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Declaration

I declare that I have developed and written the enclosed Master Thesis completely by myself, and have not used sources or means without declaration in the text. Any thoughts from others or literal quotations are clearly marked. The Master Thesis was not used in the same or in a similar version to achieve an academic grading or is being published elsewhere.

Location	Date	Signature
Hamburg	*16.06.2014*	

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ABSTRACT

Blohm + Voss Repair GmbH (the company), Hamburg has established a competitive name on the maritime market for repair, conversion and refit performances of cruise vessels, mega yachts and literally all kind of civil and marine vessels and has started to strive for projects in the on-growing Offshore and Oil & Gas (OG) market. Prospects for the near future are focused on the conversion of vessels working for the supply, operation, maintenance and/or accommodation sector in within market of offshore developments and structures.

Two different large/long-term projects have recently being processed and completed upon satisfaction of the customers. The FPSO *Enquest Produce*r formerly UISGE GORM towed to the yard in January 2013 and completed in October 2013 had received a "Lifetime-Extension" with new fit-ups, conversions and repairs throughout both main divisions of the vessel, marine and topsides ("offshore"). The repair of the FPSO *Petrojarl Banff*, started in September 2012 and completed in March 2014, was necessary due to damages on the turret of the vessel suffered from a storm in December 2011.

The extensive experiences gained from both projects revealed a considerable amount of flaws in within the company's organisation and the prerequisites necessary for the execution of projects with comparable high scopes and performance complexities, as was the case on both above-mentioned offshore projects. Based on the investigations on currently applied structures and states in the processing of repair projects at the yard, experiences gained from the two large projects, and the implementation of risk analysis the main approach of this work is to provide a sample of major states flawing or limiting not only the progress but the success of projects processed at the yard. The baseline will be the investigation on currently applied processing standards and structures and supported by further research on experiences gained from the two projects mentioned above. Based on this information the further investigation will focus on the analysis and assessment of respective causes and consequences, the establishment of a risk picture and the analysis and proposal of corrective and preventive measures to be applied on these states to improve and support the yard's quality, preparedness and good practice in the execution of future projects.

Due to the complexity and size of this topic a total (complete) risk analysis as part of this project is not feasible and not the intention. Thus the analysis of this work places the main focus on the presentation of the general approach by following current applications, providing a good overview of flaws and constraints, and the demonstration of potential attributions risk analysis could have on the overall success of a project if implemented in certain organisational levels of Blohm + Voss Repair GmbH.

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List of Abbreviations and Acronyms

BV	Blohm + Voss
BVR	Blohm + Voss Repair
BVR	Blohm + Voss Repair GmbH
CO / VO	Change Order / Variation Order
DL	Department Leader (head of department / team)
DMM	Disciplinary Management (project related)
ERP	Enterprise Resource Planning
FE	Field Engineer
HSE	Health Safety Executive
ICT	Information, Communication, Technology
IT	Information Technology
IWL	Item Work List
MFE	Main Field Engineer
NDT	Non Destructive Testing
OG (O&G)	Oil and Gas (industry)
PM	Project Manager
SFE	Sub Field Engineer
SRP	Single Response Planning
UM	Upper Management

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1. INTRODUCTION

1.1 Background and Purpose

This thesis was prepared to investigate on the sequence of repair and refit projects and respective project organisations as currently performed at Blohm + Voss Repair GmbH in Hamburg from a risk engineering & project perspective. Hereby special emphasis is put on the assessment of major flawing states in within global corporate structures and procedures limiting the success of certain major disciplines in within large project organisations. The assessment of special fields of two lately delivered and very important long-term offshore projects (*“Enquest Producer” & “Petrojarl Banff”*) shall help to support and to round out the preceding investigations. Since this study is seizing on a huge amount of data from many different disciplines with varying dependencies and uncertainties and due to the complexity and absence of quantifying measures the risk assessment will be concentrating on the qualitative (mainly descriptive) analysis and evaluation of initiating events, causes and consequences of procedures, processes and structures.

The background of this work and hence the key events revealing the needs for such an investigative work are lying especially in within the gained and fresh experiences from the above mentioned offshore projects. The ship construction and repair industry operates in a working and processing environment similar to the Offshore / Oil and Gas Industry (O&G) and also, as this thesis will point out, does the yard struggle with a number of issues O&G companies have started to attack in the mid-20th century by means of risk analysis techniques. The contingency and hence the main reason for not implementing such tools at the yard are grounded in the considerably smaller amount of streams (stakeholders, processes, industries) involved, though with a good number of similar processes, implied risks and consequences, but of lower probabilities, occurrences and severities compared to the O&G industry. Herewith the major distinctions mainly emerge from the lower amount of stakeholders’ involved, less critical risks and less severe consequences, a much shorter processing time line (project lifetime) and also the geographical/areal closure of the asset ‘yard’ and its construction sites.

Whereas certain situations would require a similar quantification of risks due to comparable consequences (such as hazards, safety of personnel, time schedules, costs and similar) many of the liabilities are of much lower or of a different quality. In order to provide assumptions why a global risk assessment approach on production and project level has not been implemented yet at the yard and why such an evaluation generally is a hard task, the following reasons could be:

- Nature of projects (usually short, fast, uncomplicated, highly divergent)
- Considerably easy projects (‘easy’ distinction of work performances)
- Hard to quantify (no or only few records taken, poor amount of reference values)
- Not needed internally (risks vs. consequences have been assessed on the fast track by either subjective or logical interpretations of given situations)
- Not requested externally (no or only few requests by customers yet)
- Effort versus benefit was too low (no capacities, no time, no foundation, no decisive advantages seen)
- The approach of risk assessment/analysis did not fit with repair philosophy of “fast, flexible, uncomplicated then safe”
- The over dominant human factor in the assessment and analysis of risks at Blohm + Voss Repair GmbH

The need of striving for detailed and thorough assessments and the consideration of the risk perspective of certain states in within a company’s organisation are grounded in the increasing complexity of performances and services requested by the ship construction and repair industry. This comprises along with higher and more complex scopes of works, the distinctive increase of time schedules needed to accomplish the jobs. Further there is a continuous increase of regulations and demands on technical, managerial, quality and safety matters, which portrays a company’s image to the public and prospective customers based on how good these measures are being grossed. Ultimately it is the yard directive’s intention and future goal to procure on rather large, complex and special projects such as offshore structures, mega-yachts or cruise ships.

One purpose of this thesis is to layout a proposal for the implementation of “BVR production risk analysis” as part of the management system at Blohm + Voss Repair GmbH. This will take place on the qualitative evaluation of currently applied circumstances, supported by experiences from two offshore projects and by means of solution proposals of flawing states. The main focus hereby is the assessment of current processes, procedures and definitions on project level, accompanied risks, major events, missing safety barriers and the respective positive and negative consequences. Based on this evaluation solution proposals will be presented that could be implemented as proactive safety barriers, mitigating measures and recovery preparedness measures to limit certain outcomes in the sequence of a project organisation.

1.2 Methodology

The collection and processing of all data and information on internal yard processes and the two offshore projects are grounded in the author’s:

- Four-year experience as a field engineer on the yard, prior to commencement of the master studies at UIS

- Participation as a project team member in the field engineering department on both projects during the months May – August 2013 (summer job)
- Discussion and knowledge experience exchanges with colleagues from the yard and the clients
- Intensive study of current applicable yard standards and the contractual agreements of the offshore projects. The main yard internal documents used, are:
    - Manual ‘Integrated Management System’ (IMS), Blohm + Voss Repair GmbH, Issue 02 January 2013
    - ‘Sub-Contractors Manual’ - “*Safety Regulations – Operating Instructions*”, Blohm + Voss Repair GmbH, Issue 01 December 2012
    - ‘Organisationsbeschreibung’ – „*4.1 Prozessablauf Schiffsreparatur und –umbau*” (engl.: ‘Process Description’ – „*4.1 Process operation of ship repairs and conversions*“), Blohm + Voss Repair GmbH, Issue 04 August 2010
    - ‘BVR shipbuilding & structural standards’ – “OFFSHORE PROJECTS”, Blohm + Voss Repair GmbH
    - Contractual agreements between Blohm + Voss Repair GmbH and Enquest Britain Limited
    - Contractual agreements between Blohm + Voss Repair GmbH and Teekay Petrojarl Floating Production UK Limited
    -

The assessment and analysis of the respective data was carried out based on the achieved knowledge from the master studies at UIS and the use and application of literature and sources as listed in the reference list at the end of this thesis

1.3 Structure of the Thesis

Chapter 1 **Introduction**	Description of the problem and background of this project’s topic and scope of this report as well as a short introduction of the yard.
Chapter 2 **Theoretical framework**	This chapter comprises the introduction of risk analysis and assessment and its application on this study. A brief insight will be provided into integrated operations to support prospective solution proposals of investigated deliverables of this report. The last part is necessary provide and outline basic background information related to yard project structures and the two offshore projects.
Chapter 3 **Analysis of BVR project processes**	Chapter 3 concentrates on the definition and discussion of states in within the company/project organisations and the two offshore projects, which limit(ed) the progress and success of major structures and procedures. The chapter represents the assessment of causes and consequences, the establishment of a risk picture and will be completed with

	the assessments gained by means of risk analysis forms attached to Appendix III.
Chapter 4 **Discussion and evaluation**	This chapter serves the purpose to discuss and to evaluate on the failure of existing barriers and the proposal of new and reconsidered barriers, and mitigating measures to limit the severity of certain processes. All barriers will be summarised at the end of this chapter and allocated according to the flawing states discussed in the preceding chapter 2.
Chapter 5 **Conclusion**	This conclusion part ends the thesis by means of conclusive remarks on the investigations performed and the proposal of potential more detailed risk analyses within certain processes and structures of the yard in the future.

2. THEORETICAL FRAMEWORK

2.1 The Risk Analysis Approach

2.1.1 Introduction

„The objective of a risk analysis is to describe risk, i.e. to present an informative risk picture” (Aven 2008)

Based on this definition, one main intention of this thesis is to provide an overview of basic ideas and approaches to implement the tools of risk analysis, evaluation and assessment into BVR project and production disciplines and to reveal its potential contributions to potential improvement of certain states in within the company. Risk analyses techniques currently applied on the yard are still limited to the phase of new project acquisitions. The HSE department recently introduced the risk assessment of critical standard and project related performances (steelworks, repairs, workshop performances, etc.) to observe on risks contributed to respective potential hazards (accidents, victims) based on a five-scaled risk matrix. Analysis performances on project, ergo on production level are not existent on a level that standardised and commonly known risk analysis techniques are used to support the decision making processes of planning, organisation and execution of repair performances on a daily run. Hence one faces a lack of documented, collected and quantified measures to define and compute probabilities for risks and related frequencies of respective consequences when analysing major disciplines of a project organisation. The risk analysis as part of this work thus places the main focus on the designation of observations and communicated knowledge to provide a brief collection of information around special cases in the company. This could be a matter of further and more detailed risk analyses in the near future.

The main advantages of risk analysis are lying in its applicability on basically all steps of an organisation. Based on expected results of this research, (Aven 2008) states that risk analysis tools can be implemented in the concept phase, be continued or newly assessed in the planning and construction period and especially provide high support potentials during on-going operational phases of a system. Each one of these phases is part of a complete BVR project. As stated in Chapter 1.1 a main goal of this work is to layout first proposals for the implementation of a BVR 'production risk analysis' and risk management system. "Risk Management relates to all activities, conditions and events, that can affect the organisation, and its ability to reach the organisation's goals and vision. The risk analysis process is a central part of the risk management" (Aven 2008) By going more into detail (Aven & Vinnem 2007) state that the "purpose of risk management is to ensure that adequate measures are taken to protect people, the environment and assets from harmful consequences of the activities being undertaken, as well as balancing different concerns, in particular HES (Health, Environment and Safety) and costs." Both of the approaches will support the further intention of this investigation.

According to (Aven 2008) the main steps of the risk analysis process are defined by planning, risk assessment – whereas risk assessment is the sum of risk analysis and risk evaluation – followed by risk treatment. The presented Figure 2-1 pictures the main steps of a risk analysis process and will further be used to align the consecutive steps of the risk analysis process in within this thesis to the standard risk analysis process.

