengths (market): Regions, Products and Key Accounts
- Innovative Development: New Markets, New Opportunities and Sustainable Business
- Improve and Perform on “Operational Excellence”: Multi Office Project Execution (MOPEX), Critical Chain and Resource Planning (CCRP) and Work Process Improvement

To support the strategies above, the following supplementing strategies haven been formulated:

- Employee Development: programs that are aligned to and will support the strategic objectives.
- Internal Communications: processes that inform and enable employees to align with the objectives

Based on the above, the author has broken down the strategy into the following important factors:

<table>
<thead>
<tr>
<th>Building on Strengths</th>
<th>Innovative Development</th>
<th>Employee Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Process Improvement</td>
<td>Internal Communications</td>
<td>Perform on “Operational Excellence”</td>
</tr>
<tr>
<td>Focus on key regions, products and accounts</td>
<td>Improve on “Operational Excellence”</td>
<td>Multi Office Project Execution (MOPEX)</td>
</tr>
<tr>
<td>Exploring new markets, new Opportunities and sustainable business</td>
<td>Inform and enable employees to align with the objectives</td>
<td>Critical Chain and Resource Planning (CCRP)</td>
</tr>
</tbody>
</table>

Additionally to the strategic plan, the ‘All Employee Meetings’ have been used as a source. This is an important communication tool of Company Management, which is held twice a year. These meetings inform employees about recent developments, strategic choices, give feedback on project progress, the financial status, etc. As in the previous sections this information source has been reviewed and the important factors will be consolidated.

6.2 Source 2: Interviews

The information retrieved from the interviews is from the first hand and therefore very useful. On the other hand, the information can also be somewhat subjective. This subjectivity needs to be filtered out and that will result in the important factors without any kind of indication whether the organization is doing well or not with regard to that particular factor. This chapter will not further discuss the interviews in detail,
because this is not the aim of this exercise. The filtered factors will be given in section 6.4, where they will be reviewed and consolidated together with the factors retrieved from other sources. The next section will discuss one of the other sources, namely an internal report which had the purpose to identify the key reasons why employees stay with Lummus.

A lot of the factors retrieved from the strategic plan and the All Employee Meetings have also emerged from the interviews. This should not be a complete surprise, because the interview is designed on strategic level, which therefore leads to factors also mentioned in the strategic plan. And the interviews indicate what the respondents value; these factors are also partly covered in the All Employee Meetings. But an important conclusion is that the strategic plan is in one way or another translated into parts of the organization. This should make it easier to implement performance measurement in the organization, on the basis of the Strategy Map.

### 6.3 Source 3: Perception of Employees

In section 5.1.2.1 has been concluded that Human assets should be emphasized. After all the employees are, especially in this line of business, the most valuable assets. To retrieve the factors that the employees value most, reference can be made to an internal report by Hooft et al. (2007). They have done research to identify the key reasons why employees stay with the company. To retrieve this information they posed a questionnaire to employees, which asked for reasons why employees joined Lummus, why employees stay with Lummus and what the reasons are to reapply with Lummus.

![Lummus: Factors to Join, Stay and Reapply](image)

**Figure 6-2 Factors to join, stay and reapply (based on Hooft et al., 2007)**

Figure 6-2 shows the factors that are considered by employees to be the most interesting that commits them to Lummus. Out of all these factors, 2 are the most leading in this analysis:

1. **Work Content**: technical content related to specific function, this means something different for an engineer, a buyer or a project manager.
2. **Development**: available room for development in desired direction.

These factors are also most leading when the results are plotted as totals in a pie chart, see Figure 6-3, with almost 50% of all factors. Also, this figure shows 4 significant factors for employees that are almost equally important factors\(^\text{17}\) with more than 20% of all factors:

1. **Work Atmosphere**: general atmosphere in the office.

\(^{17}\) Factors of importance less than 3% have been summed up in the category ‘Other’. These are not considered to be key factors for CB&I Lummus as total.
2. Easy Commute: commuting time.
3. Colleagues: colleagues as people.
4. Reputation: reliability and professionalism towards employees and Lummus known as household name in field relevant for employee.

![Key Factors of Lummus Perceived by Employees](image)

Figure 6-3  Key factors of Lummus perceived by employees (based on Hooft et al., 2007)

The information from the sections above has been retrieved directly from surveys amongst the employees of CB&I Lummus. From a theoretical point of view, Walton (1973) defines 8 primary dimensions valued by employees, see Figure 6-4. These 8 factors will be taken into account when defining the potential CSF’s (but will not have a leading role), together with the 6 factors retrieved by Hooft et al. (2007).

![Primary dimensions valued by employees](image)

Figure 6-4  Primary dimensions valued by employees (source: Walton, 1973)

6.4 Potential CSF’s

There are many factors that seem to be important for the EPC Contracting industry, not only from a theoretical point of view, but especially from an empirical point of view. Not all of these factors are equally important and critical enough to be identified as a CSF. However, in a process of consolidating and filtering
of the factors, potential CSF’s can be identified, see Table 6-1 below. The potential CSF’s are already classified according to the perspectives of the Strategy map and are also provided with a certain level towards improvement (as CSF’s should be defined, conform the secondary focus of CSF’s in section 5.1.2.2). One of the criteria of working with performance measurement frameworks is that it should not measure too little data, as well as not too much data. Therefore, additional information is required to make a decision on the identification of the final, most critical CSF’s. The tool to retrieve this information is a survey, of which will the results will be discussed in the next chapter.
<table>
<thead>
<tr>
<th>FINANCIAL</th>
<th>CUSTOMER</th>
<th>INTERNAL BUSINESS PROCESS</th>
<th>LEARNING &amp; GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve Shareholder Value</td>
<td>Meeting Project Preconditions</td>
<td>Balance between Key and New Expertise of Technologies</td>
<td>Improve Employee Satisfaction</td>
</tr>
<tr>
<td>Assurance of Business Continuity</td>
<td>Focus on determined Regions</td>
<td>Improve Multi Office Project Execution</td>
<td>Capture Lessons Learned</td>
</tr>
<tr>
<td>Sustainable Revenue Growth</td>
<td>Focus on determined Products/ Technologies</td>
<td>Increase Project Types in line with Strategic Focus</td>
<td>Employee Development</td>
</tr>
<tr>
<td>Profitability</td>
<td>Increase application of In-house Technology Licenses</td>
<td>Increase In-house Knowledge/ Competence Availability</td>
<td>Alignment of IT Systems/ Applications</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>Improve Relationship with Client</td>
<td>Improve Material Supplier (Work) Processes</td>
<td>Improve Employee Performance</td>
</tr>
<tr>
<td>Increase (paid) Workload to Jobs</td>
<td>Reliability and Integrity as EPC contractor</td>
<td>Meeting Requirements of Project Execution Plans</td>
<td>Effective Teamwork</td>
</tr>
<tr>
<td>Increase Workload to DEC’s</td>
<td>One-Stop-Shop EPC Contractor</td>
<td>Sufficient Backlog</td>
<td>Improve Technical Work Content</td>
</tr>
<tr>
<td>Minimize Overhead Cost</td>
<td>Innovativeness and Value Adding Ability</td>
<td>Anticipate on Changes in the Economic Climate</td>
<td>Stimulate Work Atmosphere</td>
</tr>
<tr>
<td>Balanced Project Portfolio (Scope, Size, Contract)</td>
<td>Improve Quality of the total EPC Process</td>
<td>Project Efficiency and Effectiveness</td>
<td>Improve Knowledge Capturement, Transfer &amp; Availability</td>
</tr>
<tr>
<td>Expand Client Base</td>
<td>Optimize Communication with Client</td>
<td>Optimize Project Risk Balance</td>
<td>Effective usage of IT-tools</td>
</tr>
<tr>
<td>Significant Market Share in the Industry</td>
<td>Improve Ability to handle Client Specific Requirements</td>
<td>Maximize Scope Capturement during Bidding Phase</td>
<td>Improve Information Capturement, Integrity &amp; Flow</td>
</tr>
<tr>
<td>More long term Agreements with Existing Clients</td>
<td>Balanced Client Type Portfolio</td>
<td>Scope Management during Project Execution</td>
<td>Increase Commitment of People to the Organization</td>
</tr>
<tr>
<td>Focus on Key Clients</td>
<td></td>
<td>Increase Flexibility</td>
<td>Secure Employee Well Being</td>
</tr>
<tr>
<td>Management of Client Knowledge</td>
<td>Selective Project Acceptance/ Bidding</td>
<td>Alignment of Work Processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Create Ownership of Total Project Objectives</td>
<td>Improve Relationship with DEC’s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improve Quality Basic Engineering Package</td>
<td>Available Cash Amount</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sufficient Capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Effective Communicating IT Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subcontract Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improve Sales Efforts</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Focus on Key Suppliers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-1 Potential Critical Success Factors (source: identified by the author, based on this chapter)
In the previous chapter the potential CSF’s in the EPC Contracting Industry have been determined. But which of these factors are the most critical ones? And how can they be measured? The first section of this chapter elaborates on the tool used for determination of the final CSF’s; these final CSF’s are discussed in the second section. So, which KPI’s can be allocated to the final CSF’s? How to do this? The last section will discuss this.

7.1 Decision Chart

As indicated in section 1.6.2, respondents have given scores to the potential CSF’s by means of forms. The results of these scores are represented in a bubble chart, see Figure 7-1. The bubble chart is a tool to visualize these results; the actual decision making is based on the scores of the potential CSF’s.

7.1.1 X-, Y-axis and Bubble Size

In section 5.1.2 has been determined that CSF’s should primarily comply with the following criteria:
1. Both observable and measurable in certain respects such that it would be easier to focus on these factors; this criteria will be represented by the Y-axis.
2. Actuality, i.e. having the largest impact on an organization’s performance (the criticality of success factors); this criteria will be represented by the X-axis.

Furthermore, according to section 5.1.2, the secondary focus should be on the following criteria:
a. Essential for the organization to accomplish its mission.
b. Essential for the achievement of the set organizational objectives.
c. Be the bases of which an organization can distinguish itself from the competition.
d. Enabling a sustainable, positive relation with the market.
e. Not only aimed at organizational bottlenecks.
f. Focused on the future by formulating in results terms (improvement): this is not really a focus of CSF’s, but more a formulation rule which has been taken into account in the previous chapter.
These 6 criteria have not been posed to the respondents, but are considered to be the theoretical criteria which CSF’s should meet. The assessment whether the CSF’s meet these criteria is also plotted in the bubble chart where they set the size of the bubble. However, seen the practical character of this exercise, this assessment is informational and will have no significant consequences on the CSF determination.

The bubble chart is divided in five sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Y-axis Measurability</th>
<th>X-axis Business Criticality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ‘Most Critical’</td>
<td>Very high</td>
<td>Very high</td>
</tr>
<tr>
<td>2. ‘Critical’</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>3. ‘Upgrade’</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>4. ‘To Consider’</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>5. ‘Forget It’</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

1. ‘Most Critical’: very easy to observe and measure and also having massive impact on performance; these factors should in any case be identified as CSF.
2. ‘Critical’: easy to observe and measure and also having large impact on performance; these factors should be identified as CSF.
3. ‘Upgrade’: not easy to observe and measure, but having large impact on performance; because these are critical to business they can be pointed as CSF’s in case of deficiency, but there should be a work around to make them easy to observe and measure.
4. ‘To Consider’: easy to observe and measure, but not having that large of impact on performance; can be considered as CSF to monitor these factors (or in case of deficiency).
5. ‘Forget It’: not easy to observe and measure an also not having large impact on performance; these factors should be excluded as CSF.

If perspectives of the Strategy Map are not represented at all by CSF’s, an option could be to select ‘Upgrade’ factors if there is a work around available to make them easy to observe and measure. Another option could be to select ‘To Consider’ factors.

### 7.1.2 Results

The Decision Chart shows that the majority of the factors are as good as concentrated in the middle of the business criticality axis, with some exceptions which have high scores on business criticality. The explanation for this is that the factors used in this analysis are all already considered important in this Industry. With regard to the measurability axis, the factors are distributed almost throughout the whole axis.

The results can be analyzed from 2 point of views: (1) from the 4 perspectives of the Strategy Map and (2) from the 5 sections of the decision chart. There are in total 63 factors distributed over the 4 perspectives of the Strategy Map. Based on the scores, these 63 factors have been allocated to one of the 5 sections. For every perspective, Table 7-1 gives the number of factors that is allocated to a section.

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Most Critical</th>
<th>Critical</th>
<th>Upgrade</th>
<th>To Consider</th>
<th>Forget It</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial</td>
<td>3</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Customer</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Intern. Buss. Pro.</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Learn. &amp; Growth</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>20</td>
<td>14</td>
<td>7</td>
<td>17</td>
<td>63</td>
</tr>
</tbody>
</table>

Table 7-1 Number of factors per perspective, per section

#### 7.1.2.1 Point of view 1: Strategy Map’s perspectives

The Financial perspective contains mostly ‘Critical’ factors, followed by ‘Most Critical’ factors secondly. From this can be concluded that in this Industry the financial perspective is very important. The Customer perspective contains mostly ‘Critical’ and ‘Upgrade’ factors. Overall, this perspective can be considered to be important, but not always that easy to measure. The Internal Business Process perspective contains
mostly ‘Forget It’ and ‘Critical’ factors. The factors of this perspective are either easy to measure and business critical, or not easy to measure and not business critical. The Learning & Growth perspective contains mostly ‘Forget It’ factors, followed by ‘Upgrade’ factors secondly. Apparently, this perspective is not believed in and if factors are somewhat critical, they are perceived not easy to measure.