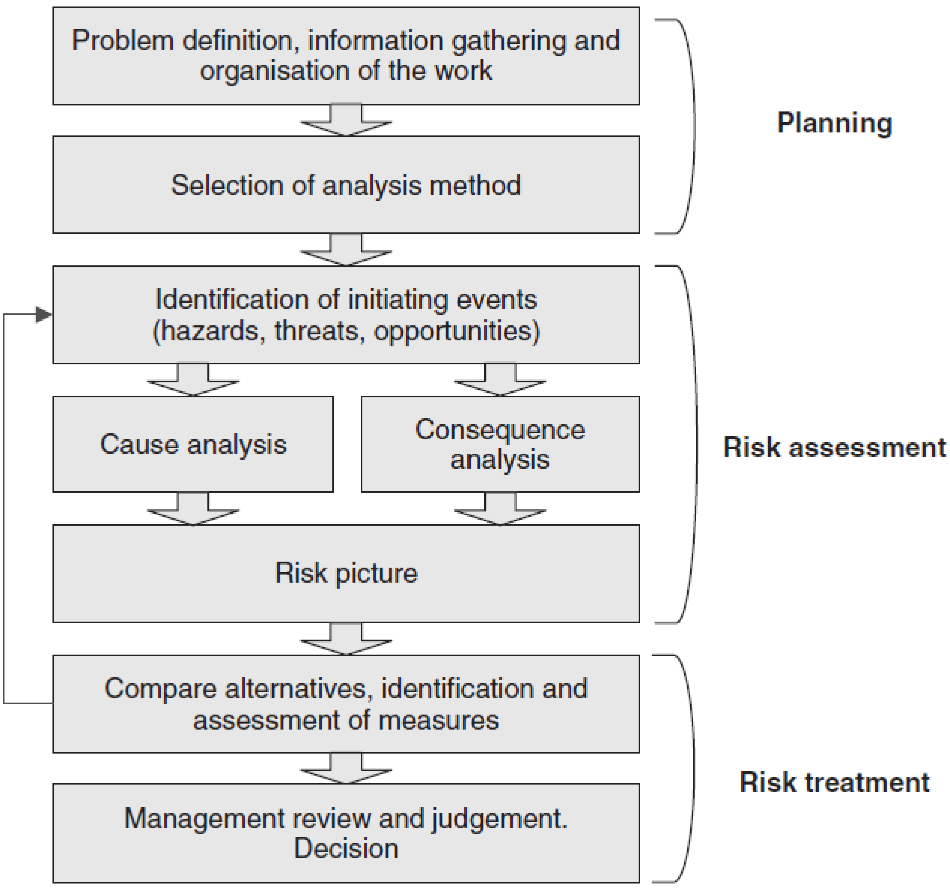

Figure 2- 1: The main steps of the risk analysis process adapted from (Aven 2008)

2.1.2 The risk analysis process

In order to support the intention and the structure of this thesis, Figure 2-1 shall be used as the main model to structure, assort and assign investigated information presented in the subsequence chapters and appendices according to the major steps of a risk analysis process as presented by (Aven 2008).

1 **Problem definition, information gathering and organisation of the work**
The problem definition and hence the background and purpose of this work is described as to Chapters 1.1 and 2.1.1. The pre-work to this thesis, hence the information gathering and collection around the topic has been carried out based on discussions with staff from different departments of the yard’s organisation and on observations, experiences and assumptions of the author. As a last issue of this first step, the description of the organisation and structure of this work is grounded in the current chapter.

2 **Selection of analysis method**
Measured by the amount of information and fields this work aims to capture and discuss, the restricted time and scope for detailed sub-analyses and the missing opportunities of implementing corrective measures/alternatives in order to loop a another risk assessment for review and judgement on changes, this work can not cover a complete (total) risk analysis process. Thus it can and will provide a necessary collection of information and approaches to implement assessments in the future. The investigated information is briefly prepared in combining elements of “simulated” coarse risk analysis and job safety analysis. The term “simulated” here implies the simulation of analysis workshops usually held by a number of different specialists of 3-10 persons according to (Aven 2008) to gather, collect and assess risks in within a certain matter and which is here accomplished by the author only. Since most of the investigations are grounded on observations, experiences and discussions with major influences from the author, many issues discussed in this work cannot be as reflective and objective as a team of specialists could be. Thus this project will be limited to major states in within yard and project structures to analyse on a set of consequences.

3 **Identification of initiating events (hazards, threats, opportunities)**
The identification of initiating events is the first step of the risk analysis and is handled in the chapters 3.2 ‘Analysis of present standard procedures’ and 3.3 ‘Analysis of two offshore projects’. Herewith the sub-chapter levels 3.2.# (3.3. #) represent the main fields/disciplines of concern and the sub-sub-chapters 3.2.#.# (3.3.#.#) the analysis and discussion of initiating events and ‘failure modes” in within these disciplines, i.e.: Chapter 3.2.1 assigns the current general project organisation as the first main discipline. Respectively, chapter 3.2.1.1 represents the initiating event by the failure of ‘structures, procedures and job/position descriptions’ and e.g. chapter 3.2.1.3 discusses the initiating event by the failure due to ‘behavioural and habitual structures’.

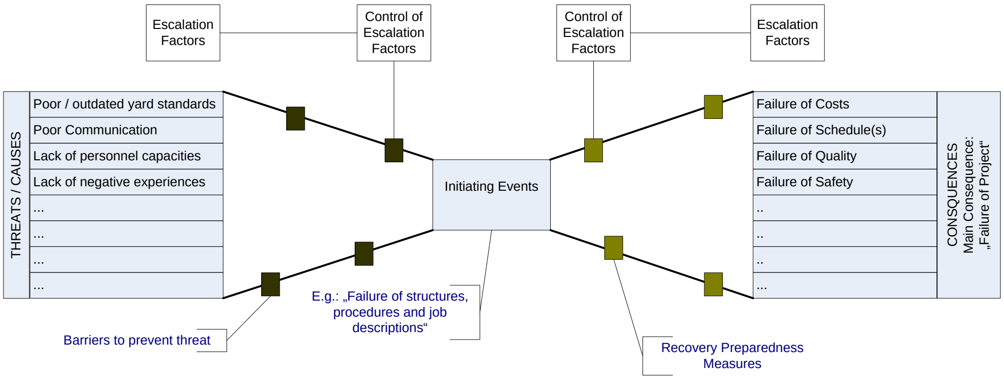

Figure 2- 2: Example of a bow-tie based on a figure by (Vinnem 2007)

Due to the post-treatment of events, their causes and consequences of states in within a BVR project organisation the risk analysis will generally follow a backward approach. This induces the identification of main resulting events or situations, leading to a limited analysis of the selected events and the analysis of respective causes. The outcome will result in a tabular sorting, according to Table 2-2, leant on a bow tie, exemplary to Figure 2-2, to visualise the causes–event–consequence relation in within the investigated disciplines.

4 Cause Analysis + Consequence Analysis

The analysis of consequences, causes and events will follow a slightly modified structure of the analysis form (Table 2-1) proposed by (Aven 2008) where risk is described by using categories for undesirable events, probabilities and expected consequence.

Sub-element	Hazards / causes			Probabilities and consequences		Comments	Risk	Possible measures	Comments
	Hazard	Undesirable Event	Causes	Consequence Analysis	Probability Analysis				
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…

Table 2- 1: Example of an analysis form for a coarse risk analysis (Aven 2008)

The modified analysis form will hence follow the structure as demonstrated by Table 2-1 and will support the thesis's risk analysis as an attachment to Appendix III. Here a slight differentiation in the consequence analyses will be made between the chapters 3.2 'present standard procedures' and 3.3 'procedures from the offshore projects'. Since the chapter 3.2 is based on a discussion on issues of a very general and broad perspective, with a huge and indiscrete number of resulting events a limitation of consequences is made based on the definition of four core values of a project requiring the definition of the main consequence and the diversification of underlying sub-consequences:

Main consequence (Def.)

The main consequence of any initiating event is defined as the “Project Failure”. Since the yard offers a product/service a different term could be “Product Delivery Failure” as to project’s core values. The product delivery failure comprises the failure of any state leading to at least one sub-consequence, each of which represents one core value.

Sub consequence(s) (def.)
The sub consequences are based on four main core values of a company, which are the compliance and assurance of safety, profit gain (costs), the assurance of quality to predefined or given requested standards and the compliance to schedules (schedule keeping). Hence, the possible sub-consequences would be defined as:

- failure of safety (i.e. hazards, accidents, injuries, victims)
- failure of profit (i.e. generally defines any loss-making business)
- failure of quality (i.e. failure of quality in management, technical execution, safety, assets, etc.)
- failure of schedules (i.e. inability to keep schedules on item and on project level)

No	Initiating Event	Causes	Consequences	Remarks	Reference		Risk	
					Thesis Refer.	Process Refer.	Description	Coarse Valuation
random numbering system	[Text]	[Text]	[Text]	[Text]	[chapter reference]	[process of project reference as to chapter 2.4]	[Text]	high / moderate / low
…	…	…	…	…	…	…	…	…

Table 2- 2: Main template for this project's risk analysis form

Example:
Let’s suppose a large project lasting over one year is processed in good technical quality, exact schedule and in a high profit gain for the yard. We assume in month nine a random event of failing on a “planning + safety” event, resulting in a severe accident with two people killed. Thus we have failed on the yard’s safety value and hence the project is to be ranked as “failed” according to the definition above.

Now for this example such a distinction between “fail” and “not fail” could in fact make sense. If we’d take the case that one of the victims simply cut his finger and the other one tripped over a cable and slightly bumped his head such a wide divergence would have crucial effect on the success/failure definition. In subsequent and prospective risk analyses of the disciplines, such distinctions are to be avoided by introducing risk aversion, which (NORSOK Z-013 2010) defines as “an evaluation of risk which places more importance on certain accidental consequences that on others" further stating that it should not be included in the quantitative expression of risk. The assessment of risk and its tolerability could thus be acknowledged on a qualitative accession. Another approach could be the consideration of acceptance criteria [RAC]. According to (NORSOK Z-013 2010) „Risk acceptance criteria illustrate the overall risk level which is determined as tolerable, with respect to a defined period of time or a phase of the activity. The RAC constitute a reference for the evaluation of the need of risk reducing measures and shall therefore be available prior to starting the risk analysis." An implementation of risk acceptance to latter example could be the introduction of frequencies and weightings / probabilities (of occurrence) for different types of accidents. Hence one could define that a certain minimum amount of accidents per time frame contribute to the failure of the safety management, if not counteracted and hence leads to the failure of the project. It will thus be used to describe a level of risk which is to be considered as tolerable for a specific action. Due to a necessary limitation of this thesis neither aversion nor RAC will be introduced as part of this analysis.

Chapter 3.3 discusses more detailed information based on actual experiences from two projects, since many issues directly result from general existing states as will be shown in chapter 3.2. The consequence analysis here will carry a slightly more detailed character based on project experiences. Adjustment is made in the analysis forms for the projects (Tables A-III-2 & A-III-3, Appendix III) where the second reference will not be made to the "project process step" but to its respective source of "initiating event" in within present standard procedures (Ch. 3.2) in order to show the contribution of and connection to existing states.

In order to o provide an adequate and informative background, the chapters 2.3 & 3.3 will also introduce the cause analysis which is summarized and completed by the means of the risk analysis forms attached to this work as Appendix III.

5 Risk picture

"Risk is related to future events A and their consequences (outcomes) C." (Aven 2008) According to (NORSOK Z-013 2010) risk is "a combination of the probability of occurrence of harm and the severity of that harm". A similar definition (Vinnem 2007; Vinnem 2014) state by referencing to ISO 2002 stating that risk is a "combination of the probability of an event and its consequences". In general risk can be described qualitatively or quantitatively by using distributions, probabilities and frequencies (time).

In order to provide a deeper insight further measures, introduced by (Aven 2008), are the uncertainty U which is to be associated with both, A and C (i.e. lack of knowledge about the occurrence), the probability P (i.e. expressing the likelihood of the event A and that by this, specific consequences will result) and the given background knowledge, K. Based on these measures, risk is then described by (C, C*, U, P, K), whereas C* is the prediction of C. In order to insert an initiating event or undesirable event (in the case of a negative outcome), the term of 'vulnerability' is presented. Vulnerability follows a similar approach of risk by considering consequence C, prediction of C (C*), uncertainty U, probability P and the given background knowledge K, but given that an initiating event is happening:

$$(C, C^*, U, P, K \mid A)$$

For the easiness of understanding the term "vulnerable" could be defined as an expression for a weak point in within a certain state or an event. Hence vulnerability can be considered as high if an initiating event occurs – defined by a given weak state – and results in a high combination of consequences and uncertainties.