The analysis from the Strategy Map’s point of view shows that the perspectives are not equally valued by the respondents. The perspectives can be ordered according to the following importance:

**Financial > Internal Business Process > Customer > Learning & Growth**

Kaplan & Norton argue that the perspectives of the Strategy Map should be in balance. However, this balance is not as important as the fact that the Strategy Map should represent a balance between the needs and requirements vital to the success of the company. These needs and requirements are represented by the CSF’s and as concluded above, there seems to be an order of importance between the perspectives. Basically, the perspectives are only used to sort the CSF’s and to make sure you do not leave out any important ones. So, it is not a requirement of the Strategy Map that all perspectives contain the same number of CSF’s, as long as important ones are not left out (a fair balance will be desirable).

### 7.1.2.2 Point of view 2: Decision Chart’s sections

The ‘Most Critical’ section contains mostly factors from the financial perspective. This emphasizes the importance of these factors. The ‘Critical’ section also contains mostly financial factors, but also equally divided customer and internal business process factors. So, this section is almost equal to these 3 perspectives and the learning & growth factors can be neglected to be critical. The ‘Upgrade’ section contains mostly learning & growth factors, but also equally divided customer and internal business process factors. So, this section is almost equal to these 3 perspectives and the financial perspective can be neglected and does not need to be upgraded. The ‘To Consider’ section contains an almost equally distributed numbers of financial factors, customer and internal business process factors. So, for this section the learning & growth perspective can be neglected and will not be considered. The ‘Forget It’ section contains mostly internal business process perspective and learning & growth factors. So, for this section, these factors need to be eliminated.

The analysis from the Decision Chart’s point of view shows that in general:

- ‘Most Critical’ perspective is the financial one,
- ‘Critical’ perspectives are all perspectives, except the learning & growth one,
- To be ‘Upgraded’ perspectives are all perspectives, except the financial one,
- ‘To Consider’ perspectives are all perspectives, except the learning & growth one,
- ‘Forget It’ perspectives are the internal business process and learning & growth factors perspectives.

This analysis has no other results than already concluded from the point of view of the Strategy Map’s perspectives: it only confirms the relatively high importance of the financial perspective and the relatively low importance of the learning & growth perspective.

### 7.2 The final CSF’s

In section 7.1.2.1 (and 7.1.2.2) has been concluded that it is not a requirement of the Strategy Map that all perspectives contain the same number of CSF’s, as long as important ones are not left out (a fair balance will be desirable). Therefore, not the perspectives of the Strategy Map should be the starting point in the CSF selection process, but the sufficient representation of the company’s needs and requirements. Consequently, the ‘Most Critical’ and ‘Critical’ factors from the organization’s point of view are identified as CSF’s, which gives a total of number of 25. An additional analysis on the scores of the ‘Upgrade’ and ‘To Consider’ factors has shown that there are 2 factors which have relative large deviations in the scores, both on the measurability axis. The scores vary from ‘very difficult to implement’ to ‘very easy to implement’, the extremes of this axis. Apparently, there are respondents who experience these 2 factors to be very easy to implement: these 2 factors will also be identified as CSF’s. This results in 11 financial CSF’s, 5 customer CSF’s, 8 internal business process CSF’s and 3 learning & growth CSF’s.
The next step is the identification of KPI’s for these final CSF’s. The first part of this process was:

1. For every CSF has been determined which KPI(‘s) is/ are most representative, based on the extensive analysis of the company and the Industry in general;
2. Information derived form the literature and empirical surveys: all existing and potential KPI’s (specific to the Industry) haven been listed.

After this step, the KPI’s have been sorted out to match the CSF’s. For this purpose the 4 views have been used as discussed in section 4.2. In this part of the process, the KPI’s are also checked against the criteria for ‘good’ KPI’s according to section 4.3. This part of the process is discussed in the next section.

### 7.3 The final KPI’s

The assumption is that except for the fair balance between the perspectives of the Strategy Map, the KPI’s should also be fairly balanced (an appropriate mix) against the way they are approached in organizations. In Table 7-2 below a brief summary is given of the identified views:

<table>
<thead>
<tr>
<th>View</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implication</td>
<td>- Lagging: KPI’s give feedback on past performance, they show that the change has happened</td>
</tr>
<tr>
<td></td>
<td>- Leading: KPI's are designed to measure future performance, they reflect upcoming change</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>- Responsive: individuals can directly influence these KPI’s internally</td>
</tr>
<tr>
<td></td>
<td>- Non-responsive KPI’s are external, outside the direct influence or control of an individual</td>
</tr>
<tr>
<td>Nature</td>
<td>- Tangible: hard/ objective KPI’s</td>
</tr>
<tr>
<td></td>
<td>- Intangible: soft/ subjective KPI’s</td>
</tr>
<tr>
<td>Location</td>
<td>- Input (means): resources consumed, what is needed to start business</td>
</tr>
<tr>
<td></td>
<td>- People: people are expected to be the main input in the primary processes of CB&amp;I Lummus.</td>
</tr>
<tr>
<td></td>
<td>- Process (activities): the intermediate steps in producing a product or service</td>
</tr>
<tr>
<td></td>
<td>- Output (performance): the product or service provided by the organization and delivered to customers</td>
</tr>
<tr>
<td></td>
<td>The other categories are already represented by the perspectives of the Strategy Map.</td>
</tr>
<tr>
<td></td>
<td>a service or organization have an intended effect</td>
</tr>
</tbody>
</table>

Table 7-2 Views on KPI’s on organizations

Every view has different categories and the boundaries between these categories are not always easy to determine. Consequently, the classification according to these categories might be arbitrary. Important, however, is to acknowledge/ recognize that there are different categories and that they are represented with at least one KPI. This resulted in the final KPI’s for the EPC Contracting Industry, see Table 7-3, where the final CSF’s and KPI’s are not only given according to the way they are approached in organizations, but also according to the perspectives of the Strategy Map.
<table>
<thead>
<tr>
<th>CSF</th>
<th>KPI</th>
<th>Implication</th>
<th>Responsive</th>
<th>Nature</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sustainable Revenue Growth</td>
<td>1 Revenue</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>2 Profitability</td>
<td>2 Earnings Before Interest and Tax</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>3 Assurance of Business Continuity</td>
<td>3 Future Net Cash Flow</td>
<td>Leading</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>4 Expand Client Base</td>
<td>4 New Clients</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>5 Focus on Key Clients</td>
<td>5 Key Clients</td>
<td>Leading</td>
<td>N</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>6 Balanced Project Portfolio</td>
<td>6 Project Type</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>7 Minimize Overhead Cost</td>
<td>7 Overhead</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>8 Increase (paid) Workload to Jobs</td>
<td>8 Paid Manhours</td>
<td>Lagging</td>
<td>Y</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>9 Increase Workload to DEC's</td>
<td>9 DEC Workload</td>
<td>Lagging</td>
<td>Y</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>1 Focus on determined Products/ Technologies</td>
<td>1 Products/ Technologies</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>2 Improve Relationship with Client</td>
<td>2 Repeat Business</td>
<td>Leading</td>
<td>N</td>
<td>Tangible</td>
<td>Outcome</td>
</tr>
<tr>
<td>3 Balanced Client Type Portfolio</td>
<td>3 Client Type</td>
<td>Lagging</td>
<td>N</td>
<td>Intangible</td>
<td>Outcome</td>
</tr>
<tr>
<td>4 Meeting Project Preconditions</td>
<td>4 Projects Finished on Time</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>5 Projects Finished within Budget</td>
<td>5 Quality of Projects</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>1 Improve Sales Efforts</td>
<td>1 Successful Bids - Value</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>2 Successful Bids - Number</td>
<td>2 Successful Bids - Number</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>3 Successful Prospects</td>
<td>3 Successful Prospects</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>4 Sufficient Capacity</td>
<td>4 Manpower</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>People</td>
</tr>
<tr>
<td>5 Sufficient Backlog</td>
<td>5 Backlog</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>6 Focus on Key Suppliers</td>
<td>6 Key Suppliers</td>
<td>Lagging</td>
<td>Y</td>
<td>Tangible</td>
<td>Process</td>
</tr>
<tr>
<td>5 Project Efficiency</td>
<td>7 Manhour Efficiency</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>Process</td>
</tr>
<tr>
<td>8 Earned Value</td>
<td>8 Earned Value</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>Process</td>
</tr>
<tr>
<td>6 Project Effectiveness</td>
<td>9 Profitable Projects</td>
<td>Leading</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>7 Improve MOPEX</td>
<td>10 Coordination Manhours</td>
<td>Lagging</td>
<td>Y</td>
<td>Tangible</td>
<td>Process</td>
</tr>
<tr>
<td>8 Subcontract Management</td>
<td>11 Subcontractor Claims - Number</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>9 Scope Management</td>
<td>12 Subcontractor Claims - Value</td>
<td>Lagging</td>
<td>Y</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>13 Change Orders Approved - Value</td>
<td>13 Change Orders Approved - Value</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Process</td>
</tr>
<tr>
<td>14 Change Orders Approved - Number</td>
<td>14 Change Orders Approved - Number</td>
<td>Leading</td>
<td>N</td>
<td>Tangible</td>
<td>Process</td>
</tr>
<tr>
<td>15 Approved Contract Value Change</td>
<td>15 Approved Contract Value Change</td>
<td>Lagging</td>
<td>N</td>
<td>Tangible</td>
<td>Output</td>
</tr>
<tr>
<td>1 Available Cash Amount</td>
<td>1 Free Cash Flow</td>
<td>Leading</td>
<td>N</td>
<td>Tangible</td>
<td>Input</td>
</tr>
<tr>
<td>2 Employee Satisfaction</td>
<td>2 Employee Satisfaction Index</td>
<td>Leading</td>
<td>N</td>
<td>Intangible</td>
<td>People</td>
</tr>
<tr>
<td>3 Capture Lessons Learned</td>
<td>3 Followed Suggestions</td>
<td>Leading</td>
<td>Y</td>
<td>Tangible</td>
<td>Process</td>
</tr>
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</table>

Table 7-3 Final Critical Success Factors and allocated Key Performance Indicators (source: author)
Table 7-3 shows that the Learning & Growth perspective contains only Leading KPI’s. This is in line with the expectations because the Learning & Growth perspective is the most future oriented perspective compared to the other perspectives. Table 7-3 also shows that the Customer Perspective contains only Non-responsive KPI’s. This is also in line with the expectations because the Customer perspective is the most externally oriented perspective compared to the other perspectives.

In the process of allocating KPI’s to the CSF’s, it has emerged that it is necessary to reconsider an earlier drawn conclusion.

Based on theory, the approach in this research was to design KPI’s which are directly related to the organization’s strategy. But, based on the Critical Success Factors for the EPC Contracting Industry, this approach needs to be redefined into: the design of KPI’s which are directly related to the organization’s strategy and which directly contribute to the organization’s strategic objectives.

Therefore, the KPI’s are identified as applicable at company and/ or project level. In some cases the company indicator is the average (weighted) value of project KPI’s. For the indicators, estimated, predicted or actual data can be used depending on the stage of progress on the project (or expected project).

**The financial perspective**
The financial perspective contains 11 CSF’s. However, this number has been reduced to 9:
- The allocated KPI for ‘Improve Shareholder Value’ is Share Price. This is an important KPI on the level of CB&I total, but not on the level of CB&I Lummus. CB&I Lummus’ contribution to the Share Price is the revenue and profit, which are separate CSF’s in this perspective.
- The allocated KPI for ‘Competitiveness’ is ‘Successful Bids’. This KPI is also allocated to a CSF of the Internal Business Process.

To every other CSF, 1 KPI has been allocated, which is expected to be representative enough: 9 KPI’s for this perspective.

**The customer perspective**
The customer perspective contains 5 CSF’s. However, this number has been reduced to 4:
- The allocated KPI for ‘One-Stop-Shop- EPC Contractor’ is Repeat Business. This KPI is also allocated to another CSF in this perspective, ‘Improve Relationship with client’.

To the first 3 CSF’s, 1 KPI has been allocated, which is expected to be representative enough. In order to cover the CSF ‘Meeting Project Preconditions’, 3 KPI’s have been allocated. Result is a total number of 6 KPI’s.

**The Internal Business Process perspective**
The customer perspective contains 8 CSF’s. However, this number has been increased to 9:
- ‘Project Efficiency and Effectiveness’ has separated in 2 CSF’s, ‘Project Efficiency’ and ‘Project Effectiveness’. On KPI level these factors are considered as different categories.

To the CSF’s ‘Improve Sales Efforts’, ‘Project Efficiency’, ‘Subcontract Management’ and ‘Scope Management’, respectively 3, 2, 2 and 3 KPI’s have been allocated in order to be representative enough. With regard to the other CSF’s, 1 KPI has been allocated, which should cover these CSF’s. Result is a total number of 15 KPI’s.

**The Learning & Growth perspective**
The learning & growth perspective contains 3 CSF’s; to all of these 1 KPI has been allocated. Result is a total number of 3 KPI’s.

An elaboration of each KPI according to the Performance Measure Record Sheet (PMRS) is given in Appendix G.

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 anomaly: The PMRS facilitates and can function as a practical guide for the design of KPI’s, see section 4.4.
The PMRS consists of ten elements, of which 2 has been left blank:
1. ‘What do they do’ (the management process to be followed): this aspect will be discussed in chapter 8 (Figure 8-3).
2. ‘Who measures’: for all KPI’s applies that the measurement is the task of the Project Controls department.

Furthermore, an additional element has been included: the ‘KPI Level’. This element has been included to indicate whether the data necessary for calculation of the KPI emerges from the Line or the Project organization. For the Project organization it is also indicated whether the formula requires an aggregation of data (several projects) or not.

7.4 Conclusions

Historically, the emphasis was on financial factors when measuring organizational performance. The conducted literature study has indicated that except for these factors, customer, internal business process and learning & growth factors are also necessary. The Strategy Map argues for a balance between these factors; however, it does not prescribe the number of CSF’s that each perspective should contain (or what the balance is between the perspectives in a quantified ratio). It is therefore plausible to state that the CSF’s of an organization should be balanced ‘fairly’ as long as the needs and requirements vital to the success of the company are taken into account. These needs and requirements are represented by the ‘Critical’ and ‘Most Critical’ CSF’s (CSF is an abbreviation for Critical Success Factor, but this distinction was necessary because some were very critical compared to the others). Additionally, 2 CSF’s have been assumed to be critical enough: these 2 CSF’s are both experienced as business critical by the respondents, but the respondents have very diverged perceptions of the measurability. Apparently, some experience these CSF’s as measurable. The determination of KPI’s for the final CSF’s was a process of collecting KPI’s for the CSF’s, filtering the KPI’s against the criteria for ‘good’ KPI’s and finally selecting them based on the 4 ways KPI’s can be approached in organizations. Also, in the process of considering KPI’s for the CSF’s, some CSF’s have been deleted or separated. To some CSF’s 1 KPI has been allocated, as for others more than 1 KPI has been allocated. The final result is a performance dashboard which contains: 9 financial KPI’s, 6 customer KPI’s, 15 internal business process KPI’s and 3 learning & growth KPI’s.

So far, KPI’s on strategic level have been discussed; the operational and diagnostic levels are discussed in the next chapter. These levels are necessary if a company wants to use the performance dashboard for management purposes; however it is crucial that performance measurement on strategic level is first in place. Also, other aspects of actually using the dashboard for management purposes will be discussed in the next chapter.
“What to do with the KPI’s?” To answer this question it is firstly necessary to analyze how the KPI’s can be used to improve performance. As mentioned earlier in the conclusions of chapter 3, the following requirements of performance measurement would be discussed in this chapter:

1. Performance measurement must aid the decision-making process (provability, explainability, believability, communicability).
2. Measurement information needs to be acted upon within the time frame needed for market survival (latency: propagation and response).
3. Performance measurement needs to operate self-reflexively and largely below the threshold of the firm’s awareness (adaptability, measurability, autonomic).

(1) How to enable performance measurement to aid the decision-making process? The Strategy Map provides partly an answer, namely by establishing and validating cause-and-effect relationships between the KPI’s. A complete answer to this question can be given by analyzing the current KPI issues at CB&I Lummus: there are no consequences following from not meeting KPI targets. Why is that? A quick scan provides a straightforward explanation: the KPI’s are not assigned to individuals. This is more a cultural issue and the question should be: how can we make (a) persons accountable for (a certain) KPI’s?

(2) How to act upon the results of the KPI’s within the time frame needed for market survival and (3) how make sure that performance measurement operates self-reflexively and largely below the threshold of the firm’s awareness. This chapter provides an answer by the design of an ongoing process for performance measurement and improvement.

Secondly, in order to answer the question ‘what to do with the KPI’s?’, a more practical approach is necessary. This thesis provides CB&I Lummus with KPI’s and also indicates how these KPI’s can be used to improve performance. However, a gap between these design attributes and actually using these attributes remains, namely an implementation plan.

Based on the introduction above, the first section of this chapter will discuss the cause-and-effect relationships, followed by the second section with discussions of how to create accountability for KPI’s. The third section elaborates on the ongoing character of performance measurement and the fourth section gives a detailed implementation plan.

Up till now performance measurement has been promoted as a tool that can not be neglected by companies. Performance measurement is indeed a powerful tool, but is it safe to grant ‘carte blanche’ to this tool? The last section will therefore discuss reservations on the use of KPI’s for management purposes.

8.1 Establishment and validation of cause-and-effect relationships

By defining cause-and-effect relationships it is expected that the KPI’s are not only used for monitoring purposes, but actually enhances decision making. However, cause-and-effect linkages of outcomes are not easily established. The outcomes can, and often do, reveal the impact of a program, but without collaborating data, it is difficult to demonstrate that a certain program was the cause of the outcome(s). To determine the extent to which a program has affected the outcomes and to measure the impact, an in-depth analysis is needed (Artley and Stroh, 2001).

Eccles and Pyburn (1992) state that for successful performance measurement it is imperative to develop a comprehensive model that (1) establishes and (2) validates causal relationships. A technique to establish relationships between KPI’s is System Dynamics (SD). Wolstenholme (1990) defines System Dynamics as an organized collection of parts (or subsystems) that are highly integrated to accomplish an overall goal (McNamara, 2005).

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19 The point at which something begins to take effect or be noticeable (source: www.thefreedictionary.com).
20 A “program” may be any activity, project, function, or policy that has an identifiable purpose or set of objectives.
21 An organized collection of parts (or subsystems) that are highly integrated to accomplish an overall goal (McNamara, 2005).
information, organizational boundaries and strategies, which facilitates quantitative simulation modeling and analysis for the design of system structure and control (in Pruyt et al, 2008). The SD-models can be developed and used to represent, analyze, and explain the dynamics of a complex system (read: organization). In an organizational environment it should be kept in mind that the structure of the system not only contains physical aspects, but also the policies and traditions important to the decision-making process in that system.

The dynamics or behavior of a system is defined by the structure and interactions of its components. So, SD-modeling helps to perceive and understand how different factors are interrelated, instead of viewing each in isolation. However, it does not provide explicit evaluation of these interactions and alternate path of actions to the decision makers (Santos et al., 2002). To overcome this, the earlier mentioned classification in section 5.3 can be used:

- **Level 1: Headline Indicators;** provide a measure of the overall, rude state of health of a firm.
- **Level 2: Operational Indicators;** bear on specific aspects of a firm’s activities and should enable management to identify and focus on specific areas for improvement.
- **Level 3: Diagnostic Indicators;** provide information on why certain changes may have occurred in the headline or operational indicators and are useful in analyzing areas for improvement in more detail.

The assumption of this classification is that when working with performance measurement, the big picture should be bared in mind first and then the focus can be concentrated on the pieces that fit into that picture.

The classification can be used to test and validate the hypothetical cause-and-effect relationship, but these relationships need to be developed based on theory or knowledge. Before testing the relationship itself, the directionality of the relationship needs to be understood.

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**Headline, Operational and Diagnostic indicators can be used to test and validate the hypothetical cause-and-effect relationships, which have been developed by using the System Dynamics modeling technique.**
Figure 8-1  Strategy Map/ Cause-and-effect relationship diagram for EPC Contractors

NOTE 1
The KPI’s and CSF’s (and their relationships) presented in this diagram have been determined in this study (and for its objectives) and are not representative for the complete business model of EPC Contractors

NOTE 2
For KPI’s which represent 1 CSF, only this CSF is given in the model in order to simplify this model (in stead of the KPI’s). These CSF are:
1. CSF: Meeting Project Preconditions represents KPI’s Projects Finished on Time, Projects Finished within Budget and Quality of Projects
2. CSF: Improve Sales Efforts represents KPI’s Successful Bids—Value, Successful Bids—Number and Successful Prospects,
3. CSF: Project Efficiency represents KPI’s: Manhour Efficiency and Earned Value,
4. CSF: Subcontract Management represents KPI’s: Subcontractor Claims—Number and Subcontractor Claims—Value
5. CSF: Scope Management represents KPI’s: Change Order Approved—Value, Change Order Approved—Number and Approved Contract Value Change
So, the first step towards establishing the causal relationship is development of a SD-model that captures the hypothesized causal relationships between KPI’s. Based on the extensive analysis of the EPC Contracting Industry in general (and CB&I Lummus specifically), the information derived from literature studies (for example the basic Strategy Map as given by Kaplan and Norton) and the in-house surveys, the relations between the KPI’s are given in Figure 8-1. This figure explains the allocated KPI’s affecting the EPC Contracting organization (the different colors indicate the perspectives of the Strategy map). It captures interactions and directionality between various KPI’s that affect the organization. Also, it captures the dynamic between various activities and outcomes (causal/ feedback loops). A positive (reinforcing) loop generates exponential growth or decay and a negative (stabilizing) loop corresponds to a goal seeking behavior (Forrester (1968) in Tu et al, 1997). Consider, for example, causal loop 1 in Figure 8-1 (red arrows).This loop captures the reinforcing dynamic between project efficiency and employee satisfaction. That is, an increase in employee satisfaction is achieved via free cash flow (free cash flow in this case implicitly assumes more investment opportunities in training employees). An increase in employee satisfaction, in turn, improves project efficiency, which positively impacts meeting project conditions. Meeting project preconditions improves repeat business, which leads to increased revenue and consequently better earnings; and eventually increasing free cash flow (implicitly leading to more budgetary allowance for training). Similarly, loop 2 represents the impact of future net cash flow on employee satisfaction. Thus the SD-model enables the understanding of hypothetical indirect and direct KPI’s affecting the organizational performance.

"Employee Satisfaction Index" has a central role in both loop 1 and 2. From this can be concluded that the satisfaction level of employees is critical for the EPC Contracting business. This complies with earlier statements in this study (see for example section 5.1.2.1).

The relationships have been determined on the basis of theoretical and practical knowledge. However, these relationships are not final, but potential. Therefore, the relationships are subject to be tested thoroughly in additional research, for example using the Delphi method. This method will enlarge the reliability of and, if necessary change, the interactions between the KPI’s by collecting and distilling knowledge from a group of experts within the EPC Contracting Industry. Additionally, it will facilitate the formation of a common group understanding and increase the basis of support.

Developing the cause-and-effect relationship between KPI’s and understanding their behavior based on these interactions is necessary but not sufficient for decision makers. It is required for them to validate these relationships and better understand the precise impact of each performance outcome on interdependent performances. To better explain the relationships and variance in performances due to interactions, the second step is classification of the KPI’s into the levels headline, operational and diagnostic. The identified KPI’s are directly related to the organization’s strategy and/ or directly contribute to the organization’s strategic objectives. Therefore, the identified KPI are not all headline indicators, but some of them are also operational and diagnostic KPI’s.
For example (see Figure 8-2), the headline KPI ‘Earnings Before Interest and Tax’ is related to ‘Repeat Business’ which is a diagnostic KPI. To understand why certain changes may have occurred in the KPI ‘Earnings Before Interest and Tax’, additional diagnostic KPI’s can be identified. And to analyze areas for improvement in more detail, operational KPI’s can be identified. Furthermore, Figure 8-2 shows the headline KPI ‘Employee Satisfaction’, but in this research no operational or diagnostic KPI has been identified for ‘Employee Satisfaction’. As an example, the KPI ‘Career Development’ is given as operational KPI, but additional operational KPI’s can be identified. Also, diagnostic KPI’s can be identified for ‘Employee Satisfaction’. The last headline KPI in Figure 8-2 is ‘Projects Finished on Time’. For this KPI also operational and diagnostic KPI’s are proposed, but as with the other headline KPI’s, additional KPI’s can be identified.

If it is not easy to classify the KPI’s in headline, operational and diagnostic KPI’s, a tool is then (when comparing 2 KPI’s of different levels) to identify which one is the measured KPI and which one is the latent KPI. A measured KPI is one that can be observed directly and is measurable (also known as observed KPI). A latent KPI can not be observed directly and must be inferred from measured variables (also known as unobserved KPI’s).

In order to understand why certain changes may have occurred in KPI’s and to analyze areas for improvement in more detail, it is necessary to identify operational and diagnostic KPI’s for all headline KPI’s. The identified operational and diagnostic KPI’s have to represent the related headline KPI sufficiently. There are three questions that should be kept in mind: (1) How well do the KPI’s reflect the latent one? (2) Are some measurable KPI’s better than others? And (3) How reliable is each measured KPI? Once a set of measurable KPI’s has been derived that work well, the attention can be turned to the system as a whole to see how well it fits the data. Are there some latent KPI’s that don’t have significant paths to others or (even worse) have significant paths but with the wrong way?

In this section, SD-modeling has been used to describe the causal relationships between KPI’s. Another important function of SD-modeling is the power of simulation. From this point of view, simulating what will happen to different KPI’s over time is a means of encouraging discussion and consensus on central basic assumptions. What effect should be assumed that an action/ initiative/ program will have on certain KPI’s, and in what time frame? For example, what will happen if we increase the ‘Followed Suggestions’ or if we increase ‘New Clients’? Through the use of qualitative and quantitative attributes, a SD-model helps to understand the change in behavior of the KPI’s of a system due to change in policies or reconfiguration of other parts of the system. The SD-model provides understanding of the change in behavior of the various system KPI’s due to the explicitly defined interactions.
By simulating the KPI’s according to the determined causal relationships, business processes can be viewed more dynamically. It is of course not possible to predict the future, but better decisions can be made for the future by using simulation tools to test different decision alternatives (‘what if’ scenarios) as a basis for discussing how the future might look.

One of the tools to simulate a system by using System Dynamics is PowerSim Studio. This tool will not be discussed further; more information can be retrieved from the site www.powersim.com.

8.2 KPI’s and Accountability

How can we make (a) persons accountable for (a certain) KPI’s?

8.2.1 Accountability at CB&I Lummus

What is accountability? Accountability refers to the obligation assumed for the execution of authority and/or the fulfillment of responsibility (Artley, 2001). This obligation means:

- Reporting on the results of that execution and/or fulfillment;
- Answering (providing an explanation or justification) for the execution of that authority and/or fulfillment of that responsibility;
- Assuming liability for those results.

The obligation mentioned above arises from the side of individuals, groups, departments or organization to which the authority and/or responsibility has been assigned (the obligee). On the other side, an audience is required (obligier). An audience is made up of other parties in an organization such as colleagues, superiors and/or clients, that observe the individual’s behavior, evaluate it and have the authority or power to reward or punish him or her, based on the outcomes of his or her performance (Turusbekova, 2007). The audience also has responsibilities towards the obligees:

- Task Clarity; clear standards which reflect the preferences and performance expectations of the audience (which makes unambiguous what exactly needs to be accomplished). Issues will arise when language in an accountability policy or procedure is vague and subject to interpretation (or misinterpretation).
- Personalized Responsibility; implies that responsibility should be unique or, in other words, belong exclusively to the agent, rather than being dispersed, shared or undefined.
- Feedback provided by the audience to the obligee regarding his or her task performance. If staff members are not being told how accountable they have been, they cannot be expected to improve.
- Ensurance that accountability is commensurate with authority: if an employee is made accountable for a process, he or she is given the tools/resources necessary for oversight and intervention.