In order to introduce one way of calculating risk we will have a look at the following approach. (Vinnem 2014) assumes that the most commonly expression of risk used, is the expected value R or EX. A formula he presents, expresses risk as an expected consequence, where as R is the summation of probability p multiplied by consequence C over an accident sequence, i.

$$R = \sum_i \left(p_i \cdot C_i \right)$$

where:	i =	accident sequence
	p =	probability of accidents
	C =	consequence of accidents

As already mentioned a thorough or 'total risk analysis' is not possible, simply due to the amount of different disciplines, respective discussions, dependencies and finally due to the different necessary analysis methods. Calculations similar to the formula presented above will not be provided. The risk picture, which will be developed throughout the analysis steps, is hence greatly simplified and descriptive. In the tables provided by ANNEX III, risk will be described by two measures, which are as defined as follows:

1 Description ("threat"):
The definitions of single risks are supported by describing a 'subsequent cause' of the respective collection of main threats/causes.

2 Valuation ("value"):
The subsequent cause or worded "risk" is thus measured on a simplified three–level coarse scale of "low", "moderate" and "high" and underlies the subjections of the author only.

As part of the risk analysis process, this risk picture is assumed to be adequate in order to investigate on major flaws of given events and to evaluate existing and missing and corrective measures.

6 Compare alternatives, identification and assessment of measures

This step is treated in this work with the discussion and evaluation of corrective measures in chapter 4 'Discussions and Evaluation'. The information collected in Appendix III regarding causes and consequences in context with initiating events and the rendered risk picture of each discipline is discussed in this chapter in regards of solution proposals or barriers and recovery preparedness measures needed to limit or exclude the occurrence of respective initiating events or to diminish its effects on assigned consequences.

Since the analysis carries a huge descriptive character, i.e. mainly worded analysis of states and solution proposals of barriers and measure – the loop to the first step of a second risk assessment as demonstrated in Figure 2-1 will not be possible. Hence effects of proposed measures on certain states and possible changes cannot be part of this work.

7 Management review and judgement, Decision
Due to the limitation stated latter step, a review on the effects of risk treatment can not be offered at this moment. Though as part of this work this step will represented by chapter five "Conclusion", which will be used to summarise all investigations and outcomes of this thesis in a briefly manner. The major outcome will be the evaluation of a checklist similar to the proposed checklist-based approach by (Aven 2008) in order to assort the investigated fields to possible, future or subsequent risk analysis methods.

2.2 Integrated Operations

The term Integrated Operations (IO) is widely referred as to a continuous research and development of work processes with the help of new technologies. For the past two decades the implementation of IO is of driving importance in within the Oil and Gas Industry in order to react upon the global changes on the petroleum market, the growing complexity in the exploration and development of already existing and new oil fields and the respective rise of the price of oil.

The definitions of this term vary throughout the many participants of the industry. The (IOC 2013) defines Integrated Operations as "the integration of people, organizations, work processes and information technology to make smarter decision" According to (Statoil 2008) IO imply the usage of "real time data and new technology to remove the divides between disciplines, professional groups and companies and [!] is commonly associated with operative cooperation between sea and land."

Across many other definitions found during the research of this topic, the key approach of Integrated Operations can be outlined as the endeavour for new work processes and clean decision-making solutions in within a company's organisation using modern technologies for data acquisition, assessment, visualisation, planning and distribution.

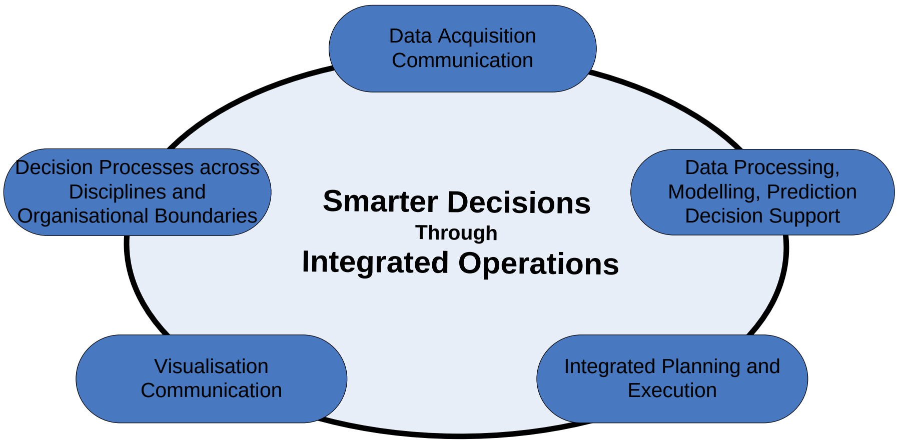

Table 2- 3: The IO loop, based on a figure by (IOC 2011)

Figure 2-3 shall give an insight to some aspects of the IO loop in terms of improving decision-making procedures. Not all of the aspects of IO might be relevant for the ship repair industry or the present situations at BVR but some do have higher potential to attribute improvements on the long run. Despite the managerial, technical and environmental differences between the ship construction/repair industry and the O&G industry it is much of a coincidence that many of the trouble shootings this thesis is aiming to discuss show parallels to problems and flaws the O&G industry has started to tackle by implementing techniques for Integrated Operations.

An introduction of IO as part of this study is targeting for two main objectives. The first one is to work out a proposal for the implementation of IO techniques adjusted to the needs of BVR. This further goes along with the presentation of the potential of IO performances in order to propose a new approach for assessing a modern operational and managerial philosophy at the yard. The second objective is to outline the necessity of obtaining a sustaining compatibility to attained processes and structures of customers already working with standardized IO systems. This especially pertains on customers from the offshore industry and grabs the yards approach to further establish itself in the construction, conversion and repair of offshore structures.

2.2.1 Integrated work process

The elementary differences between traditional work processes and integrated work processes (IWP) are captured and discussed in a study of (OLF 2005) describing an implementation process for IWP on a two generation model. The main differences of these two practices, i.e. traditional and intelligent/integrated work processes are to be found in the emphasis on interdisciplinary methods, the collaborative environment across companies (on- and offshore, suppliers, operators, etc.) and parallel work processes. According to (Bai & Liyanage 2012a) Integrated Work Processes (IWP) "involves an effort to integrate work processes across operational disciplines by using Information Communication Techniques (ICT) involving [!] a series of technical and managerial measures". In order to enhance the interdisciplinary management environment towards improvement of time, quality, cost and less risk (Bai & Liyanage 2012a) further state the necessity to make these indicators "available to all parties involved, online and in real time". The baseline for successful IWPs in within an organisation is generally defined by an intelligent implementation of planning processes adjusted to the needs of the company, dealing with the rearrangement of both, disciplinary and interdisciplinary responsibilities, tasks and activities. According to (Bai & Liyanage 2012b) a systematic development of IWP involves two major aspects:

- Application of new technologies/tools for better communication capacity and information exchange
- Adjustment and rearrangement of current work processes and performance practices to reduce conflicts and to improve better time and resources and capacity management

2.2.2 Integrated planning

IP in general can be described as a planning process aimed at integrating all dispersive plans across different disciplines, enabling the alignment of key operational planning processes to provide a common perspective across work plans. (Kayacan & Çelik 2003)

Integrated Planning enforces the definition and integration of operational plans in to one central planning system which reveals critical dependencies, processes or collision of critical processes. An example of operational plans on a BVR project could be seen on field engineering level when coordinating and processing many different performances and trades (e.g. steel, welding, painting, electrics) which are limited to areal or scheduling constraints. The implementation in Integrated Planning thus involves the introduction of a neat and horizontal cooperation between field engineers, project engineers or other disciplines with an established planning team and respective IP planners allocated on either yard global or project level (see Ch. 4.2.5.2 for more) to investigate on necessary data and respective constraints. This group of "experts and IP planners investigate this information and solve conflicts in the work schedules through workshops or other support tools and finalise periodic plans (i.e. short-term, medium-term, and long-term plans) together. (Bai & Liyanage 2010) These period plans are categorised upon three time-controlled levels:

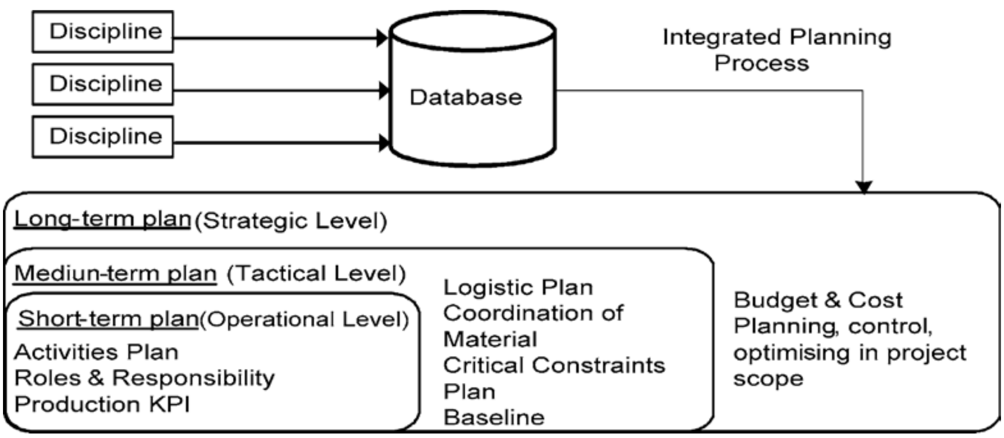

Table 2- 4: Different periodic plans are addressed in Integrated Planning (Bai & Liyanage 2012a)

Short term plan (weekly basis, / operational level):
This plan describes performance activities and assigns the roles and responsibilities and tasks of project procedural performances. It requires the definition of measurable quantitative indications in order to ensure its success.

Medium term plan (monthly base / tactical level):
The medium term plan is necessary to define future tasks in order to ensure the production continuity, based on the evaluation of constraint factors that might limit certain capacities. The continuous analysis of current states against future needs support the coordination of requirements and conflicts.

Long-term plan (yearly base / strategic plan)
“The long-term plan (one-year plan) is the reflection of the organisation’s strategy that involves information about cost, time, quality and risk which are fundamental components of business planning. (Bai & Liyanage 2012a) The specific benefits of the implementation of Integrated Planning in to BVR business context and thus into project processing context are (Bai & Liyanage 2012a) summarise by means of three main operational requirements:

1 Planning the future work with horizontal periodic plans based on constraint factors
2 Creating commitment to work process milestones and templates for continuous integrity in planning
3 Enhancing the IT environment to be well-suited for the users’ requirements and optimising the Integrated Planning work process

Similar to the O&G industry, the maritime and shipbuilding industry is impacted by very intensive technological, economic, environmental and safety related processes. The complexity of these work processes is constrained by the participation of huge amounts of companies of different businesses, socio-cultural differences as well as operational and regulatory constraints. (Bai & Liyanage 2010) mention that there will never be one ultimate IP solution covering all aspects since solutions for different regions depend “on the businesses and other conditions that a company and the producing asset is exposed to”. In order to differentiate states and conditions (Bai & Liyanage 2010)introduce a classification of IP into four different levels, varying from basic to advance:

- **Level 1** defines the basic or conventional status. Single disciplines and sections are planning their respective work processes for the next period and bring these up to a list of work. By the means of interdisciplinary workshops and teams, critical work packs are assessed and prioritised upon considered constraints.
- **Level 2** is defined as the minor intermediate state and implies the constitution of the expected activities of each discipline into an independent database. The integrated work processes are prioritised by the means field-wide horizontal plans (i.e. short, medium and long term objectives and attributed through milestones or performance indicators (PI) such as dates, durations, costs, deployments, material, complete percentage, responsibilities, priorities.
- **Level 3** is the major intermediate status in the planning process. The main approach of this level is to integrate all planning to Onshore Centers (OC) by the use of

advanced communication technologies. These offer the possibilities of real time support and dynamic coordination of multi-disciplinary actions by means of monitoring tools and visualisation technologies.

- **Level 4** as the “relatively advanced status” puts an advanced focus on the cooperation between external vendors and partners.