The audience also needs to have Power; accountability implies monitoring and evaluation by the audience and having to justify one’s decision or actions in front of it. Audience Power makes its evaluation meaningful to the obligee, since positive or negative consequences for the obligee are contingent upon this evaluation. This implies that on the basis of this Power, obligees can be punished when targets are not met. Or, approached from another point of view, meeting targets can be rewarded with incentives. If the audience decides on a policy of rewards or punishment, it should not misuse this as fear tactics to motivate people. This may include repercussions or denial of incentives for failing to meet a goal. Secondly, the reward levels should not be the same (incentive according to performance). When the reward levels are generally the same for everyone, there is less incentive for the non-producer to produce. No one is really held accountable for poor performance; rather, he or she is rewarded for it (bad performance is rewarded equally with others who perform well). Consequently, this system will become a demotivator for the well performers, and eventually they would leave to seek a more equitable accountability system or begin to not perform at the same level, and at the same time it gives no incentive for poor performers to improve. Finally, whether it is compensation or punishment, accountability systems that strive to make every circumstance equal usually do not work. Circumstances may affect the magnitude and severity of the consequences of the decision, the rationale for the decision, the accuracy of the information provided to make the decision, and the tenure and experience of the person making the decision. If there is no reference to previous circumstances, then punishment is doled out the same for everyone regardless of the actual performance.
Accountability in the organization enables the audience to manage the organization with KPI’s by linking punishment or incentives to (not) meeting KPI targets. In this policy the audience as well as the obligees have their obligations and responsibilities. A basic set of rules is given above to deal with punishments or incentives of which the conclusion is that an accountability policy will inspire workers to perform by making efforts in differentiation and not by maintaining equity. However, concluding negative or positive consequences from (not) meeting KPI targets can be a very sensitive and emotional issue, whether it is at the corporate level or on project execution level. Reservations are therefore necessary, less emphasis on individual reward and punishment is required. A good accountability policy will focus on the goals of the organization as opposed to individual punishments and rewards (the emphasis should be on the process instead of the people, the question is what went wrong and not who’s too blame). Such a policy recognizes the synergistic effect that must take place, in which the efforts of many will be greater than the strides of a few.

Typically, issues with accountability usually arise when something has gone wrong and the culture seeks a person to blame. But, the goal of accountability is to improve performance, not to place blame and deliver punishment. In spite of this fact, some may look at accountability in a negative way and as something to be avoided instead of as a useful management tool. According to Smith (cited in Zairi, 1994), when using performance measurement as a punitive measurement system, 'the reality of measuring unconstrained human behavior is that the act of measuring a particular indicator will induce behaviors which have as their objective the maximization of the performance of the indicator, virtually regardless of its effect on the organization as a whole.' Using performance measurements as a punitive measurement system, a way to catch employees doing something wrong and to punish them, will also lead to employees feeling not very committed and not very loyal. It decreases employee performance (and this is very important in the EPC Contracting business, see section 8.1), which in turn decreases organizational performance.

Artley (2001) takes over Conners’ et al (1994) argument, who, in order to offer a solution, make a distinction between reactive and proactive accountability:

- **Reactive accountability**: based on the ‘command and control’ approach to management. In this scenario, accountability is not a relationship, but, instead, a one-way street with management telling subordinates what to do and then confronting them when results were less than expected.
- **Proactive accountability**: the focus is on improving performance. In this approach, accountability is a relationship and process through which performance expectations are planned, defined, and negotiated at the outset; resources are allocated; performance is evaluated; and adjustments/corrections are made as necessary. In this process, the obligee is actively involved in each of these phases. This could also mean that the control should be given to those held responsible for performance and improvement and all “interested” parties involved in the process.

Obviously, proactive accountability is preferred, combined with the incentive scenario: this will create a basis upon which positive or negative consequences can be allocated which will be acceptable for the obligees. With regard to the KPI’s identified in this research, Company Management of CB&I Lummus is accountable (the obligee). As Company Management they have the obligation mentioned above towards CB&I total, which is the audience. The KPI’s have to be assigned to the functional Directors of CB&I Lummus: Projects & Construction, Engineering, Procurement, Finance, TQM/HRM, HSSE and Business Development. Every accountable director is also responsible for further elaboration of KPI’s to the departments and projects for which they will be the audience in turn.

### 8.2.2 Single Point Ownership of cross-functional KPI’s

Ideally, every KPI needs to be owned by a single owner. For most of the KPI’s, it’s possible, but there are KPI’s, where there are multiple functions contributing to its success. So, in the process of assigning accountability of the KPI’s to the Directors, a problem can arise in the establishment of a single point obligee, e.g. cross-functional KPI’s. Especially with regard to KPI’s which arise out of inter-team cooperative effort. It is therefore crucial to drive a single point ownership while ensuring a collective effort.

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22 In the text in this section it is probably more appropriate to talk about liability in stead of punishment. But this has not been changed, because it indicates the opposite of reward.
The following question then arises: how to assign a single KPI owner for KPI’s which are linked to more than one function, for example projects, sales, finance, etc. Typically, within an organization, people would like to be held responsible for their part of work. The reality, however, is that as organizations move towards working more on effectiveness, the cross-functional linkages around KPI’s only increase. The following methods are supplied to assign a single owner of a KPI, while still having a manageable political basis (Gupta, 2009):

- Empower the KPI owner; the KPI owner needs to be empowered, so that he can hold the ‘contributing functions’ on accountability towards their piece within the KPI, e.g. he should be able to connect with other functions and ask for the ‘what, why...’ aspects of their performance related to the KPI.
- Assign a more senior KPI owner for the cross-functional KPI; the reason is that the seniority assumes higher gravitas. The other reason is that due to multi-functional ownership, he will be having a greater proportion of ownership to the KPI.
- Make the KPI skewed towards the KPI owner; the KPI can mostly be linked to the performance of the KPI owner’s function.
- Shift the responsibility regularly; the ownership of a KPI can be shifted across the functions on a quarter to quarter or year by year basis. There is no harm in trying this, as it provides a good perspective to the KPI owner function of the other contributing functions.

8.3 Iterative and adaptive character of performance measurement

Performance measurement is a dynamic phenomenon; it is subjected to internal and external changes. In order to keep the measurement effectively, the organization has to learn from it. Figure 8-3 below visualizes the iterative procedure that the company needs to apply to not only measure performance and act on KPI target deviations, but also to adapt changes in these KPI’s and their targets and even in work processes.
Figure 8-3 Ongoing process of performance measurement and improvement (source: author)
The procedure starts with the design of KPI’s and the targets allocated to these KPI’s. This was part of the scope of this thesis. After that accountability is needed for each KPI, as discussed thoroughly in the previous section of this chapter. Once these steps are taken, the actual measurement can start. Based on the analysis and review of the produced measurement data, it can be evaluated what information can be filtered from it. The next step therefore is how to utilize the gained information? It starts with the KPI targets: if the targets are met, the assumption is that the related CSF is performing well. No action is then required and the KPI can be measured as it is in the next round. If KPI targets are not being met, it is obvious something is wrong. However, this is not a reason to immediately intervene. Only if from multiple measurements can be concluded that a KPI shows a negative trend, action is required. If a negative trend is not determined, no action is required and the KPI can be measured as it is in the next round. A negative trend itself does not always provide the reason. Instead, it raises a flag requiring investigation. Possibilities include performance expectations that were unrealistic or not well defined KPI’s. These 2 possibilities need to be taken into account prior to investigating other possibilities.

When changing KPI’s, a challenge appears in the normalization of the time series data. If measurement definitions change (frequently), it makes it difficult to normalize the same KPI over the period of time.

The third possibility is that of taking corrective action(s) in work processes/ procedures. Before any program is launched to facilitate corrective action, investigation is necessary with regard to the related operational and diagnostic KPI’s. Because when deviations occur in the values of KPI’s, it can be firstly pinpointed in which KPI it has occurred and then how it is (directly) interrelated with other KPI’s. This will give a better insight of the problem area (it will enable the company to explain performance results and to define and address the contributing factors), on the basis of which a program can be launched. If one or more programs are determined, the cause-and-effect relationships need to be taken into account, as discussed in the first section of this chapter. This will indicate how any program will influence other KPI’s. If modeling the cause-and-effect relationships shows that no improvement is being achieved or actual implementation of the programs over time does not show improvement, the final alternative is to challenge the strategy and the related strategic objectives and work processes/ procedures. The principal of a learning organization requires then an adjustment in the design of the KPI’s. A negative trend is also the trigger for a company to award incentives or penalties, depending on the accountability policy chosen for, according to the second section of this chapter.

The continual process in Figure 8-3 is an ongoing process that should become a routine for the company. It should be kept in mind that also for this process holds that it is subjected to changes where necessary.

The sections above have discussed topics related to managing the company with KPI’s. The next section will elaborate how to implement the whole concept of KPI’s and its purposes.

### 8.4 Implementation Plan

A well designed KPI-concept can still fail in the implementation phase. The failure is usually due to the lack of communication and coordination across the functional barriers or due to the lack of attention for those parts of the organization which are subject to change. An answer to this failure is the development of a pragmatic implementation plan, which starts with the awareness of needing KPI’s up to implementation and usage of KPI’s. For every step it has been indicated whether CB&I Lummus still needs to do it or already has done it. Most of the aspects in this section have already been issued in this thesis, but are now presented in defined steps to be taken.

The implementation of this KPI-concept begins at the top. The General Manger and the Director Projects must be aware of the need for a KPI-concept. A clear defined need for KPI’s is a requirement for the design. In interviews prior to the elaboration of this thesis, this awareness was confirmed. Also, the General Manger and the Director Projects must be 100% sold on and committed to leading and supporting the process. Based on the interviews with the General Manger and the Director Projects, it can be concluded that they fully support a KPI-concept (they are also the sponsor as it fits perfectly with the responsibilities they have).
Their following step has been the delegation of the process facilitation task to the Director Project Services. But this will work only after the General Manager and the Director Projects have succeeded in committing the entire Company Management Team; all members need to be an integral part of the early KPI-concept development process. Also, Project Managers and Department Managers need to be an integral part of this process. In this thesis, these groups have been involved early in the development process by interviewing them and by means of the survey. Although the respondents were positive with respect to a (new) KPI-concept, these tools are not sufficient. These groups need to learn (more) about performance measurement, understand and believe the process will add value and commit to leading their functional teams through the process.

From this point on, the General Manager and the Director Projects also need to delegate the task of forming a steering committee to the Director Project Services. The Director Project Services will be the chairman of this committee. The required resources should be made available. A possibility is to use consultants as facilitators of the entire implementation process in order to help build consensus and commitment amongst all managers (it can also help overcome internal resistance to change). Also, all members of this committee need to be educated with respect to performance measurement knowledge. A possibility is to organize a workshop where this thesis can function as reference material.

Once the required level of team commitment has been achieved, the initial requirements can be assumed to be completed. The steering committee will next write the action plan and, when ready, the action plan can be presented to all managers.

For all companies holds that the initial requirements of the development of a KPI-concept are:

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<td>a.</td>
<td>Awareness of the need for a KPI-concept (responsible: the business owner/ top leader).</td>
</tr>
<tr>
<td>b.</td>
<td>The business owner/ top leader must be 100% sold on and committed to leading and supporting the development process.</td>
</tr>
<tr>
<td>c.</td>
<td>Commitment of all management groups in the early KPI-concept development process (responsible: the business owner/ top leader).</td>
</tr>
<tr>
<td>d.</td>
<td>Establish a KPI implementation steering committee. The process facilitation task can be delegated to a member of the company management team or to a consultant (responsible: the business owner/ top leader).</td>
</tr>
<tr>
<td>e.</td>
<td>Enhance performance measurement knowledge of the steering committee members (responsible the business owner/ top leader).</td>
</tr>
<tr>
<td>f.</td>
<td>Write and present action plan (responsible: steering committee).</td>
</tr>
</tbody>
</table>

With the requirements as described above as a starting point, the following implementation steps need to be taken in the KPI-concept development process (these should be part of the action plan mentioned above):

1. Create the vision and strategy (responsible: the business owner/ top leader)
   Actually, performance measurement is not really about developing the vision and strategy; its value is in ensuring execution of a strategy which is already in place (which was the case in this thesis). Before implementation, however, it would be very wise to use the initial management team consensus building process described above as an opportunity to clarify and re-state the organizational vision and strategy. In this thesis the strategic plan of CB&I Lummus was already in place and has also been used as a source for important factors.

2. Identify and define the Critical Success Factors: what should we measure? (responsible: joint effort of all managers, execution: steering committee)
   These are the factors that will drive the company towards long range success. These factors should cover the four perspectives of the Strategy Map: financial, customer, internal business process and learning & growth. There are a lot of factors which are important to a company, the key is to retrieve those that are (the most) critical. This should be done by determining to what extent the company perceives a factor (1) business critical and (2) measurable. In the case of CB&I Lummus, this has been executed by a delegated person, namely the author of this thesis.

3. Design the strategic level Key Performance Indicators: how should we measure? (responsible: joint effort of all managers, execution: steering committee)
The goal of this step is to allocate Key Performance Indicators to the determined Critical Success Factors in the previous step. The steering committee can help by studying the business and facilitating a team process to create the KPI's. The steering committee should take the responsibility to determine that the final dashboard is valid, i.e., that the CSF's are represented sufficiently. In the case of CB&I Lummus, this has been executed by a delegated person, namely the author of this thesis. As also done for CB&I Lummus, the KPI's need to be 'good' and need to be elaborated in a structured way by using the Performance Measure Record Sheet.

4. Create infrastructure for data collection (responsible: the business owner/ top leader or the process facilitator).
   This is the phase in which systems and procedures are put in place to collect and process the data that enable the measurements to be made regularly. This may involve computer programming to trap data already being used in the system and present them in a more meaningful form. It may involve initiating new procedures, so that information currently not recorded is captured and it may involve completely new initiatives, such as the setting up of a regular employee survey.