Similar to (Bai & Liyanage 2010) example of a random oilfield, any project initiated on this yard might limit itself to one specific level according to the business environment or could be scheduled downwards from one level to another. Based on the levels described above the further scope of this work will discipline where the implementation of IO processes on BVR project level could attribute to the success of performances and the project accomplishment

2.3 Theoretical framework of BVR projects

2.3.1 The process of repair and conversion of ships

This chapter serves the purpose to give a closer insight to procedures and organisational structures of the repair and conversion of ships and similar structures as they are currently applied at Blohm + Voss Repair GmbH.

In order to perceive a wider understanding of the recently applied procedures and organisational structures on the yard the reader is recommended to study ANNEX I: ‘Process of repair and conversion of ships’ prior to processing with this chapter. This paper was created based on the study of current applicable yard standards mainly published in German language only and to provide a summarised English written version. It is to be stated that the contents are collected by summarisation and translation of existing papers and are not intellectual property of the author. Based on the information given in this paper and discussions with former colleagues a process description was developed in order to visualise and describe the course of a standard project at BVR as to present state and is attached to this project by ANNEX II. The evaluated flowcharts in the Appendix and based on this reduced flowchart as to Figure 2-3 shall provide basic understanding of the two main phases in within a ship repair project at BVR. Thus this chapter will give a general overview of the main consecutive steps in within each phase – descriptions and specifications of the main and intermediate steps of each phase can be found in ANNEX II.

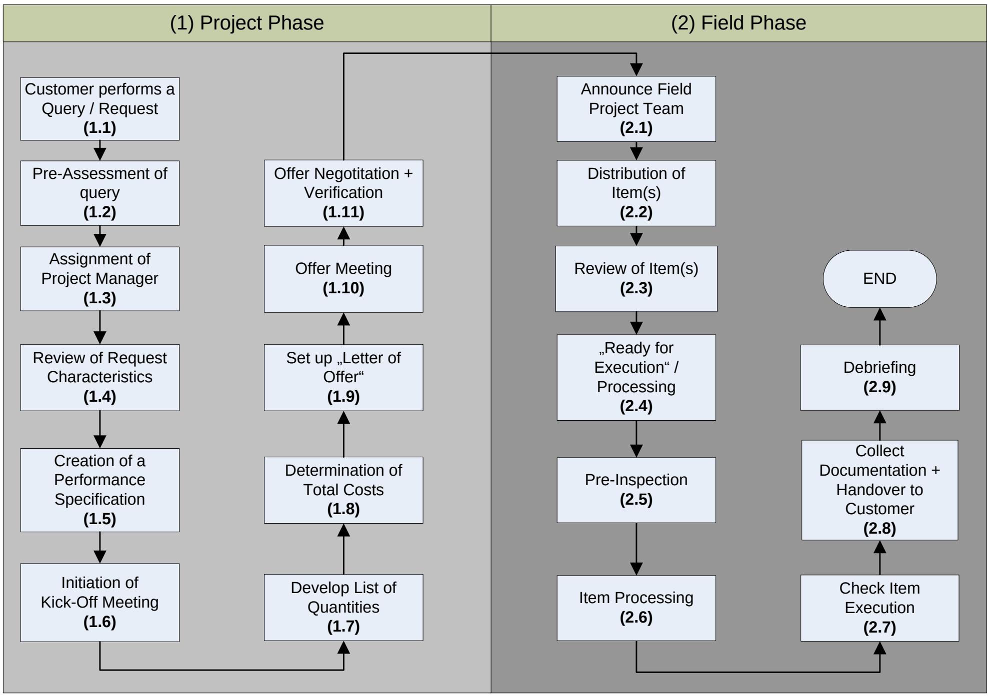

Figure 2- 3: Process diagram for a standard BVR project

1 The Project Phase

"The project phase comprises the period of processing a request or query for repair/conversion without having a contractual order yet issued by the prospective customer." (Appendix I, Ch.4 'The Project Phase')

(1.1) Customer performs a Query Request
(1.2) Pre-Assessment of Query
(1.2.1) Rejection of Query
(1.3) Assignment of a Project Manager
(1.4) Review of Request Characteristics
(1.5) Creation of the Performance Specification
(1.6) Initiation of a Kick-Off Meeting
(1.7) Development of the List of Quantities
(1.8) Determination of the Total Costs
(1.9) Setting up of the "Letter of Offer"
(1.10) Offer Meeting
(1.11) Offer Negotiation and Verification

2 The Field Phase

The field phase comprises the period of processing given, that a contract is signed for a repair, a conversion or a new-built. It introduces all necessary steps of pre-assessment, evaluation, execution and finalisation on management and production level of any kind of project initiated on the yard.

(1.12) Announce Field Project Team
(1.13) Distribution of Item(s)
(1.14) Review of Item(s)
(1.14.1) Obtain and Check Documentation

(1.14.2) Provide New Documentation
(1.14.3) Clarification
(1.14.4) Item(s) Cancellation
(1.15) Ready for Execution / Initiation of Processing
(1.16) Pre-Inspection
(1.16.1) Clarification
(1.16.2) Item(s) Cancellation
(1.17) Item Processing
(1.18) Check Item Execution / Inspection
(1.19) Collect Documentation + Handover to Customer
(1.20) Debriefing

2.3.2 Introduction of two offshore projects

In order to perceive a general impression of the latest two offshore projects the subordinated two chapters 2.3.2.1 & 2.3.2.2 will provide a brief and tabular overview of necessary background information regarding the two projects of interest.

2.3.2.1 Enquest Producer

Vessel	Enquest Producer, formerly UISGE GORM
Client	Enquest Britain Limited
Duration	January 2012 - October 2013
Project Leadership	2 x yard's own project managers (+1 support)
Classification Society	Lloyd's Register (LR)
List of main performances	‘Repair and Lifetime Extension and Upgrade of FPSO Uisge Gorm' Repair and Lifetime Extension Jobs • Repairs of all kind Upgrade Work • Hull Naval & Marine Systems (fatigue brackets, flare stack removal and new installation, upgrade + new installation of foundations) Accommodation (decommissioning, conversion and new installations) • Ship Systems (decommissioning, conversion and new installations) • Ship Utility Systems (decommissioning, conversion and new installations) • Power & Heat Generation Systems (decommissioning, conversion and new installations) • Electrical Systems (decommissioning, conversions & new installations) • Production Systems (FPSO production systems) • Turret & Mooring Systems (turret, support structure, swivel, spider, turntable) • Integration performances (installation of modules, equipments, aggregates)

Table 2- 5: Project - Enquest Producer; basic background information of the project

Figure 2- 4: [left] *Uisge Gorm* in drydock 11 on 15/06/2012; [right] *Enquest Producer* at lay berth 13/14 on 05/06/2013

2.3.2.2 The Petrojarl Banff

Vessel	Petrojarl Banff
Client	Teekay Petrojarl Floating Production UK Limited
Duration	September 2012 - April 2014
Project Leadership	2 x yard external contracted project managers (not own)
Classification Society	Det Norske Veritas (DNV
List of main performances	Repair / renewal of turrent and concurrent performance. Due to the necessity of larger chains and respective integrity of supporting structures: → increase of fair leads (fabrication and installation) → increase of supportive structures (fabrication and installation) → increase of required space in within the ship structures (fabrication and installation) → increase of moonpool (fabrication and installation)

Table 2- 6: Petrojarl Banff; basic background information of the project

Figure 2- 5: *Petrojarl Banff* in dry dock 'Elbe 17' [left] on 03/09/2013 [right] on 27/09/2013

3. Analysis of BVR Project Processes

3.1 Introduction - a BVR philosophy approach

The Blohm + Voss yard can draw back to a tradition of almost 150 years of shipbuilding and repair. Due to the needs for specialisation and in order to survive on the global market the yard was separated into different service sectors throughout the middle nineties to serve specific niches and to spread the responsibilities for labour and respective costs. The sector Blohm + Voss Repair GmbH which has specialised on the conversion and repair of ship structures has thus clearly proven its good name throughout the last two decades. Compared to yards serving a similar industry, the prices appraising at BVR for repairs of ships and similar structures might belong to the highest worldwide, which could be grounded in the higher average salaries of employees and the respective costs compared to the rest of the world. Still though do the small amount of permanent employees and the yard’s ability of deploying additional labour on a fast and flexible track assure its global competitiveness in the ship repair industry.

The good salaries of the permanent employees compared to different industrial sectors even within Germany itself and the identification and pride of working for one of the best traditional German companies do have very high effects on the motivational backgrounds of everyone involved and provide an essential base for the senior management. Despite minor running battles between departments and trades (management vs. production, mechanical vs. steel etc.) as one will find in any other company there is an essential and universal understanding for collaboration when it comes to the provision and completion of a project. Several factors such as the rising demands of the customers and complexity of systems, the essentiality of gaoling new markets (in particular the offshore business) and continuously rising regulations (in terms of technology, contracts, safety and working environment) the yard has to adapt to the time and the higher challenges. The essential structures, management and labour is omnipresent to deliver a great, flexible and fast work but also have their shortcomings in some areas, which are to be discussed in the following chapters.

3.2 Analysis of present standard procedures

Based on the generated Appendices I & II the preceding chapters will provide a detailed insight into current difficulties standard and large projects as currently processed at BVR face throughout its accomplishments. The evaluated information shall be used to define the accompanied risks and the respective consequences of each main field of investigation. Further not only the risks but also the certainties and securities shall be mentioned and discussed where possible and necessary. This will help to understand the diversification of problems, flaws but also advantages that occurred throughout the two projects of concern.

Many known flaws represent the main points of objection throughout most of the departments and trades on the yard. They occur in different peculiarities dependent on the nature of the project, organisation structure and the type of employees involved and do not always have an impact on the failure / mislead of a project – in many cases they might even not be recognized. It is the combination of these flaws that reduces particular core values a company might be aiming for; see examples in Figure 3-1.

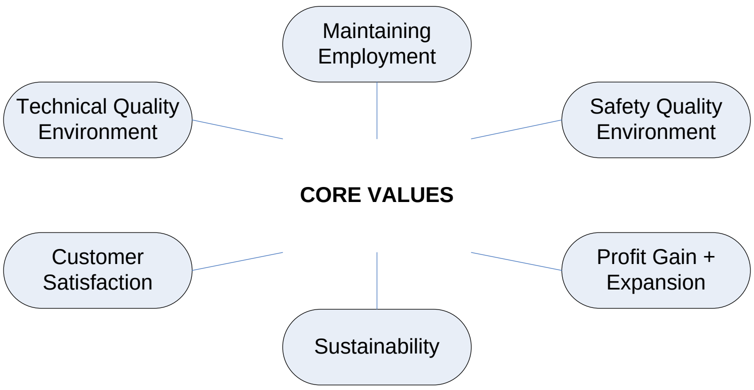

Figure 3- 1: Example of core values of a random company

The descriptions of flaws and difficulties discussed in the up-following sub-chapters are based on the discussion with staff from different levels of the yard's organisation and on the observations and experiences of the author. It is not the author's intention to criticise individuals in within the company's organisation but to reveal discrepancies of the existing conditions on a general and most possible objective level.

3.2.1 The Organisation (general issues)

The yard possesses a tremendous amount of job and process descriptions as well as assignments of structures and responsibilities, on a top down starting from the senior manager down to the welder. One essential problem which is stated throughout a number of departments is the fact, that these documents and the information one is seeking for, are spread throughout several different papers (such as the 'IMS-Manual', the 'Process Description 4.1' and others) which are obsolete or do not reflect the real situations. A certain number of documents has not been revised and updated throughout the last decade. These documents are not false – many descriptions are correct, globally accepted and are necessary to be kept to conditions – but they are either too brief, too complex or do not provide enough traceability for tasks in within positions. The misconception of the staff results from the comparison to the real "practical" situations. On-top one will find many behavioural and habitual structures throughout all trades and professional groups that have developed in the last decades and which are hard to overcome. Many of these structures clearly make sense in a daily and fast repair business environment but do limit the success of complex large and long-term projects, where the quality of an outcome is constrained by clear and neat management of time, resources and capacities.