5. Establishment and validation of cause-and-effect relationships (responsible: steering committee for establishment and company management team for validation).
   KPI's need to be linked in order to create cause-and-effect relationships. By representing them in a causal diagram, it will become clear how KPI's influence each other. A System Dynamics model can be used to simulate different scenarios. Recommended is to delegate the set-up of a System Dynamics model in a software program to an outside expert. In this thesis, initial cause-and-effect relationships have been defined.

6. Make individuals accountable for the strategic level KPI's: the functional directors (responsible: the business owner/ top leader in joint effort with the functional directors)
   A key implementation step is to design and announce an accountability policy with a reward and recognition system for the company and directors in achieving the KPI targets. Getting creative here and sending the message that management is serious and employees can earn rewards (in a later stage) for progress will give the process its due attention. A proactive accountability policy is recommended.

7. Cascade the strategic level KPI's (responsible: steering committee as facilitator, execution by managers in joint effort with their teams).
   This step is cascading strategic level KPI's down through the organization. Cascading involves functional teams taking the strategic level KPI's and breaking it down to KPI's relevant to more functional day-to-day work. It is recommended that all managers drill down for ideas by involving their respective groups in making KPI proposals. A distinction is necessary between headline, operational and diagnostic level KPI's. This results in KPI sets for functional or departmental work groups and offers a larger meaning to their day-to-day work. All KPI's should fit into the System Dynamics model (to be facilitated by the System Dynamics modeling expert). The managers should be accountable for these KPI's.

8. Educate and communicate to stakeholders (responsible: the business owner/ top leader, input from steering committee)
   In this step all employees are informed what is going on. This company communication meeting is to introduce what the steering committee has been working on. CB&I Lummus can make use of the 'All Employee Meeting' held by the General Manager. It is a chance for him to not only present the KPI concept and the implementation plan, but to also emphasize the company strategy and vision. The goal of this communication process is to convince every staff member that their work and responsibilities make a difference. They should see in the presentation KPI examples of their day-to-day functional work being targeted and with progress to be monitored. Ultimately, they should make the connection that what they do is linked (through the strategy) to the vision and long term goals of the company.

9. Continuous execution of measurements and review of progress (responsible: delegated employee for execution and managers for communication)
Another key implementation step is to continuously review and communicate progress towards the set targets. This means developing a system to (1) measure and report progress to management and (2) for management to keep employees informed through regular employee meetings or written communications. This lets everyone know the leadership is serious about the strategic vision and that it will monitor the steps to get there.

10. Based on the progress review, company management can now make decisions, which should be communicated to all employees. These decisions can be taking corrective actions in business processes, but can also be changing/ updating/ refining KPI’s, their targets or even challenging the strategy.

11. The ‘last step’ in the implementation is to realize that there is no last step in this process of continuous measurement and improvement. The closed feedback process advised in this thesis means the process never ends (responsible: company management team). This means that company management reflects once a year on the KPI concept. They need to determine whether the proposed KPI concept in this thesis is successful or not. They should analyze on which ways the concept can be improved. Did it really lead to taking the correct decisions? Is it easy to use? Is it fully embedded and implemented in the organization?

It should be noted that these phases of design, implementation and use are conceptual. This is the sequence of phases through which the KPI concept should progress. However, the phases can overlap as different individual KPI’s are implemented (and revised) at different points in time. Thus, some KPI’s (especially the strategic KPI’s) can be implemented before all the KPI’s have been completely designed, and it could also happen that there is an overlap between implementation and use.

Based on the general implementation plan above, the following steps are still to be taken by CB&I Lummus (assumption is that this thesis has covered the other steps):

- All manager groups need to learn about performance measurement and understand and believe that the process will add value (responsible: General Manager and the Director Projects). Also, the manager groups need to commit to leading their functional teams through the development process. This thesis can function as guide and reference in this part of the process.
- Establishment of a KPI Implementation steering committee (responsible: Director Project Services).
- Enhance performance measurement knowledge of the steering committee members (responsible: Director Project Services, facilitator: consultant).
- The action plan can be written and presented (responsible: steering committee)
- Create infrastructure for data collection (responsible: Director Project Services).
- Empirical testing of the causal relationships established in this thesis (responsible: company management team, facilitated by the steering committee).
- Define accountability policy (responsible: General Manager and the Director Projects)
- Identification of operational and diagnostic KPI’s for all headline KPI’s (responsible: steering committee as facilitator, execution by managers in joint effort with their teams).
- Inform all employees what is going on in one of the ‘All Employee Meeting’ held by the General Manager (responsible: General Manager, input from steering committee).
- Continuously execution and review progress (responsible: project controls engineer for execution and managers for communication).
- Based on the progress review, company management can now make decisions, which should be communicated to all employees.
- Company management needs to reflect once a year on the KPI concept.

The implementation plan above has been designed by considering the 4 central requirements to which a process design should comply, according to de Bruijn et al. (2002). They state that a process (1) needs to be open, (2) offers protection of the core values of stakeholders, (3) has sufficient stimulation for progress and (4) offers sufficient guarantees for the quality of the results.

In the 4 sections above the discussions concerned designing, using and implementing KPI’s, but what are the side effects when managing with KPI’s? The next section will elaborate on this.
8.5 Reservations on managing with KPI’s

Performance measurement is not a neutral activity and can lead to all sorts of side effects. Therefore, performance measurement needs to have a clear purpose: is it about making critical business decisions that will in turn drive business improvement or is it about assessing managers? It should be kept in mind that KPI’s are means and not goals. KPI’s are never unconditionally reliable; there are several risks when using KPI’s in organizations.

Numerical quotas
There is a danger when performance objectives become numerical quotas. The setting of numerical goals and quotas does nothing to accomplish improvements in the process. Identification of the challenges and changing the processes are what is needed to improve performance and achieve desired outcomes. Sometimes data can also be summarized so much that it becomes meaningless. If business decisions are going to be based on the data, then the data needs to be reported clearly and understandably. In collecting data it should be prevented to collect inconsistent, conflicting or unnecessary data, all data should lead to some ultimate measure of success for the company.

Manipulation
Performance measurement provides a valuable tool for management and continuous improvement. However, people might try to “game” the system in a way that will make their programs look good (people manipulate the KPI to hide bad performance): ‘what gets measured, gets improved’. Additionally, accurate data may not be available. These are among the reasons why the need exists to recognize the fact that the measured factor is not the same as the actual factor.

Resistance
Working with people makes it inevitable that there will be resistance to the performance measurement process. Performance measurement may expose weak areas in employee performance and it also carries along that ‘accountability factor’. The only way to deal with resistance is by involving employees in the performance measurement process from start to finish. Another aspect of resistance occurs if one person or a group of people may consider the performance measurement area to be a part of “their territory” and therefore will not want to relinquish control to anyone else.

Actually using the data
At the end of the performance measurement process, a lot of data has been collected. Managers should not fail to base business decisions on the data. A lot of managers make decisions based on intuition and past experience rather than the data being reported to them. If the data is valid, it should be used appropriately: the purpose of a performance measurement system is not merely to collect data but rather to collect data upon which to make critical business decisions that will in turn drive business improvement.

Tunnel vision
Tunnel vision comes after measurement data has been collected, analyzed, and reported. It happens when management focus only on one piece or area of measurement data on which to base their decisions, completely forgetting about the consequences of doing so. They either fail to take into account other measurement areas or completely ignore those areas which can not be expressed in measurable terms. When working with performance measurement, the big picture should be firstly analyzed, then the focus can be on the pieces that fit into that picture.

So, what to do? Measure organizational performance or not? Because theoretically, it is possible that an organization which does not measure performance, actually performs well. And on the other hand, an organization which measures its performance thoroughly, may actually perform badly. To overcome this dilemma, it should be realized that without measuring performance, it will always be “possible” to “improve” performance: it can only not be proven. Consequently, these side effects should not be a reason to not measure performance.
This research emphasizes that designing a continuous performance measurement method at company level is imperative to support the management of Engineering, Procurement and Construction Contractors. Considering this objective (and the related issues) of this research, the thesis has largely been rudimentary in character by drawing conclusions during the execution of every chapter. This chapter first provides a summary per issue with the most important and interesting findings, which are therefore worth a reiteration. The second section issues the recommendations including some suggestions for future study. Finally, the last section discusses the validity and reliability of this research.

9.1 Conclusions

The research objective has been operationalised with the following central question: “In which configuration and how can Key Performance Indicators contribute to the measurement and improvement of the performance of Engineering, Procurement and Construction Contractors?” This central question can be answered by dealing with each sub-question separately.

The first set of sub-questions is aimed at the enhancement of Key Performance Indicators and Performance Measurement knowledge. The following sub-questions can be answered:

- **“Why do companies need to measure their performance?”**
  In order to sustain a competitive advantage and therefore to survive as an organization, companies should be capable of continuously improving their performance. If a company wants to improve its performance, it will first have to measure what the current performance is. From that point on, the company can make decisions in order to improve its performance in those areas where needed. Simultaneously, measuring performance has additional benefits, which enhance the need of it.
  
  *When a company decides to measure their performance, it needs to comply with some basic requirements.*

- **“What are the requirements for performance measurement?”**
  When measuring performance, companies should be both internally and externally oriented, the measurement information needs to meet a certain time frame, the measurement information must aid the decision-making process and performance measurement should not require too much extra effort.
  
  *Performance is measured by Key Performance Indicators.*

- **“What are Key Performance Indicators?”**
  Key Performance Indicators are measurable characteristics of products, services, processes and operations directly related to the organizations’ strategy, that give a good indication of the success (or failure) of success determining factors that are critical for the execution of the organizations’ strategy. An organization’s Key Performance Indicators together make up its performance measurement dashboard.
  
  *Key Performance Indicators are approached from different point of views in organizations.*

- **“What are the views on Key Performance Indicators in performance measurement?”**
  4 views have been identified. With regard to these views, the identified KPI’s has been balanced fairly: Implication, Responsiveness, Nature and Location. This is crucial if an organization aims to cover all important aspects.
  
  *Key Performance Indicators have to be ‘good’.*

- **“What are ‘good’ KPI’s?**
  Indicators are ‘good’ if they are Specific, Measurable, Achievable, Relevant, Time framed, Valid and Reliable. Indicators are also ‘good’ when they are well structured. To do this, the Performance Measure Record Sheet has been used for all KPI’s. Finally, KPI’s are ‘good’ when they are implemented as part of a broader context.

By answering the question for this issue a set of basic assumptions has been created to function as reference throughout the thesis. Also, requirements have been indicated for measuring performance and criteria have been developed for designing Key Performance Indicators.
The second set of sub-questions is aimed at the determination of a measurement framework to analyze the company performance of EPC Contractors with Key Performance Indicators. The following sub-questions can be answered:

- **“Which frameworks can be used to measure performance?”**
  In general, multiple, seemingly conflicting, measurement frameworks exist because they all add value; they all provide unique perspectives on performance and approach organizations from a different point of view to cover business activities. These frameworks all have their strengths and weaknesses; as long as it is acknowledged that performance measurement should be executed according to a framework. The last few years several frameworks have been developed: the works of Kaplan and Norton (the Balanced Scorecard (BSC) and the Strategy Map) and Neely’s Performance Prism are considered to be the most prominent theoretical performance measurement frameworks. Organizational performance is closely related to Quality Programs due to the self-assessment factor of these Programs. The EFQM Business Excellence Model and the Malcolm Baldrige National Quality Program are two well-known models. Except of these conceptual models, there are also empirical models. There are two relevant empirical models for the EPC Contracting business: (1) a model designed by the KPI Working Group and (2) a model designed by the Construction Products Association.

- **The most effective framework has to be determined.**

- **“Which criteria are important in the measurement of performance?”**
  Deciding on which framework to apply should not be done by analyzing which framework fits best to this specific Industry/line of business, because the frameworks approach organizations from a high abstraction level. This means that each framework is applicable to every organization regardless of the Industry line of business they operate in. Deciding on a framework should be done by comparing them against criteria for effective frameworks. Based on the theoretical review, criteria have been identified. Frameworks have to be assessed against these criteria to identify the most effective one.

- **“Which framework is the most effective one for the evaluation of the performance of an EPC Contractor?”**
  When comparing the frameworks against the criteria for effective frameworks, it can be concluded that the Strategy Map complies most. This conclusion is enhanced by a critical comparison of the frameworks amongst each other.

By answering the question for this issue, first criteria have been developed for effective measurement frameworks. And the criteria have been applied on measurement frameworks which resulted in the choice for a framework.

The third set of sub-questions is aimed at defining a set of Key Performance Indicators that represents the determined measurement framework for company performance. The following sub-questions can be answered:

- **“What are important organizational features of EPC contractors, specifically of CB&I Lummus?”**
  There are many factors that seem to be important for the EPC Contracting industry, not only from a theoretical point of view, but especially from an empirical point of view. Not all of these factors are equally important and critical enough to be identified as a Critical Success Factor (CSF). However, in a process of consolidating and filtering of the factors, potential CSF’s have been identified. Additional information has enabled the determination of the most critical CSF’s. These CSF’s can be balanced fairly across the perspectives of the Strategy Map; they take into account the needs and requirements that are vital to the success of the company.

  - **CSF are measured by using KPI’s**
  - **“What are the Key Performance Indicators that Company Management need to use in order to evaluate the company Performance?”**
    The determination of KPI’s for the final CSF’s was a process of collecting KPI’s for the CSF’s, filtering the KPI’s against the criteria for ‘good’ KPI’s and finally selecting them based on the 4 ways KPI’s can be approached in organizations. Also, in the process of considering KPI’s for the CSF’s, some CSF’s have been deleted or separated. To some CSF’s 1 KPI has been allocated, as for others more than 1 KPI has been allocated. The final result is a performance dashboard which contains: 9 financial KPI’s, 6 customer KPI’s, 15 internal business process KPI’s and 3 learning & growth KPI’s.
By answering the question for this issue the specific features of the Industry have been indicated. The defined KPI's are expected to increase the ability to fulfill requirements in line with the organizations policy and objectives.