Initiating Event ("failure of / due to …)			
Chapter	**Description**	**Risk Analysis Form No**	**Project Process Key Reference (ch. 2.31)**
3.2.1.1	Structures, procedures, job descriptions	G01.01	all
3.2.1.2	Action, communication and planning	G01.02	all
3.2.1.3	Behavioural and habitual structures	G01.03	all (spec. field phase "2")
3.2.1.4	The "neglect/exclusion" of specialists advice	G01.04	1,4-1,5 + subsequently 1,7-1,9
3.2.1.5	Feedback and communication	G01.05	all
3.2.1.6	The item work list	G01.06	(1,4-1,9) 2,0
3.2.1.7	The time constraint	G01.07	(1,4-1,11) 2,1-2,4

Table 3- 1: 'Initiating event(s)' (failure of/due to General Issues): summary and reference to risk analysis form and process key step(s)

The assessment of threats (causes) and consequences and the definition the risk picture of subsequent chapters and respective events is presented in APPENDIX III.

3.2.1.1 Structures, procedures and job/position descriptions

The baseline for any company is a comprehensive and traceable collection of standards providing enough information to anyone who is part of the company or a subordinated project organisation. These papers shall provide enough information regarding organisational structures, main standard procedures and every position description within the organisation answering the following questions:

- What are the own tasks and responsibilities?
- What is the quality and what is the extent of these tasks?
- What are the hierarchical levels of the own and the other positions involved?

- What are the tasks of the others?
- How to react and who to contact in case of tasks, which are not covered in the description?
- What are the directive powers (downwards and upwards)?
- Where does one find standard procedures and how to work with them?
- others

3.2.1.2 Action, communication and planning

In order to support any process and job description, standards should be provided by analysing and evaluating all actions, communication and planning procedures for every professional group and position in within a project team. This could be compiled in the layout of guidelines or spread sheets and would represent an elementary part of the job descriptions to help each employee to react upon potential problems and deviations he/se faces and to him/her to address these directly to the right responsibilities.

3.2.1.3 Behavioural and habitual structures

This term comprises the advanced evaluation of detailed procedures and structures on specialisation level. As mentioned earlier, many practices and decisions as applied on the yard follow habitual developments of the last decades as a reaction to certain necessary situations. One could refer these “modifications” as to the out-dated practices, which limit the compliance of today between current applicable yard standards and the practical “as-applied” execution of the tasks. Such adaptions are to be found throughout all departments/trades in within the yard and have to be evaluated each on its own on specialist’s level. More discussion will follow and be underlined by a collection of examples from the production in chapter 3.2.6. Due to the exceeding amount of potential flaws, events and consequences this topic will not be evaluate in detail in the proceeding risk assessment but is to be considered as an important phenomena which needs to tracked.

3.2.1.4 The ‘Neglect / Exclusion’ of specialists advice

The project phase is the main period in which performance characteristics, necessary boundary conditions and the respective costs are negotiated between the yard’s management and the prospective customer. As part of the quotation process and the quantification of performances the project manager and his supporting team of calculators draw back to standardised lists/spread sheets for working hours, prices and schedules/procedures as well as on investigative conventions with key personnel from the production departments (incl. engineering and field engineering department, foremen, sub-contractors, etc.). A regular problem the production trades face throughout the technical execution of a project’s field phase is the ‘inadequate quotation’ of items and the non-consideration of all constraints necessary to accomplish the respective performances. The resulting dilemma is hence grounding in consensual complaints between calculation/management and the trades/production. There are a number of causes for this flawing development, which makes it difficult to accuse specific instances. This chapter states only one cause which is the neglect/exclusion of specialist’s advice in the project phase. This topic has further deep connections and dependencies with other issues such as the ‘Feedback & communication (Ch. 3.2.1), the ‘Item Work List’ (Ch. 3.2.1.6) and the ‘Time Constraint’ (Ch. 3.2.1.7) discussion.

The neglect or exclusion of specialist’s advice in the project phase comprises the feedback and communication problem between management, calculation, engineering, production and quality specialists at the early stages of a project quotation. Briefly speaking it is a communication shortcoming between management and production. The motivational backgrounds of both parties are easy to follow. The management has to quote jobs on a competitive but profitable level and is not focused on the very detailed execution constraints. Comments of the production in all extents potentially hinder the assessment of a quotation, extend the preparation of an offer and might lead to a rejection of the customer. Furthermore this department often faces the lack of basic information around performance requests (poor customer specifications, no experience data, etc.) and has to quote upon assumptions. The production departments are willing to plan their jobs up to their needs based on the easiest, fastest and most qualitative manner and generally outsource the limiting financial factors. Taking all request and necessities of the trades into account would extend the quotation periods and would result in very high quotes a prospective customer could tend to refuse. As a result of this flawing communication, the production departments finally and often have to adapt to fixed quoted prices and schedules set up by the management. Chances are varying immense between receiving a good quotation of items and poor one, which might endanger the feasibility of specific performances to given constraints.

In posterior debriefings of projects of low satisfaction, issues related to insufficient quality, loss of profit or inferior customer satisfaction fall back to the achievements of the production departments, false calculations or poor communication.

3.2.1.5 The feedback & communication

“All projects that have been executed significantly below the calculated list of quantities are to be debriefed under the auspices of the head of Controlling/Purchase and/or the Directive Board“ (APPENDIX I: Ch. 5.9 ‘Debriefing of Projects’). Feedback meetings are regularly held upon completion of specific projects but as stated in current yard standards, generally limited to projects of negative outcomes. Especially throughout the field-engineering department complaints are arising since of debriefings of these kinds are often executed on managerial and financial level only, i.e. production representative and coordinators are not invited to participate Followed by completion of projects, there is often no exchange and evaluation of information and experiences between all participating teams. If a company is striving for any higher quality improvement and the obtainment of larger and more complex projects a vivid feedback policy is one of the most important issues to consider. The evaluations and assessments of projects with both, negative and positive outcomes between all main participants during and after the project are providing the baseline for any improvement policy in within a company’s organisation. As mentioned earlier the feedback issue is an elementary part of the quotation process in the project phase and can also be allocated to Chapter 3.2.1.2 ‘Action, Communication and Planning’.

3.2.1.6 The ‘Item Work List’ (IWL)

The Letter of offer, hence the generated performance specification and the item work is are based on the owner’s specification. This is a document describing all requested work items/packs in full or decent detail. Although the work list is to be treated as the measure of all performances in within a project, it is often prepared in an extent, which impairs the execution of jobs. Reasons for this have already been stated in the preceding chapters and can be related to points such as poor basic information, the neglect of specialists, general poor feedback policy or simply misjudgements of performances. The quality of a work list can hence be constrained by a number of strained and unintentional reasons. A basic problem, the production trades, the partner companies and even the customer representative face is the high scope for interpretation and clarification of queries in within work list item descriptions, resulting in the difficulties of tracing generated costs and man hours. The customer representative usually has a clear definition of his performance requests stated in the provided owner specification. Dissatisfaction and anger of the customer appear to be understandable when it comes to signing a Change Order (CO) for services he requested for at the very beginning of the project, but which have not been considered in the calculations or as part of the contract and thus the work list. The trades and contractors of the yard are facing a similar problem. The production departments will start their work based on the assumption that their items are quoted to the customer on the constraints and backgrounds they have been specified to the calculation department during the quotation period. If not communicated or rechecked, single items easily exceed quoted costs or schedules and might contribute to the failure of the project. Examples for poor IWL characteristics are:

- Poor English descriptions (language)
- Poor, missing or shortened descriptions of the performances
- Missing accounted costs and man hours per item on the work lists. These are only accessible in the ABAS-system and even there, hardly comprehensible. This particularly concerns employees who do not work with the computer system on a regular base such as e.g. field engineers, foremen etc.
- Tended room for manoeuvre and negotiation

3.2.1.7 The time constraint

According to (APPENDIX I: Ch. 5 The Field Phase / 5.1 The organisation') a projects field organisation is superior to the yard's organisational structure throughout the period of its accomplishment.

The yard's backbone is its high flexibility and expedition in the accomplishment of repair and conversion services at good quality. This explicitly is grounded in the high identification of each employee within the yard and his understanding of the necessity of stimulating all efforts needed to deliver any kind of service in time. Since many of the jobs accomplished at the yard are scheduled upon a stipulated and fixed timeframes, core working hours and off-days can often not be considered. In times of high and continuous workload this particularly results in high average working hours of the participating project members. The specific time-schedules in mind, the harsh environment at site and the exhausting working time, ultimately have an effect on the quality of a performance. This has enormous effects on the safety at site, the quality of the executed work (on technical and managerial level) and finally on the motivation of the participants in within the project organisation. Since it is within the human nature of doing mistakes, especially in times of stress, overload and lack of structure adequate controlling instances have to be existent in order to protect one’s labour and to maintain a continuous and good quality of performances across a longer time period.

3.2.2 Engineering and planning

Engineering and planning requires a high degree of communication and organisation. Appendix I – thus current applicable yard standards – state that the project manager carries main responsibility for all engineering and scheduling performances of a project. It further states that these tasks can be forwarded to other responsibilities such as engineering managers, field engineers or planers but it does not provide an adequate overview of potential tasks (when? how? what? who?). Regarding the engineering part three possible main line-ups are repeating on a regular base depending on the size of a project.

Line-up 01 (small projects)

- No or minor engineering performances required
- Engineering reduces to an amount that is managed by the performances of the field engineers (with supports of foremen, yard internal designers, welding engineer, etc.) at site in cooperation with the customer and the classification society representatives – it could be described as “on-the-field engineering/designing”
- Engineering performances are supported by sketches, basic calculations and references to standards and regulations
- The project manager usually keeps track of the performances, carries main engineering responsibilities towards the customer but generally is not involved in the technical details

Line-up 02 (small to medium-sized projects)

- Minor to moderate amount of engineering performances (usually accompanied with checking and certification of tertiary authorities)
- Engineering performances (calculation, drawing, certification, etc.) are carried out by external engineering/designing offices under the information provision and cooperation of the field engineers (and support) – construction and engineering constraints are either discussed on a preceding process and then built or it is a parallel process, i.e. technical execution at site and engineering processes are running parallel in continuous mutual updates and could be named “as-built-engineering/designing”
- The project manager carries main responsibilities towards the customer and can act as an observer or main coordinator of the engineering performances. Generally he is not involved in the technical details. Most of the technical information is provided by the field engineer.

Line-up 03 (medium and large projects)

- Moderate to high amount of engineering performances (comprises all engineering, calculation, designing and certification performances
- Engineering performances are carried out by an external engineering/designing department situated at the yard and guided by an (external) engineering representative under the information provision and cooperation of department internal labour or by any other production and management staff in within the project (project manager/engineer, field engineers, foremen, welding engineer, etc.)

- Construction and engineering constraints are either discussed on a preceding process followed by production or it is a parallel process, i.e. technical execution at site and engineering processes are running parallel in continuous mutual updates. This could be named as "all-in-one-engineering/designing"
- The engineering representative is responsible for the execution of all required engineering performances. The project manager carries main responsibilities towards the customer and can act as an observer or main coordinator of the engineering performances. Most of the technical information at site is provided by the production departments, i.e. field engineers, foremen, etc.

Planning tasks in within projects follow a similar structure as presented above for the engineering performances. The background of presenting these three line-up examples is to reveal the close connection between the project manager and the field engineer and the debate around responsibilities for engineering and planning processes which are hard to trace from current applicable yard standards. From the financial and contractual view it is necessary to assign the project manager as the main responsibility for any engineering and planning process, but it is clear that he will not have the capacity of dealing the details. Based on the technical and procedural backgrounds it is necessary to have the field engineer implied into general engineering and planning practices but due to his main tasks of coordinating the trades and contracted companies at site, he will not have the capacities of managing or guiding the engineering and/or planning performances to full extent. Thus this topic must be a matter of neat organisation, process and communication standards in order to assign one's responsibilities according to the size, schedule and nature of a project.

The field engineers are coordinating trades and contracted partner companies, and planning processes based on pre-defined milestones (time-constraints, delivery-constraints). This team is hence elementary part of the planning process. Due to a number of important other tasks (such as quality assurance, compliance of work according to contract, safety control, facilitators) chances are high that planning tasks are not treated with the necessary amount of attention and parallel reflection (horizontal, interdisciplinary, consecutive) they would require. Due to missing integrated planning support structures and other communication difficulties appearing throughout a project lifetime field engineers can carry high risks and potentials in failing single item performances on. Results could be the false or misunderstood execution of performances, the misguidance of trades, the neglecting of critical items resulting loss of profit, schedule and safety to personnel.

Initiating Event ("failure of / due to …)			
Chapter	**Description**	**Risk Analysis Form No**	**Project Process Key Reference (ch. 2.31)**
3.2.2	General (engineering + planning)	G02.01	(1,4-1,8) 2,1-2,4
3.2.1.2	Engineering	G02.02	(1,4-1,8) (2,1-2,4) 2,6

3.2.1.3	Planning	G02.03	(1,4-1,8) (2,1-2,4) 2,6

Table 3- 2: ‘Initiating event(s)’ (failure of Engineering + Planning): summary to risk analysis form & process key step(s)

3.2.3 The documentation management

The documentation management (schedule plans, drawings, calculations, report, certificates, etc.) of small and diverting projects executed on the yard in the last decades has been a matter of neat communication between the yard representatives, the customer and the classification society representatives. Due to the growing complexity of systems, the exceeding scope of performances and services to deliver and continuously tightened regulations in terms of the execution, inspection, testing and safety of systems/builds one has a growing demand for extensive, clear and traceable documentation. This reveals a development that explicitly shows the yard’s unpreparedness especially on large projects. Main failures of project documentation are grounded in missing standardisations of below stated documentation management tasks:

1 <u>(Lack of) Organisation / Structure (Assignment of Tasks & Responsibilities)</u>
Missing guidelines/standards regarding the organisation and assignment of responsibilities by tasks are leading to incomprehension, flawing treatment and/or lack of communication of documentary work between the project team members.

2 <u>(Lack of) Consistency</u>
Missing standards for layouts of any kind of documentation and paper work are leading to poor recall value and traceability. Every paper produced as part of a BVR project should follow the same outline, size and requested details on an evaluated standard according to the information it should present. Examples could be but are not limited to:

- Drawings, Part Lists
- Test and Inspection Plans, Survey Records, Docking Records, Operation and Maintenance plans, NDT certificates
- Performance Certificates (own, contractors, customer, etc.)
- Schedule Plans (planning software)
- NDT certificates
- Change Order and Variation Order records and application forms
- other project specific documents such as: risk assessments, lifting plans, etc.

3 <u>(Lack of) Traceability and IT-support</u>
Large and complex projects inquire a huge amount of documentary work throughout it’s’ lifetimes. This includes the care-taking and filing of pre-existing documents (contractual, specifications, guidelines & regulations) as well as documents arising from daily performances (variations and change orders, certificates and plans, etc.) and the final documentation papers to be delivered. At the end of a project’s lifetime

a neat documentation is the base to account the provision of performances versus the clearing/contribution of a customer. Since documentation easily results in thousands of files, papers and email conversions that need to be prepared in a manner to allow for easy and fast traceability of information at any stage of the project, the documentation tasks is of highest importance to support and underline the quality of company's service/product. Projects processed at BVR are serving the documentation collection and filing by means of email distribution lists and by storing all accounting documents in projects files in the server system. Now that the storage and retrieval of data is the basis for any kind of work nowadays the comprehensive, easy and fast access to any project relevant information is a challenging and time-consuming progress in an advanced project at BVR. Besides project relevant repeating files, others are created by project team members named, sorted and filed based on their habits. In a progressed project 3 main issues regularly arise due to a missing project internal IT support team: Project relevant repeating files are reaching a size that make the retrieval of useful and correct information fairly impossible, since one has not only to find the right information but also needs to check for the timely relevance (update), versions and correctness of the data. The idea of creating files of team members in order to save project relevant information on the server is generally a good and necessary approach to keep information on project level, but it does not fulfil an information exchange character between the members. A different issue that appears on a regular scale is that many "private" files are filled with very useful information (literature, technical templates and spread sheets and even direct project relevant certificates, records etc.) other team members with access to the server could use or need in order to accelerate their own tasks or to prevent double work. In summary it can be said that there is simply no adequate, comprehensive and easy-to handle information exchange and IT environment to support all team members continuously and on-line.

Initiating Event ("failure of/due to …)			
Chapter	**Description**	**Risk Analysis Form** **No**	**Project Process Key Reference (ch. 2.31)**
3.2.3	Organisation	G03.01	(1,4-1,8) (2,1-2,4) 2,6-2,8
3.2.3	Consistency	G03.02	2,6-2,8
3.2.3	Traceability	G03.03	2,6-2,8

Table 3- 3: 'Initiating event(s)' (failure of Document Management): summary and reference to risk analysis form & process key step(s)

3.2.4 The IT-management

Standard communication devices such as common Windows supported computer systems, mobile devices, cameras and similar are inevitable and being used thoroughly on the yard. Devices which are missing for a company of that size and its executed projects are standardised and commonly distributed software systems and a department exclusively dealing with the maintenance and training of these systems. Such software could for example be based on ERP (Enterprise-Resource-Planning) or SRP (Single Responsible Planning) or any other object oriented planning software. One system only should be implemented offering a wide range of editable modules. It should be clearly structured, informative, easy-to-use and be guided in a continuous manner by assigned responsibilities. Such systems exist, e.g. in the nature of scattered software programmes such as MS Project Manager or Primavera but are limited to the use and understanding of a few. They rarely provide enough or continuous information and do not encourage the communication and exchange of data, especially on the background as already discussed in the preceding chapter. The implementation of an IT-System usefully adjusted to the needs of the yard of such a kind has a clear potential for improving many issues stated in the subchapters of 3.2. More over the implementation of an IT department would be inevitable when going for the introduction of an Integrated Planning policy.

Initiating Event ("failure of/due to …)			
Chapter	**Description**	**Risk Analysis Form No**	**Project Process Key Reference (ch. 2.31)**
3.2.4	IT support management system	G03.01	"1 – 2" (project + field phase)

Table 3- 4: 'Initiating event(s)' (failure of IT-Management): summary and reference to risk analysis form & process key step(s)

3.2.5 The Safety management

The assurance of health and safety of all labour working on the yard is the main premise when executing any kind of job at BVR. Due to very strict applicable safety regulations here in Germany and good experiences gained from the past projects, the yard's health and safety department is a doing continuous and comprehensive job in the maintenance of the safety environment and in developing the labour's knowledge of the yard's safety conception. As a reaction on the two offshore projects the HSE department started to implement risk assessment tools by introducing a five-level matrix to evaluate possible risks and consequences implied in standard and special steel repair performances at site and in the workshops. The preparation of all standard assessments are made in cooperation with key field and production labour and will be introduced as a standard tool and as part of a number of other improvements in the proceedings of the next months and projects.

The main difficulties the HSE departments and basically every other project member carrying statuary safety responsibility are striking with, are grounded in within the yard's necessity for flexibility and especially in the power of the staff's habits. The flexibility term comprises the yard's small size and its dependence on easy and fast recruitment of external contractors, which often work with labour from East European countries which are not aware or properly trained in the safety standards requested. Flexibility further means the yard's conditioning in executing very complex tasks in a very fast manner under the objective "Safety is important, but keeping the schedule is equally important". This is a conflict, which is not always possible to satisfy, and sometimes results in decisions where specific safety relevant issues are defined as “potential hazards revised, but neglect able” on behalf of the projects schedule/success. The HSE department is aware of this conflict, and thus tutors on continuous sensitization of the employees to work and behave on site at the safest possible way and to watch out one for another. Still does the problem of the time-constraint, the complexity of performances, diffuse organisational structures and the lack of understanding the distribution of responsibilities in within projects create potentials for hazards and accidents which could be reduced to a minimum if adequately communicated by means of a yard philosophy as well as continuous training of the labour.

Initiating Event (“failure of/due to …)			
Chapter	**Description**	**Risk Analysis Form No**	**Project Process Key Reference (ch. 2.31)**
3.2.5	IT support management system	G03.01	“1 – 2” (project + field phase)

Table 3- 5: ‘Initiating event(s)’ (failure of Safety Management): summary and reference to risk analysis form & process key step(s)

3.2.6 The ‘Production’ and the ‘Field Engineering Team’

As opposed to yard definitions this thesis comprises the production or production team by following specialists group:

- Trades
- Subcontractors and subcontracted trades
- Field Engineering

The Field Engineering Department, although situated on managerial level of a project, is involved in the daily coordination of trades and subcontractors at site and therefore a key position in the provision of a product/service “repair/conversion” according to a contract. As part of this position the following main tasks are lying in within the responsibility of a field engineer but are not limited to the below stated:

- Planning and preparation of items according to IWL (main task 01)
- Coordination of trades and subcontractors (main task 02)
- Engineering performance (to certain extent)
- Planning performances (on daily, weekly and partly monthly schedules)
- Budget control (performance control)
- Quality control (tests, inspections, etc.)
- Safety control (every field engineer is responsible for adequate safety at his construction sites)
- Support of the project management
- Communication with customer and classification authorities in terms of technical solutions
- Others…

As one can see the position of a field engineer introduces highly multi- and interdisciplinary competences of the respective staff. Depending on the size and nature of a project the above stated collection of main tasks differ in higher or lower attention of the field engineer based on the priorities set by the project management, the contract, the safety issue, the quality or personnel subjections.The quality approach on a field engineer shall be shown when referring to the sphere of additional performances the FE Naval/Steel/Structural faces, which are the coordination of, but not limited to:

- interior installation performances
- safety and outfitting installation performances (cranes, rescue equipment, gangways, chains and anchors, etc.)
- painting performances
- long working hours per day/week/month
- generally highest amount of different contractors to coordinate

The intention of putting a focus on the expected performances of the field engineering team is not to commit this specialists team superior to any other department or trade but to indicate the high risk factor a single person (field engineer) carries towards all consequences potentially endangering a project success, if there is no adequate distinction, continuous control and maintenance of respective performances and responsibilities in within a project. Past projects have shown that the high amount of tasks, a field engineer faces throughout the lifetime are executable to certain extent but obviously not all jobs are possible to be executed in the perfection they would require. Based on the immense amount of decisions and situations a field engineer has to face in a course of a standard project day the consequences single actions have on other fields often cannot be evaluated and reflected in necessary detail. This might result in fatal decisions on work performances, performance quality, schedules and budgets and especially in the safety matters of personnel involved.

Other main difficulties the “Production” faces shall be mentioned in recital only:

- Small amount of own key personnel (engineers, foremen, craftsmen)
- Time Constraints (tight schedules)
- Flawing communication
- Huge amount of contractors (of all trades)
- Parallel and interactive performances of many trades
- Poor or no performances indicators
- High level of uncertainty on the construction sites (permanent adjustment of work scopes)
- Habitual Structures (example given below)
- Quality approach for technical of performances and traceability

Examples of habitual developments from the past years:

Example 01: The Welder’s Job (Quality Approach)

It is a standardized procedure to have contracted companies at site, which take care of grinding, cleaning and rigging jobs. Hence grinding of intermediate and final welding seams is done by labour of these companies and not by the welders themselves. Especially in the intermediate welds of critical connections and welds tested with NDT it is the welder only who knows where bond failures or flaws from the welding process could have occurred. Due to quality deviations in within the grinding team and/or poor communication between welder and grinder it would make sense to assign the welder himself to grind his own welds, at least for the intermediate steps in order to assure a higher quality.

Example 02: The Steel Fitters. (Safety Approach)

The steel fitters totally rely themselves on the posterior service of the grinding and cleaning teams. This induces that meanwhile or with the accomplishment at a specific repair spot the area is left in inadequate "messy" condition. Sensitising the fitters to assist the housekeeping team would keep areas clean continuously and could reduce the risk of injuries and hazards at site. Another safety issue is the use of oxy-acetylene hoses which usually are wildly spread throughout many areas at site and which have to be disconnected from the main disperser connections before breaks or at the end of shifts. Continuously tutoring them to track their hoses on special paths could reduce the tripping, fire and explosion hazards for any labour at site. Every owner of a hose should be taken into responsibility for its connection/disconnection and its technically safe condition. Hoses could be distributed by name and number in order to determine the owner of connected or defect hoses at site to initiate proceedings for disciplinary warnings.

Example 03: The Foreman Inspection Responsibility (Quality *Approach)*

Generally the foremen are invited to attend intermediate and final inspections with the field engineer, the customer and the classification society. Although the foremen are responsible for the quality of the executed jobs in first instance it is the field engineer only to sign for compliance as the representative of the yard. Sometimes situations occur where the foreman cannot attend or did not execute/follow the work as to an agreed performance and leaves the field engineer under pressure for failing this compliance. Although situations of this kind can easily be prevented by clean communication between the trades it would be recommended to implement new methods to comprise the responsibilities of the foremen. A possible technique could be by adding them to sign on the final inspection papers.