The last sub-question is aimed at the design of a process/ procedure for continual performance improvement on the basis of the performance evaluation. The following sub-question can be answered:

- “How can the Key Performance Indicators be used effectively for the management of EPC contractors?”

The KPI's are primarily designed on strategic level, but for effective management, the operational and diagnostic levels are also necessary. By acknowledging these levels, the hypothetical cause-and-effect relationships can be tested and validated; but initially it is necessary to develop these relationships by applying the System Dynamics modeling technique. The identification of the operational and diagnostic level will also increase the understanding with regard to why certain changes may have occurred in KPI's and to analyze areas for improvement in more detail. By simulating the KPI's according to the determined causal relationships, business processes can be viewed more dynamically. It is of course not possible to predict the future, but better decisions can be made for the future by using simulation tools to test different decision alternatives (‘what if’ scenarios) as a basis for discussing how the future might look. Another aspect of effective management with KPI's is the introduction of an accountability policy that will inspire workers to perform by making efforts in differentiation and not by maintaining equity. However, concluding negative or positive consequences from (not) meeting KPI targets can be a very sensitive and emotional issue, whether it is at the corporate level or on project execution level. To cope with this, proactive accountability is preferred, combined with the incentive scenario: this will create a basis upon which positive or negative consequences can be allocated which will be acceptable for the obligees. With regard to the KPI's identified in this research, Company Management of CB&I Lummus is accountable (the obligee). As Company Management they have the obligation mentioned above towards CB&I total, which is the audience. The KPI's have to be assigned to the functional Directors of CB&I Lummus: Projects & Construction, Engineering, Procurement, Finance, TQM/ HRM, HSSE and Business Development. Every accountable director is also responsible for further elaboration of KPI's to the departments and projects for which they will be the audience in turn. Another aspect of managing with KPI's is that this is a dynamic phenomenon; it is subjected to internal and external changes. In order to keep the measurement effectively, the organization has to learn from it, adapt changes and make sure that performance measurement becomes an ongoing process in the company. When managing the company with KPI's, some side effects occur. But these side effects should not be a reason to not measure performance because without measuring performance, it will always be “possible” to “improve” performance: it can only not be proven.

By explicitly creating a procedure, an ongoing process is ensured for performance measurement. This procedure embodies organizational improvements as well as of the improvement processes itself. Also, working according to this procedure allows for identification of improvement possibilities (and evaluation) on a systematic way. Also (for companies in general), based on the knowledge gained in this study, the development process of performance measurement and improvement is given. And by explicitly designing an implementation plan, it is expected that the probability to succeed with the KPI-concept will increase. The implementation plan is aimed at bridging the gap between the developed concept and the actual use of it, because a well designed KPI-concept can still fail in the implementation phase or even in an earlier phase when it is not clear who needs to do what and when.

9.2 Recommendations

The theoretical study at the beginning of this research made clear that it is imperative for organizations to measure their performance. Although measuring performance (with the existing KPI's) has not resulted in significant improvements so far for CB&I Lummus and seen the reservations on (using KPI's for) measuring performance (which are acknowledged), this study shows that it is possible to use performance measurement for organizational improvements. But to actually introduce improvements, it is a matter of the highest importance that organizational performance is measured by using the Key Performance Indicators as defined in this research. The extensive study, both theoretical and practical, enables the effectiveness of these Key Performance Indicators and of it's successful implementation. Successful implementation is also expected due to the created basis of support during the execution of this study and due to the fact that
the company strategic plan ‘lives’ in the organization. Another aspect of successful implementation is that the information necessary to calculate/ determine the Key Performance Indicators values mostly already exists in the organization or is collected for other purposes. This complies with the requirement of performance measurement that it should not require too much extra effort. The information needs to be collected and then customized in the format required for the KPI’s.

One of the main recommendations following from this study is to apply the Strategy Map as a theoretical reference (performance measurement) framework. From a theoretical review, the Strategy Map was adjusted with regard to one of the perspectives. Looking back, the perceived weakness was not that critical for implementation of the strategy Map. A general advice to others (read: companies operating in other lines of business) is to see the Strategy Map as a high-level framework, with 4 leading perspectives. The main items/ issues per perspective as given by Kaplan and Norton are not of crucial importance (they can function as inspiration source, but are not fixed), as long as Critical Success factors can be determined for that specific organization. The perspectives exist to ensure that Critical Success Factors are not left out; by doing this the needs and requirements vital to the success of the company are taken into account.

Another, possibly more, crucial aspect of performance measurement is actually using the Key Performance Indicators to manage the company. This study discusses the issues which should be taken into account when doing this. The first issue is viewing Key Performance Indicators in the context of causal relationships. This will indicate interrelationships between Key Performance Indicators, explain changes in Key Performance Indicators and reveal areas for improvement. To do this, System Dynamics modeling can be used, which additionally enables the execution of ‘what if’ scenarios. Secondly, individuals in the company have to be made accountable for the Key Performance Indicators. This study has already indicated that the functional Directors are subject to accountability, but they are also responsible for elaboration of lower level KPI’s and making department and project managers accountable for these, taking into account the single point ownership of cross-functional KPI’s (one of the Director should be assigned as the overall implementation coordinator). The last issue is the strong recommendation to apply the Key Performance Indicators according to the ongoing process of performance measurement and improvement given in this study (see Figure 8-3). This will enable the recurring periodically execution of the measurement. Additionally, the procedure functions as a guide in measuring performance.

This study is in the first place intended for CB&I Lummus – The Hague office. The advice is therefore to implement performance measurement according this research in this office. After a, to be determined leaning period, the Key Performance Indicators can also be applied in all CB&I Lummus offices. When doing this it is of importance to standardize the Key Performance Indicators, because this will enable consolidation for CB&I Lummus overall performance. Another reason to implement the same Key Performance Indicators in all offices is to create a consistent perception of the company strategy and that all offices experience the responsibility to contribute to overall company performance (and therefore enable CB&I Lummus to cope with plural internal strategies). Also, standardized KPI’s will enhance benchmarking between CB&I Lummus offices. Another recommendation is that the results of this study should not only be followed by CB&I Lummus, but the results are also applicable and important for the other active parties in the EPC Contracting business (CB&I Lummus can be assumed to be one of the important/ large player in this line of business). If other companies have different views on this research, they can at least see this study as an important source of inspiration. The advantage of standardized KPI’s in the EPC Contracting business would be that competitors can benchmark their performance amongst each other.

In order to bridge the gap between the developed KPI-concept and the actual use of it, companies are recommended to implement the concept according to the pragmatic implementation plan designed in this study (EPC Contractors can skip steps 2 and 3). Specifically for CB&I Lummus holds that a filtered plan has been designed, because some of the steps have already been fulfilled in the course of this research.

The reader may have noted some possibilities for future research throughout the previous chapters. This section contains some explicit suggestions for future research that hopefully will encourage others to conduct studies in order to advance the performance measurement knowledge of the EPC Contracting Industry. The main focus of future/ additional research should be in the area of empirical testing of the causal relationships. The relationships are assumed to be potential relationships and are subject to be
tested thoroughly in additional research. A positive side effect of this will be that it will stimulate common
group understanding which will increase the probability of successful implementation of this KPI concept.
Related to this subject is the System Dynamics model to be set up for simulation purposes. Secondly, the
focus should be on the identification of KPI’s at each level. The foremost challenge is the determination of
a limited set of KPI’s that can provide a reasonable view of the whole company, with minimum complexity
in creating the model. The reason for this is that the number of measures can quickly run into hundreds,
which make it very difficult for modeling part of the design. The second challenge is availability of the data.
In many cases data on human processes are not collected. Since human-oriented process (learning &
growth) comprises a significant part of the EPC Contractor, it is difficult to explain the variance without
understanding human-oriented processes as well. The third challenge is unifying the KPI’s. In several
cases there could be repetitive collection of same measure at different sources. For example, customer
satisfaction can be measured by the project team as well as the business development department.
Another approach could be to select a subset of KPI’s out of all KPI’s designed in this study. Hypothesizing
the relationships among these KPI’s and validating the relationships using the methods explained in the
conceptual design should then follow (System Dynamics). This can then be considered as a learning
model.

Whether the new KPI concept recommended in this study is successful can only be determined on the long
term. The pay off will be a positive trend in the financial KPI’s (a period of a number of years). The
assumption is that the customer, internal business process and learning & growth KPI’s drive the financial
KPI’s and that the results can only be seen on a longer term. A pre-condition is that management follows
the recommendation in this study and that they take effective decisions based on the KPI measurements.

9.3 Validity & Reliability

Validity of the results if this study is an expression of how well the KPI’s measure the issues actually meant
to be measured, the CSF’s, and how well these CSF’s actually represent the needs and requirements vital
to the success of the company. However, there is no objective way of determining to what extent the KPI’s
and CSF’s are valid or not, in other words, the level of validity has been determined on a subjective basis.
It is reasonable to assume that there is a certain degree of validity, because the questions of the interviews
and surveys have been studied and determined to be ‘good’ in relation to the purpose they serve. Firstly by
review sessions with the client of this study and other knowledgeable persons in the company (these
persons are in one way or another related to organizational performance) and secondly by the author,
meaning executing a test interview/ survey and adjustment afterwards by taking into account the
comments. This indicates a high level of validity, more specifically external validity. Internal validity is also
important: internal validity is the logical relationship between an investigation and the available theory in
the studied area (Verschuren and Doorewaard, 2005). This relationship between existing theory and the
empirical study was established by an extensive review of the literature in the performance measurement
area. The theoretical framework established throughout that review was used as the basis for the research
questions in the interviews/ surveys, as well as when analyzing the results.

Reliability of the results of this study is an expression for the capability of the results to withstand random
effects: research (methods/ techniques) that generates the same or similar results on multiple occasions
have high reliability23. The use of clearly defined questions in the interviews, as well as in the surveys,
increases the probability of replicating this study. Moreover, the research method is clearly defined and
described in this thesis, and the reliability is also positively affected by the fact that the questions were
tested in a test-interview. Actually, the clearer and more stringent the questions are, and the more
standardized the measurement method is, the higher the reliability.

There are various sources of mistakes affecting the quality of this research in terms of validity and
reliability. It is therefore important to acknowledge that this study is executed in such a way that it
accurately has identified and described the studied subject and the used methods/ techniques. By doing
this a sufficient level of credibility is expected for this study and the following conclusions.

23 Note: it is practically impossible to make several completely consistent investigations, as there will always be a
certain level of random effect in all investigations.
10 REFLECTION

Looking and reflecting back on this thesis, the following can be noted:

In the beginning of the thesis I had set a tight schedule for its completion. But gradually it became clear that in practice it was impossible to meet the set schedule. In my view, the main cause was the fact that it was not possible to spend as many hours in the study as I had planned for. It is not easy to combine your private-life with your working-life as well as your study-life. Even the minor irregularities disrupt the process. Therefore I am pleased that CB&I Lummus made hours available to spend on this study. This does not alter the fact that many evening and weekends were necessary to complete this thesis. How to cope with this on forehand? I suppose building float in the schedule and trying to manage the irregularities as much as possible. Another cause of the delay was the dependence of information (especially input from the surveys). I guess this can not be avoided; it should be taken into account when scheduling the research. Intensively expediting is also a possibility, but that is easier said than done: you are dependent of the respondents and not the other way! In my situation, it was also necessary to maintain a good relationship with the respondents seen the fact that they are my (direct) colleagues.

Another tension that I had expected when starting this scientific research at CB&I Lummus, was between my day-to-day activities in the company which is also subjected for study. Would the recommendations affect my future career? What would the stakeholders in the company think of the quality delivered? Would this positively of negatively change their view of me? I guess this is something that time will learn. But the interviews and surveys learned that the stakeholders (respondents) reacted positively that this subject was researched. I think (and hope) that by involving the stakeholders in the process, the results of this study will be better with regard to the acceptability.

Surprisingly, there was no tension between my current function and the topic of study. I have not been frustrated internally in any way, I received all necessary cooperation. I have not experienced any feelings of restraint during execution and in the conclusions and recommendations. I think this is caused by the fact that the conclusions and recommendations do not directly affect individual employees (in negative sense). Individuals will come more in the picture when specific KPI’s are assigned to them and for which they are accountable.

The initial assignment from the company was to revise the existing KPI’s. But we soon noticed that this was to narrow and scientifically not well based. Fortunately, the company and I came to an understanding that the topic embodied much more which led to adjusting the research objective and questions.

At approximately half way of the thesis I wondered whether I did not spent too much time and energy in the theoretical and set-up issues. Regularly I questioned myself: is it really necessary? But in the later phases this time and effort seemed to pay off. Relatively less time was spent in these phases (except for the execution of the interviews and surveys and the processing of it). So, it is worth while to invest a lot of time and energy in the starting phases of a research, this will create a solid basis to elaborate on further in the research.

The last notion concerns the language of this thesis. For this thesis English is not required, Dutch is sufficient. I knew that doing it in English increased the level of difficulty, but there were 3 reasons to still execute in English: (1) the company language is English, (2) I expected to develop my English skills and (3) most of the sources used are in English.


Internal
- Best Practice, Multi Office Execution, 2006.