Example 04: The Work Wear Problem (Communication Approach)

In order to differentiate the production labour (welder, fitter/technician, foreman, field engineer) aboard or at site each professional group is easily *identified by the colour of the work wear. Field engineers are assigned olive green coloured suits. The problem regarding particularly this work wear is at these suits are also handed out to any existing or new/additional employee who does not fulfil the function of any of the other groups and trades, i.e. contracted engineers or other external labour, project managers/engineers, designers, trainees, inspectors etc. Besides the foremen, the coordinative and directive personnel for own production trades and partner companies are the field engineers only. Confusion and communication problems occur when craftsmen at site take orders and instructions by others, than the field engineers. This particularly occurs on large projects with a specific high amount of external deployed labours, where tracking/differentiating between FE’s and other wearing the same suits is much more of a task.*

Initiating Event (“failure of/due to …)			
Chapter	**Description**	**Risk Analysis Form No**	**Project Process Key Reference (ch. 2.31)**
3.2.6	Field Engineer	G06.01	2,3-2,7
3.2.6	Trade + subcontractors	G06.02	2,3-2,7

Table 3- 6: ‘Initiating event(s)’ (failure of the Production groups): summary reference to to risk analysis form & process key step(s)

3.2.7 The ‘Quality Assurance and Control’

One elementary target of this thesis is to outline and discuss misalignments in within the company’s project organisation, which limit the quality of work and performances of certain internal steps and institutions. The term of quality basically comprises every environment, action and service in within every single discipline of a company. For the easiness the term “quality” will be reduced to the following main disciplines: management, technology/production and safety. Other quality streams such as finances, organisation, sustainability, production and others are assumed to be part or subordinated approaches. There are two main reasons to put special emphasis on the quality issue of BVR.

1 The multidisciplinary stake of quality assessment and control,
i.e. this comprises the evaluation, discussion and assessment of all items stated in the chapters 3.2 and 3.3, which are defined as limiting factors of BVR project execution quality

2 The quality department support
One major requirement set up by the customers of the respective offshore projects was the existence of a quality management system as to ISO 100005:2005 and BS EN ISO 9001:2000. At that time Blohm + Voss Repair

GmbH was certified as to ISO 9001:2008 and hence fulfilled customer's requests. The quality assurance and control on the yard was at that time in hands and in responsibility of the HSE department. An independent quality assurance and control department responsible for the compliance on technical and production level did not exist, since by history these tasks had been in the responsibility of the foreman, the field engineers and superior engineers and managers (welding engineer, production leader, etc.) under the continuous monitoring of the head of HSE and his supportive structures. It thus required the provision and implementation of a quality department on project level, which is strictly aware of all constitutive parts of the above-mentioned standards and the additional contractual requests of the customer. As part of the project organisation built-up, project internal Quality Assessment and Control departments have been created in order to serve the needs of the customer and, to support and to monitor the production performances. As an outcome of the two projects, two different QAQC-departments have been developed and observed, and now consecutively serve the ongoing creation and implementation of an independent BVR Quality Assessment and Control Department. An evaluation and discussion of the two experiences gained from the projects will be the emphasis of chapter 3.3. Since the final presentation of this new department is to be awaited in the middle of 2014, this thesis shall help to support the decision finding for the implementation of certain processes and procedures not yet taken into consideration.

Initiating Event ("failure of/due to …)			
Chapter	**Description**	**Risk Analysis Form No**	**Project Process Key Reference (ch. 2.31)**
3.2.7	Assessment + control of quality issues	G07	"1 – 2" (project and field phase)

Table 3- 7: 'Initiating event(s)' (failure of Quality Assurance and Control): summary and reference to risk analysis form & process key step(s)

3.3 Analysis of the offshore projects

3.3.1 Difficulties regarding both Projects

Beside the actuality and the intensive amount of work and time these two projects absorbed, the main reason analysing exactly these two examples lies in the exceedingly huge amount of pilot experiences the yard faced throughout their accomplishments in terms of the strict standards, regulations, procedures and intensive amount of documentary performances required by the customers and the offshore industry. Although other offshore structures have already been processed earlier, the yard didn't face such a comparable amount of new regulations, performances, repair nature and required organisational needs to accomplish the requested services.

A different background is the gain in experience of two different projects of same field but with totally different repair/refit nature, work scope, project related organisational needs, clients and classification societies. Hence two different yard project teams had to assort themselves on two different ways resulting in a higher number and partly totally different types of outcomes. Whereas the work carried out on the *Petrojal Banff* was more of a refit repair as a reaction on the failure of steel-structural design integrity with emphasis on one coherent area, the activities carried out on the *Enquest Producer* were requiring repair, conversion and new-built performances of all disciplines – i.e. steel, machinery, systems, electrics, offshore (turret) – across the whole ship structure. Furthermore the yard faced long and parallel running lifetime of both projects creating additional complications in the processing, organisation, prioritisation and solution finding.

Before analysing each project on its own a short introduction shall be made on the flaws and difficulties both projects had to struggle with. Most of these problems can be streamed to five main disciplines, which continuously interacted and affected each other throughout the project processing time. Due to the limited scope of this thesis the assessment and analysis of these flaws will be made by putting the main emphasis on the leverage these flaws did have on the production and manufacturing processes. The five disciplines of investigation are assigned as follows:

1 Existing flaws

The existing flaws mainly cover all issues discussed in chapter 3.2. The reasons for assigning these as one main branch are grounded in within the established structures and procedures of the yard’s global organisation and the inevitable impacts they have on subordinated streams such as a project organisation. Pre-existing flaws on global corporate level will naturally be carried on towards substructures such as a project organisation if not treated adequately and preventive.

2 Management & organisation

This topic includes all managerial, organisational and structural decisions and solutions taken by the yard, the customer/client or in close consultation of yard and client. For both, this implies the internal deployment of specialists and labour (project managers, engineers, craftsmen etc.), the line-up of internal organisational and procedural structures (field-related teams) and the respective responsibilities, the assessment and processing of work packs, communication procedures, engineering and planning processes, documentation, IT and safety. The difficulties this extensive field faced throughout the time of accomplishment of both projects are settled in the lack of experience and knowledge of all parties involved, resulting in decisions of rather reactive nature adapted to the various circumstances, conditions and problems the projects passed through in different states. Due to the complexity in the development of these issues partly caused by continuously emerging changes of situations (unforeseen changes, complications, changes in contract) and the respective learning processes the yard and the customers went through on both projects a thorough analysis of this topic would go beyond the purpose of this thesis. For this purpose only the key decisions in within the management and organisation will be discussed which had direct effects on the production and manufacturing processes.

3 Production and quality assessment

This point captures all aspects of the technical performances including the deployment of specialists and craftsmen, work processes, performance quantity and quality, communication and cooperation between the trades on production level and the quality assessment and control of the executed work. Flaws on this level are related to external and internal sources, which interacted on a regular scale. As part of this discussion external impacts are to be understood as routes from lacking superior structures (management, organisation, distribution of responsibilities, time constraints, customer requirements and/or misleads, etc.) whereas internally work performances where suffering from quality failures on execution level, i.e. poor level of construction, welding, installation performances.

4 Synchronic processes and prioritisation management

Synchronic processes and prioritisations are to be observed on project and on corporate level. On project level they describe work processes and decision chains proceeding on parallel or synchronic circumstances such as, interconnected, interdisciplinary or field related areas of performances and operations, weather and time constraints. Although prioritisation decisions had to be made in order to assort processes and ensure precedence, an absolute technique to back up the integrity of such assessments was not implemented at neither of the two projects. The quantification of any kind of operation or process usually followed very generic milestones in terms of scope of work, real area of influence (criticality) at site, dates, presence of engineering performances (calculations, drawings) or capacity of labour. The assessments and the resulting decisions often had a reactionary character and were kept in within single disciplines only, i.e. missing horizontal structures for an interdisciplinary approach or have simply been shot to pieces by key responsibilities.

The term of synchrony and prioritisation on corporate level comprises all processes, organisations and decisions outside the project organisation. This includes the management of parallel processed projects, the prioritisation between these, and other tasks such the maintenance of the yard’s total occupancy, the acquisition of new projects, the maintenance of systems and plants and the safety policy environment.

5 Integrity and preparedness

This main theme covers the technical, managerial and organisational integrity and preparedness of all parties participating in the projects. It includes the yard’s flawing internal structures and offshore expert knowledge in an equal measure as the customer’s poor experiences in the processing of large-scale projects (Enquest Producer) or the abilities to react upon quality deviations by the help of technically feasible and applicable solutions (Petrojarl Banff). Other points to be mentioned are the lack of specialists forcing the yard to deploy huge amounts of external personnel on short notice, often resulting in the problem of high exchange rates and poor continuities of personnel among all levels of the organisation. Further both projects were having immense struggles to reach the safety environment as well as the quality and procedural standards as were predefined by offshore regulations.

3.3.2 Enquest Producer

The assessment of causes, risks and consequence can be found in APPENDIX III – Table A-III-2: ‘Risk assessment (Enquest Producer).

The repair, lifetime extension and upgrade of the former Uisge Gorm (Enquest Producer) required an extensive amount of performances in basically all areas of a project organisation and repair processing including the management, engineering, planning, safety, the quality control and assurance and finally the technical execution of the refit works. Due to the facts that basically every single spot on the vessel had to be checked upon technical and quality integrity in order to carry out the assigned repair and conversional performances, this project required a sizable team of specialists responsible for the management, engineering, planning, control and execution of the immense number of performances. This impaired on a number of difficulties the project organisation had to attack right from the beginning of the project. The main difficulties the project had to struggle, with are listed in the subsequent chapters.

3.3.2.1 Management & organisation

1 Project organisation (general issues)

- inadequate general standards for the processing of this kind of project
- inconsistent project team at the beginning
- continuous development & change of project team structures throughout the whole lifetime of the project
- blown-up structures, complicated traceability of positions and responsibilities

2 Underestimation of work scope and performances (and potential problems)

- lack of experience about total scope at the beginning
- continuous underestimation of single items throughout the course of the project

3 Deployment of labour / lack of specialists by scope and experience

- external project managers (positive + negative effects)
- huge amount of external engineers and specialists (positive + negative effects)
- unpreparedness in terms definition, allocation and assignment of responsibilities, communication and action descriptions for deployed staff
- poor control measure of deployed labour

3.3.2.2 Production and quality control

1 Quality Assessment + control (missing department)

- external contracted quality manager (good support in many fields throughout the project, but external contracted)
- external contracted inspectors (good cooperation between field engineers and trades, but external contracted)
- no effective introduction of quality plans, ITPs, MITs, and other quality measures
- external partner company of BVR for NDT left alone / not guided
- poor traceability support management and measures

2 Poor Quality of production trades + assets

- unpreparedness in terms of quality requirements set up by the client and the offshore regulations
- time necessary for “testing-out” / gaining experience on the requirement of quality on production level
- poor traceability support management and measures
- huge amount contracted production companies
- extensive work load on yard key labour

3 Owner/Client integrity problem

- lack of experience about total scope at the beginning
- misguidance of yard performances due to lack of knowledge and experience

3.3.2.3 Synchronic Processes and Prioritisation

1 Planning + scheduling

- extensive amount of performances against lack of structures, procedures and lack adequate functioning integrated operations (of yard and client) and prioritisation methods
- main outcomes:
  - collision of performances
  - multiple performances
  - extension of schedules (item and project level)

2 Planning + safety problem

- extensive amount of performances against lack of structures, procedures and lack adequate functioning integrated operations (of yard and client) and prioritisation methods
- lack of qualitative safety personnel
- huge amount of labour on sites during peak times (up to 1000 persons)
- main outcomes:
  - collision of performances with safety criticality
  - regular disruptions of performance due to safety criticality
  - extension of schedules

3 Prioritisations towards external assets

- other parallel processed projects are being prioritised due to restricted time schedules (e.g. cruise ships)
- main outcomes:
  - temporary shifting of engineers, foremen, craftsmen and attention to other assets
  - deceleration of project performances

3.3.2.4 Integrity and preparedness

1 Quality measures
- poor quality measures (lack of knowledge)

2 Documentation performances
- poor documentation standards

3 Traceability performances
- lack of traceability support management (lack of knowledge)
- poor cooperation between traceability performance of production trades and quality department

4 Safety performances
- lack of knowledge and experience of client / offshore safety standards
- good process development throughout the project

3.3.3 Petrojarl Banff

The assessment of causes, risks and consequence can be found in APPENDIX III – Table A-III-3: 'Risk assessment (Petrojarl Banff).