Online
- Intranet: www.intranet.nlhag.lummusonline.com
- Website Baldrige: www.baldrige.nist.gov
- Website EFQM: www.efqm.org
- Website INK: www.ink.nl
APPENDIX A  Abbreviations and Keywords

BEM -- Business Excellence Model
BSC -- Balanced Scorecard
CB&I -- Chicago Bridge & Iron Company N.V.
CIM -- Continual Improvement Measures
CLN -- CB&I Lummus Netherlands
CMT -- Company Management Team
CSF -- Critical Success Factors
EFQM -- European Foundation for Quality Management
EPC -- Engineering, Procurement and Construction
EVA -- Economic Value Added
KPI -- Key Performance Indicator
MBNQA -- Malcolm Baldrige National Quality Award
MBNQP -- Malcolm Baldrige National Quality Program
MOPEX -- Multi Office Project Execution
PMC -- Management Contracting
PMRS -- Performance Measure Record Sheet
SD -- System Dynamics
SMART -- Specific, Measurable, Achievable, Relevant, Time framed
SPI -- Secondary Performance Indicators
APPENDIX B  Research Material

Important steps towards accomplishing the research challenges are to make a selection of relevant research material. This appendix will form a structure of the research material that is needed.
<table>
<thead>
<tr>
<th>QUESTIONS</th>
<th>SOURCES</th>
<th>METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the added value of Key Performance Indicators, e.g. which objectives does Senior Management want to achieve with Performance Measurement?</td>
<td>1) Theories/ articles on performance measurement 2) Senior Management</td>
<td>1) Desk research 2) Individual face-to-face interview</td>
</tr>
<tr>
<td>What is CLN’s current KPI concept to measure performance?</td>
<td>1) Existing concept</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>What is the performance of CLN with regard to these indicators?</td>
<td>1) Historical data</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>Are the influences on these performances?</td>
<td>1) Senior Management</td>
<td>1) Individual face-to-face interview</td>
</tr>
<tr>
<td>How does Senior Management use the measurements for management purposes?</td>
<td>1) Senior Management</td>
<td>1) Individual face-to-face interview</td>
</tr>
<tr>
<td>Which factors influence the evaluation criteria’s?</td>
<td>1) Historical data</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>Who are the other stakeholders regarding performance measurement and what are their perception of the problem, objectives and interests?</td>
<td>1) Senior Management</td>
<td>1) Individual face-to-face interview</td>
</tr>
<tr>
<td>What are the critical success factors for sufficient performance measurement?</td>
<td>1) Theories/ articles on performance measurement</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>What are the design/ assessment criteria for sufficient performance measurement?</td>
<td>1) Theories/ articles on performance measurement 2) Senior Management</td>
<td>1) Desk research 2) Individual face-to-face interview</td>
</tr>
<tr>
<td>Which measurement concepts have proven to be sufficient?</td>
<td>1) Theories/ articles on performance measurement 2) Benchmark information</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>Which relevant performances of CLN are subject for measurement?</td>
<td>1) Senior Management</td>
<td>1) Individual face-to-face interview</td>
</tr>
<tr>
<td>What is meant by effective management of business processes?</td>
<td>1) Theories/ articles on strategies and management</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>What are the criteria’s for effective application of the measurements?</td>
<td>1) Theories/ articles on performance measurement 2) Senior Management</td>
<td>1) Desk research 2) Individual face-to-face interview</td>
</tr>
<tr>
<td>Which (relevant) business processes can be distinguished in the business execution of CLN?</td>
<td>1) Section leaders 2) Business processes</td>
<td>1) Individual face-to-face interview 2) Desk research</td>
</tr>
<tr>
<td>What is significant information for Senior Management for effective management of business processes?</td>
<td>1) Senior Management</td>
<td>1) Individual face-to-face interview</td>
</tr>
<tr>
<td>What are the strategies to use performance measurement for the management of business processes?</td>
<td>1) Theories/ articles on performance measurement, strategy and management</td>
<td>1) Desk research</td>
</tr>
<tr>
<td>What are the shortcomings of the Performance Measurement method in the current situation?</td>
<td>1) Analysis from research project</td>
<td>1) Secondary research</td>
</tr>
<tr>
<td>Which indicators can be determined to measure CLN’s performance sufficiently?</td>
<td>1) Analysis from research project</td>
<td>1) Secondary research</td>
</tr>
<tr>
<td>What strategy can be determined to use the measurements for the management of business processes?</td>
<td>1) Analysis from research project</td>
<td>1) Secondary research</td>
</tr>
<tr>
<td>What are the consequences (and risks) in terms of responsibility, organization, scope and cost?</td>
<td>1) Internal documents 2) Analysis from research project</td>
<td>1) Desk research 2) Secondary research</td>
</tr>
<tr>
<td>Does the new concept support the need of Senior Management better than the old concept?</td>
<td>1) Analysis from research project</td>
<td>1) Experiment</td>
</tr>
</tbody>
</table>
APPENDIX C  Leading questions Strategy Map

To define Corporate KPI’s we need to determine the Factors that are crucial for the success of the business strategy (Critical Success Factors).

General
1. What is the company level you have in mind with regard to Corporate KPI’s?

Financial: determination of financial objectives.
1. How can we increase shareholder value?
2. What financial objectives must be achieved in order to meet the expectations of Company Management?
3. What financial objectives must be achieved in order to meet the expectations of CB&I?
4. What financial objectives must be achieved to survive as ongoing company?
5. How do you define company growth?
6. What are the strategies for company growth?
7. What are the strategies for productivity/efficiency?
8. How can we maximize profit?

Customer: determine on which critical factors customers judge us.
1. How does CB&I Lummus want to appear to its stakeholders (image)?
2. What does CB&I Lummus want to convey to its stakeholders?
3. What are the customer segments on which CB&I Lummus wants to aim at?
4. What are the market segments on which CB&I Lummus wants to aim at?
5. What is exactly of value for the target group?
6. What were in the past the deciding factors for clients to award projects?
7. What aspects will be essential in the future for the client’s choice for CB&I Lummus?
8. What are the deciding factors for clients to award projects?
9. In which areas does CB&I Lummus excel compared to competitors (distinguishing ability)?
10. What is the power or influence of suppliers and/or 3rd parties?
11. On which way can CB&I Lummus use her influence to enable suppliers and/or 3rd parties to contribute to our success?
12. Which product/service-attributes are critical in order to operate excellently in the view of clients?
13. Which relational aspects with clients need to be stressed on specifically in the view of clients?

Internal Process: determine how processes should be organized in order to serve the selected customer segments on the chosen way.
1. What is necessary to realize the targeted quality?
2. How can the desired cycle time and delivery time be realized?
3. For which business processes do the targeted objectives have specific consequences?
4. Which business processes need to be managed tightly?
5. Which requirements does the communication with the client demand?
6. Which specific competencies do employees need to dispose of?
7. What are the objectives with regard to the creation of new products/services?
8. What are the objectives with regard to the penetration of new markets and customer segments?
9. In order to increase customer value, how can we deepen our relationships with existing clients?
10. How can we achieve operational excellence in the execution of projects?
11. How can we achieve operational excellence in our logistics processes?
12. In order to become a good corporate citizen, how can we establish effective relationships with external stakeholders (regulatory and environmental processes)?
Learning & Growth: determine which factors (1) contribute to continual innovation and (2) add value to the overall operations.

What do we have to do to improve the following assets?

1. Financial: cash that is needed in order to invest into other resources.
2. Physical: tangible infrastructures, such as resource location and ICT (databases, servers, networks (intranet)).
3. Relationship: relationship and exchange of knowledge between CB&I Lummus and its (external) stakeholders.
4. Cultural: shared framework of our employees to interpret events.
5. Practices and routines: how our employees deal with processes and how work flows through the organization.
6. Intellectual property: the tools and enablers that allows CB&I Lummus to gain a protected competitive advantage.

Human/ people Assets: determine which human factors (1) contribute to continual innovation and (2) add value to the overall operations.

1. How can we improve the core competences of our employees?
2. How can we improve the core knowledge of our employees?
3. How can we improve the skills of our employees?
4. How can we improve the commitment of our employees?
5. How can we improve the motivation our employees?
6. How can we improve the loyalty of our employees?
7. How can we improve teamwork between employees?

Closure
1. Are there any other factors that are critical for the success of our operations?
APPENDIX D  Factors linked to the four measurement criteria

Kellen (2003)

- Breadth: refers to how much of the total set of activities needed to be measured are actually measured. Breadth needs to be balanced between internal state and activities inside of the firm and activities and items external to the firm such as customers, suppliers, competitors, market conditions, environmental conditions, etc.
- Depth: refers to the unit of analysis. Levels of analysis, or granularity, can include the employee, the workgroup or team, the functional unit, the business unit, the product, the customer, the firm as a whole, the marketplace or the economy at large. BPM systems can and typically do cover multiple levels of analysis.
- Coherency: refers to the how much breadth and depth factors combine together to improve performance. How do lower levels of measurement contribute to higher levels? How do units of measurement at the same level coordinate together to contribute higher levels?
- Predictability: refers to how accurately and far into the future a BPM system can project.
- Provability: refers to how the BPM system can show the relationship between causes and effects. Identifying causes and effects helps managers better understand where (which object) to apply attention.
- Explainability: refers to how easily people in the firm can explain relationships between measurements and how the BPM system functions.
- Believability: Refers to how much people in the firm trust the BPM system. Do people in the firm believe what the BPM system is expressing? Data quality and overall measurement trust (reliability, consistency, accuracy) are key components.
- Communicability: refers to how well can people in the firm communicate measures and discuss them amongst themselves?
- Adaptability: refers how easily and completely the BPM system can be altered. Is the BPM system automatically self-changing? How much intervention is required to change it? Is the human component capable of changing?
- Measurability: refers to how the BPM system itself is measured (meta-measurement). Is the BPM system working within normal parameters? What is the quality of service? How effective is the BPM system? Where is improvement in the BPM system warranted? Is it measuring the right things?
- Autonomic: how much does the BPM system help the firm self-correct? How much management attention and effort does operating the BPM system require?
APPENDIX E     PMRS Criteria

Neely (1997)
1. be derived from strategy
2. be simple to understand
3. provide timely and accurate feedback
4. be based on quantities that can be influenced, or controlled, by the user alone or in cooperation with others
5. reflect the “business process” – i.e. both the supplier and customer should be involved in the definition of the measure
6. relate to specific goals (targets)
7. be relevant
8. be part of a closed management loop
9. be clearly defined
10. have visual impact
11. focus on improvement
12. be consistent (in that they maintain their significance as time goes by)
13. provide fast feedback
14. have an explicit purpose
15. be based on an explicitly defined formula and source of data
16. employ ratios rather than absolute numbers
17. use data which are automatically collected as part of a process whenever possible
18. be reported in a simple consistent format
19. be based on trends rather than snapshots
20. provide information
21. be precise – be exact about what is being measured
22. be objective – not based on opinion
<table>
<thead>
<tr>
<th>Critical Success Factor</th>
<th>Measurability</th>
<th>Business Criticality</th>
<th>Proposed KPI</th>
<th>How to measure?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very Bad</td>
<td>Low</td>
<td></td>
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<tr>
<td></td>
<td>Very Poor</td>
<td>Medium</td>
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<td>Poor</td>
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<td>Very Good</td>
<td>Very High</td>
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<td></td>
<td>Very Poor</td>
<td>Medium</td>
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<tr>
<td></td>
<td>Very Good</td>
<td>Very High</td>
<td></td>
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</tr>
</tbody>
</table>

**I. Financial**
- FIN01 Creating Shareholder Value
- FIN02 Assurance of Business Continuity
- FIN03 Sustainable Revenue Growth
- FIN04 Increased Profitability
- FIN05 Available Cash Amount
- FIN06 Increase Workload to Jobs
- FIN07 Increase Workload to DEC’s
- FIN08 Optimize Material Cost
- FIN09 Balanced Project Portfolio (Scope, Size, Contract)
- FIN10 Softwared Revenues

**II. Customer**
- CUS01 Significant Market Share in the Industry
- CUS02 Focus on determined Regions
- CUS03 Focus on determined Products/Technologies
- CUS04 In-house Knowledge/Competence Availability
- CUS05 Increase usage of In-house Technology Licenses
- CUS06 Reliability and Integrity as EPC contractor
- CUS07 One-Stop-Shop EPC Contractor
- CUS08 Innovativeness and Value Adding Ability
- CUS09 Focus on Key Clients
- CUS10 Optimize Communication with Client
- CUS11 Optimize Relationship with Client
- CUS12 More long-term Agreements with Existing Clients
- CUS13 Management of Client Knowledge
- CUS14 Improve knowledge of Clients
- CUS15 Balanced Client Type Portfolio
- CUS16 Improve Ability to handle Client Specific Requirements
- CUS17 Improve Competitiveness

**III. Internal Business Processes**
- IBP01 Balance between Key and new Specialisms/Technologies
- IBP02 Sufficient Capacity
- IBP03 Increase Flexibility
- IBP04 Selective Project Acceptance/Rejection
- IBP05 Improve Project Portfolio
- IBP07 Maximize Scope Capturement
- IBP09 Reduce Scope Changes During Project Execution
- IBP10 Increase Project Types in line with Strategic Focus
- IBP11 Avoid Scope Changes During Project Execution
- IBP12 Meeting Project Preconditions (Schedule, Budget, Quality, Safety)
- IBP13 Maximize Involvement of Total Project Objectives
- IBP14 Measuring and Improving Project Execution Plans
- IBP15 Measuring and Improving EPC Process
- IBP16 Optimize Project Risk Balance
- IBP17 Improve Multi Office Project Execution
- IBP18 Improve Quality Basic Engineering Package
- IBP19 Subcontract Management
- IBP20 Improve Material Supplier (Work) Processes
- IBP21 Focus on Key Suppliers
- IBP22 Anticipate on Changes in the Economic Climate

**IV. Learning & Growth**
- L&G01 Improve Employee Satisfaction
- L&G02 Increase Commitment of People to the Organization
- L&G03 Encourage Employee Development
- L&G04 Secure Employee Well Being
- L&G05 Improve Employee Quality
- L&G06 Encourage effective Teamwork
- L&G07 Improve Work Content
- L&G08 Stimulate Work Atmosphere
- L&G09 Employee Well Being, Transfer & Availability
- L&G10 Effective usage of IT tools
- L&G11 Improve Information Capturement, Integrity & Flow
- L&G12 Capture Lessons Learned
- L&G13 Alignment of IT Systems Applications
- L&G14 Alignment of Work Processes
- L&G15 Improve Relationships OE’s

**V. Suggested Critical Success Factors**

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APPENDIX G  
Elaborated KPI’S (according to the PMRS)
| 1 KPI: | Revenue |
| Purpose / CSF: | Sustainable revenue growth |
| Relates to: | EBIT, Sales Efforts, Profitable Projects, Repeat Business, New Clients |
| Target: | ≤ 1.00 |
| Formula: | Planned revenue / actual revenue |
| Frequency: | 1 / year |
| Who measures: | |
| Source of data: | Business plan and financial system |
| Who acts on the data: | Corporate Finance |
| What do they do / mgmt process: | |
| KPI level: | Line Organization |

| 2 KPI: | Earnings Before Interest and Tax (EBIT) |
| Purpose / CSF: | Increase Profitability |
| Relates to: | Free Cash Flow, Overhead, Revenue |
| Target: | ≤ 1.00 |
| Formula: | Planned EBIT / actual EBIT |
| Frequency: | 1 / year |
| Who measures: | |
| Source of data: | Business plan and financial system |
| Who acts on the data: | Corporate Finance |
| What do they do / mgmt process: | |
| KPI level: | Line Organization |

| 3 KPI: | Future Net Cash Flow |
| Purpose / CSF: | Assurance of Business Continuity |
| Relates to: | Sufficient Backlog, Employee Satisfaction |
| Target: | ≥ EUR 10\(^{*}\)10\(^{6}\) |
| Formula: | Forecasted Net Cash Flow in business plan |
| Frequency: | 1 / year |
| Who measures: | |
| Source of data: | Based on Backlog, Prospects and Proposals |
| Who acts on the data: | Corporate Finance |
| What do they do / mgmt process: | |
| KPI level: | Line Organization |

| 4 KPI: | New Clients |
| Purpose / CSF: | Expand Client Base |
| Relates to: | Revenue |
| Target: | 20% |
| Formula: | Expected revenues from new Clients / total Revenues |
| Frequency: | 1 / year |
| Who measures: | |
| Source of data: | Business Development and financial system |
| Who acts on the data: | Business Development |
| What do they do / mgmt process: | |
| KPI level: | Line Organization |

<p>| 5 KPI: | Key Clients |
| Purpose / CSF: | Focus on Key Clients |
| Relates to: | Repeat Business |
| Target: | 60% |
| Formula: | Expected revenues from key Clients / total Revenues |
| Frequency: | 1 / year |
| Who measures: | |
| Source of data: | Business Development and financial system |
| Who acts on the data: | Business Development |
| What do they do / mgmt process: | |
| KPI level: | Line Organization |</p>
<table>
<thead>
<tr>
<th><strong>6 KPI:</strong></th>
<th><strong>Project Type</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td>Balanced Project Portfolio</td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td>Employee Satisfaction</td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td>% per category</td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td>Revenue per Project (scope) category: FEED (30%), EPCm (60%) or Study (10%)</td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td>1 / year</td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td>Business Development and financial system</td>
</tr>
<tr>
<td><strong>Source of data:</strong></td>
<td>Business Development</td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td>Line Organization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>6 KPI:</strong></th>
<th><strong>Overhead</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td>Minimize Overhead Cost</td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td>DEC Workload, Paid Manhours, Coordination Manhours, EBIT</td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td>≤ EUR 25 / year</td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td>Total overhead / billable manhours</td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td>1 / quarter</td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td>Financial system</td>
</tr>
<tr>
<td><strong>Source of data:</strong></td>
<td>Corporate Finance</td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td>Line Organization</td>
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</table>

<table>
<thead>
<tr>
<th><strong>8 KPI:</strong></th>
<th><strong>Paid Manhours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td>Increase (paid) Workload to Jobs</td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td>Overhead</td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td>90%</td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td>Paid manhours / total spent manhours</td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td>1 / quarter</td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td>Financial system</td>
</tr>
<tr>
<td><strong>Source of data:</strong></td>
<td>Corporate Management</td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td>Line Organization</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th><strong>9 KPI:</strong></th>
<th><strong>DEC Workload</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td>Increase Workload to DEC's</td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td>Overhead</td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td>50%</td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td>DEC manhours / total spent manhours</td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td>1 / quarter</td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td>Financial system</td>
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<tr>
<td><strong>Source of data:</strong></td>
<td>Corporate Management</td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td>Line Organization</td>
</tr>
<tr>
<td>KPI</td>
<td>Purpose / CSF</td>
</tr>
<tr>
<td>-----</td>
<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>Focus on determined Products/ Technologies</td>
</tr>
<tr>
<td></td>
<td>% per category</td>
</tr>
<tr>
<td></td>
<td>1 / year</td>
</tr>
<tr>
<td></td>
<td>Business Development and financial system</td>
</tr>
<tr>
<td></td>
<td>Line Organization</td>
</tr>
<tr>
<td>2</td>
<td>Improve Relationship with Client</td>
</tr>
<tr>
<td></td>
<td>Revenue, Key Clients, Meeting Project Preconditions, Products/ Technologies</td>
</tr>
<tr>
<td></td>
<td>Revenue of clients not new to company/ total revenue</td>
</tr>
<tr>
<td></td>
<td>1 / year</td>
</tr>
<tr>
<td></td>
<td>Business Development and financial system</td>
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<td>Line Organization</td>
</tr>
<tr>
<td>3</td>
<td>Balanced Client Type Portfolio</td>
</tr>
<tr>
<td></td>
<td>Project Efficiency</td>
</tr>
<tr>
<td></td>
<td>Revenue per Client Type: cost (30%) or involvement driven (70%)</td>
</tr>
<tr>
<td></td>
<td>1 / year</td>
</tr>
<tr>
<td></td>
<td>Business Development and financial system</td>
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<td></td>
<td>Line Organization</td>
</tr>
<tr>
<td>4</td>
<td>Meeting Project Preconditions</td>
</tr>
<tr>
<td></td>
<td>Repeat Business, Project Efficiency, Followed Suggestions, Manpower</td>
</tr>
<tr>
<td></td>
<td>Projects finished within end date / total projects finished</td>
</tr>
<tr>
<td></td>
<td>1 / year</td>
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<tr>
<td></td>
<td>Project Controls</td>
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<td>Project Organization</td>
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<tr>
<td>5</td>
<td>Meeting Project Preconditions</td>
</tr>
<tr>
<td></td>
<td>Repeat Business, Project Efficiency, Followed Suggestions, Manpower</td>
</tr>
<tr>
<td></td>
<td>Projects finished within budget / total projects finished</td>
</tr>
<tr>
<td></td>
<td>1 / year</td>
</tr>
<tr>
<td></td>
<td>Project Controls</td>
</tr>
<tr>
<td></td>
<td>Project Organization</td>
</tr>
<tr>
<td>6 KPI:</td>
<td>Quality of Projects</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Purpose / CSF:</td>
<td>Meeting Project Preconditions</td>
</tr>
<tr>
<td>Relates to:</td>
<td>Repeat Business, Project Efficiency, Followed Suggestions, Manpower</td>
</tr>
<tr>
<td>Target:</td>
<td>≤ 1%</td>
</tr>
<tr>
<td>Formula:</td>
<td>Forecast cost of quality issues at mechanical complete / total project cost</td>
</tr>
<tr>
<td>Frequency:</td>
<td>1 / year</td>
</tr>
<tr>
<td>Who measures:</td>
<td>Project Controls</td>
</tr>
<tr>
<td>Source of data:</td>
<td>Project Management</td>
</tr>
<tr>
<td>Who acts on the data:</td>
<td></td>
</tr>
<tr>
<td>What do they do / mgmt process:</td>
<td></td>
</tr>
<tr>
<td>KPI level:</td>
<td>Project Organization - aggregation</td>
</tr>
<tr>
<td>KPI</td>
<td>Successful Bids - Value</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Purpose / CSF:</td>
<td>Improve Sales Efforts</td>
</tr>
<tr>
<td>Relates to:</td>
<td>Revenue, Sufficient Backlog, Employee Satisfaction</td>
</tr>
<tr>
<td>Target:</td>
<td>≤ 1.00</td>
</tr>
<tr>
<td>Formula:</td>
<td>Value of lost bids / value of awarded bids</td>
</tr>
<tr>
<td>Frequency:</td>
<td>1 / quarter</td>
</tr>
<tr>
<td>Source of data:</td>
<td>Business Development</td>
</tr>
<tr>
<td>Who measures:</td>
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<td>Who acts on the data:</td>
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<tr>
<td><strong>6 KPI:</strong></td>
<td><strong>Key Suppliers</strong></td>
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<tr>
<td>------------</td>
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<tr>
<td><strong>Purpose / CSF:</strong></td>
<td><strong>Focus on Key Suppliers</strong></td>
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<tr>
<td><strong>Relates to:</strong></td>
<td><strong>Project Efficiency</strong></td>
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<tr>
<td><strong>Target:</strong></td>
<td><strong>70%</strong></td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td><strong>PO's with key suppliers / total PO's</strong></td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td><strong>1 / quarter</strong></td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td><strong>Procurement</strong></td>
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<td><strong>Who acts on the data:</strong></td>
<td><strong>Procurement</strong></td>
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<tr>
<td><strong>What do they do / mgmt process:</strong></td>
<td><strong>Line Organization</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>7 KPI:</strong></th>
<th><strong>Manhour Efficiency</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td><strong>≤ EUR 25 / year</strong></td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td><strong>Meeting Project Preconditions, Subcontract Mgmt, Scope Mgmt, Employee</strong></td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td><strong>600 mhrs</strong></td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td><strong>Total manhours / total pieces of equipment</strong></td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td><strong>1 / quarter</strong></td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td><strong>Project Controls</strong></td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td><strong>Project Management</strong></td>
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<tr>
<td><strong>What do they do / mgmt process:</strong></td>
<td><strong>Project Organization - aggregation</strong></td>
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<table>
<thead>
<tr>
<th><strong>8 KPI:</strong></th>
<th><strong>Earned Value</strong></th>
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<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td><strong>Project Efficiency Improvement</strong></td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td><strong>Meeting Project Preconditions, Subcontract Mgmt, Scope Mgmt, Employee</strong></td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td><strong>≤ 1.00</strong></td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td><strong>Actual cost / earned value</strong></td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td><strong>1 / quarter</strong></td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td><strong>Project Controls</strong></td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td><strong>Project Management</strong></td>
</tr>
<tr>
<td><strong>What do they do / mgmt process:</strong></td>
<td><strong>Project Organization - aggregation</strong></td>
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</table>

<table>
<thead>
<tr>
<th><strong>9 KPI:</strong></th>
<th><strong>Profitable Projects</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td><strong>Project Effectiveness Improvement</strong></td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td><strong>Subcontract Mgmt, Scope Mgmt, Revenue</strong></td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td><strong>Expected profitable projects / total projects</strong></td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td><strong>1 / year</strong></td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td><strong>Project Controls</strong></td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td><strong>Project Management</strong></td>
</tr>
<tr>
<td><strong>What do they do / mgmt process:</strong></td>
<td><strong>Project Organization</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>10 KPI:</strong></th>
<th><strong>Coordination manhours</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose / CSF:</strong></td>
<td><strong>Improve MOPEX</strong></td>
</tr>
<tr>
<td><strong>Relates to:</strong></td>
<td><strong>Overhead</strong></td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td><strong>5%</strong></td>
</tr>
<tr>
<td><strong>Formula:</strong></td>
<td><strong>Coordination manhours / total manhours</strong></td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td><strong>1 / quarter</strong></td>
</tr>
<tr>
<td><strong>Who measures:</strong></td>
<td><strong>Project Engineering</strong></td>
</tr>
<tr>
<td><strong>Who acts on the data:</strong></td>
<td><strong>Project Management</strong></td>
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<tr>
<td><strong>What do they do / mgmt process:</strong></td>
<td><strong>Project Organization - aggregation</strong></td>
</tr>
<tr>
<td>KPI</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
</tr>
<tr>
<td>11</td>
<td>KPI: Subcontractor Claims - Number</td>
</tr>
<tr>
<td>12</td>
<td>KPI: Subcontractor Claims - Value</td>
</tr>
<tr>
<td>13</td>
<td>KPI: Change Orders Approved - Value</td>
</tr>
<tr>
<td>14</td>
<td>KPI: Change Orders Approved - Number</td>
</tr>
<tr>
<td>15</td>
<td>KPI: Approved Contract Value Change</td>
</tr>
</tbody>
</table>

*Change Notifications are raised by the Contractor and issued to the Client. If Client approves the Change Notification, it becomes a Change Order.
<table>
<thead>
<tr>
<th>KPI</th>
<th>Description</th>
<th>Purpose / CSF</th>
<th>Relates to</th>
<th>Target</th>
<th>Formula</th>
<th>Frequency</th>
<th>Who measures</th>
<th>Source of data</th>
<th>Who acts on the data</th>
<th>What do they do / mgmt process</th>
<th>KPI level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Free Cash Flow</td>
<td>Available Cash Amount</td>
<td>Employee Satisfaction, EBIT</td>
<td>≤ 1.00</td>
<td>Planned free cash flow / actual free cash flow</td>
<td>1 / mth</td>
<td>Business plan and financial system</td>
<td>Corporate Finance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Employee Satisfaction Index</td>
<td>Employee Satisfaction</td>
<td>Sales Efforts, Future Net Cash Flow, Free Cash Flow, Project Type, Project Efficiency</td>
<td>avg 8 (scale 1-10)</td>
<td>Composed on basis of factors in section 6.3</td>
<td>1 / year</td>
<td>Survey</td>
<td>Corporate TQM</td>
<td></td>
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<tr>
<td>3</td>
<td>Followed Suggestions</td>
<td>Capture Lessons Learned</td>
<td>Meeting Project Preconditions</td>
<td>85%</td>
<td># followed CIM's / # raised CIM's**</td>
<td>1 / quarter</td>
<td>CIM database</td>
<td>Corporate Management</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** CIM: Continual Improvement Measures (actions), an existing system where individual can raise improvement suggestions.