The repair of the Petrojarl Banff required an extensive amount of performances in the project organisation and thorough knowledge and experience on technical and steel structural issues. Although the focus of the work was concentrated on one coherent area in within the vessel the complexity of the required performances and areal limitations made it a hard job for both, yard and client. Two main and over-dominating events complicated the processing of this project. The first was the introduction of a yard's quality assessment + control department entirely deployed of external labour leading to thorough complications between and with client quality representatives and yard's production. The second issue was the appearance of crack after certain repair works have been accomplished. This resulted in entire re-evaluations of design and construction issues, client's suspicion towards the abilities of yard performances and the increase of requests and stricter controls of yard performances. Further main difficulties are listed in the subsequent chapters.

3.3.3.1 Management and organisation

1 Project organisation (general issues)
- inadequate general standards for the processing of this kind of project
- inconsistent project team at the beginning
- development of project team structures to serve adequate processability was 'too late'
- flawing cooperation between project managers and field engineers

2 Underestimation of work scope and performances (and potential problems)
- lack of experience about total scope at the beginning
- continuous underestimation of single items throughout the course of the project

- very experienced client

3 <u>Deployment of labour / lack of specialists by scope and experience</u>

- deployment of entirely external contracted quality assessment + control department (no positive effects)
- unpreparedness in terms definition, allocation and assignment of responsibilities, communication and action descriptions for deployed staff
- poor control measure of deployed labour

3.3.3.2 Production and quality assessments

1 <u>Quality Assessment + control (missing department)</u>

- quality assessment, control and approval department consisted entirely of external deployed labour
- main outcomes:
  - no experience & knowledge about yard procedures, staff, standards, etc.
  - implementation of complicated and partly useless quality assessment templates (inspections, documentation, approval, etc.)
  - blockage of the production (no or tough cooperation with field engineers and trades) → “working against each other”
- external contracted quality manager (no support at all)
- later quality management lead by project management (perplexed relations between PM and field engineers)
- complicated introduction of quality plans, ITPs, MITs, and other quality measures
- external partner company of BVR for NDT left alone / not guided
- poor traceability support management and measures

2 <u>Poor quality of production trades + assets</u>

- unpreparedness in terms of quality requirements set up by the client and the offshore regulations
- time necessary for “testing-out” / gaining experience on the requirement of quality on production level
- poor traceability support management and measures
- huge amount contracted production companies
- extensive work load on yard key labour

3 <u>Owner/client integrity problem</u>

- huge distrust issues after failure (appearance of cracks)
- main outcome:
  - strict tightening of requests and control of performances
  - many scrutinizing issues

3.3.3.3 Synchronic processes and prioritisation

1 Planning + scheduling

- extensive amount of performances against lack of structures, procedures and lack adequate functioning integrated operations (of yard and client) and prioritisation methods
- main outcomes:
  - cracks
  - collision of performances
  - multiple performances
  - extension of schedules (item and project level)

2 Planning + safety problem

- extensive amount of performances against lack of structures, procedures and lack adequate functioning integrated operations (of yard and client) and prioritisation methods
- lack of qualitative safety personnel
- main outcomes:
  - collision of performances with safety criticality
  - disruptions of performance due to safety criticality
  - extension of schedules

3 Prioritisations towards external assets

- other parallel processed projects are being prioritised due to restricted time schedules (e.g. cruise ships)
- main outcomes:
  - cracks
  - temporary shifting of engineers, foremen, craftsmen and attention to other assets
  - deceleration of project performances

3.3.3.4 Integrity and preparedness

1 Quality measures

- poor quality measures (lack of knowledge)

2 Documentation performances

- poor documentation standards

3 Traceability performances

- lack of traceability support management (lack of knowledge)
- poor cooperation between traceability performance of production trades and quality department

4 Safety performances

- lack of knowledge and experience of client / offshore safety standards
- good process development throughout the project

3.4 Summary: risk assessment (risk analysis form)

Latter investigations of current states and experiences from the two offshore projects are assessed and summarised upon initiating events, causes, consequences and measured by means of risk according to the risk analysis form introduced in Chapter 2.1.2. The collection of results is presented in Appendix III 'Risk assessment (risk analysis form)'.

4. DISCUSSION AND EVALUATION

4.1 Introduction

The intended score of this chapter is the discussion and evaluation of existing barriers against the proposal of new and revised existing barriers and mitigating measures to improve the success of certain states based on the investigations and discussions of experience measures of latter chapter.

The main outcome of the investigations made until this point might be seen in the subsistence of 'Existing Flaws' within the corporate structures and its respective severe influences on the main field streams of project organisation presented by Figure 4-1.

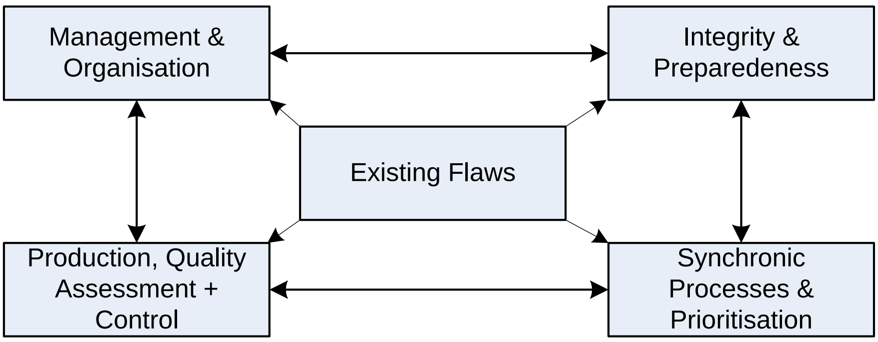

Figure 4- 1: The impacts of current flaws on project disciplines

Thus elementary deficiencies in within existing states have to be treated prior to the implementation of additional barrier improvements on project organisation level. Since the investigation of safety measures on global and project level in this thesis requires a synchronic approach for the assessment of defaults the further evaluation will be constrained on the structure as applied to chapter 4.2 and comprises the following main steps:

1 Presentation of a ‘Standard Project Team’ structure, incl. respective barrier proposals on general level (Ch. 4.2.1)
2 Presentation of departments according to the ‘Standard Project Team’, incl. respective barriers on department level (Ch. 4.2.1 – 4.2.5)
3 Presentation of barriers and measures on global level to evaluate on existing global flaws and respective influence on project structures (Ch. 4.2.6)
4 Presentation of additional supportive barriers to enhance planning and prioritisation management on project level (Ch. 4.2.7)
5 Summary of investigated barriers (Ch. 4.3)
6 Allocation of barriers and recovery preparedness measures according to discussed present standard procedures of Ch. 3.2 (Appendix IV: Barrier allocation)

4.2 Assessment and discussion of barriers and mitigating measures

4.2.1 The ‘Standard Project Team’ structure

Based on all the information discussed until this point, a proposal for the assembly of a standard project team for large / long-term projects was developed and is presented by Figure 4-2. The chart developed serves the purpose to visualise the required basic teams of such projects on technical-managerial level and the responsibilities and specialists involved. Interdisciplinary connections between the teams and the team members are not yet visualised, but will be revealed throughout the next chapters. The teams/departments assigned are divided upon technical-managerial disciplines, i.e. Project Engineering, Field Engineering, Quality Control & Assessment, Documentation / Planning / IT / Competence and Contract & Finances. The Project Manager (PM) represents the governance of the project team.

In order to proceed with the discussion on barriers a distinction has to be made between the definitions for ‘re-evaluation’ and ‘introduction’. If barriers are discussed in the context of re-evaluation it implies that certain measures do exist and are revised and adjusted in order to improve their effectiveness. The ‘introduction’ of barriers amplifies that similar measures do not exist in the yard or in project structures of BVR yet, and as to author’s best knowledge.

Further distinction has to be done for this chapter between the definition of Item, Discipline and Department Levels.

Department Level:	Represents a team/department according to main function in the project and as separated (marked) by colours in Figure 4-2.
Discipline Level:	Main sub-division of tasks/performances or specialisations in within a department; e.g. Field Engineer: FE “Structural/steel” or FE “Mechanical”

Item Level: Further sub-division of tasks/performances and specialisations; e.g. Field Engineer “Structural/steel”: hull, tanks, upper structure, and others

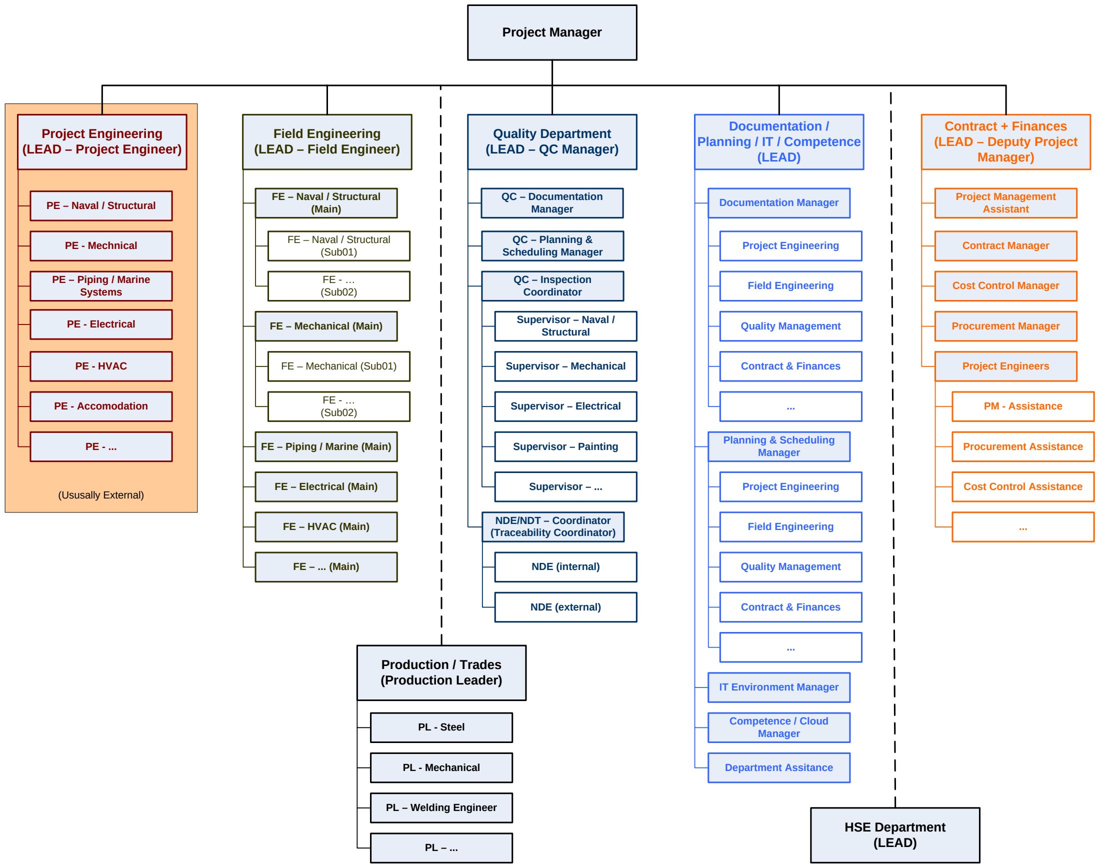

Figure 4- 2: Outline for a 'Standard Project Team' for large projects at BVR

The PM is responsible for the technical, commercial and scheduling success of the project. Due to his announcement at the very beginning of the project assessment he carries detailed knowledge of contract conditions, is responsible to implement these into a project organisation and pays special attendance to the global costs, progresses, quality and success of the project and the requests of the customer/client. He reports to the Senior Management (directive board) of the yard, carries statuary and directional power towards all other members of the project team and is the main contact to the client/customer.

As was done on both offshore projects, the scope and complexity of work required the division of tasks and liabilities of the project management between two or more members. This can either take place on a quantitative separation of all tasks between the assigned project managers, i.e. on a 50/50 division, or on a qualitative division of responsibility streams (financial, technical, organisational, etc.). The deployment and the distribution of the project managers can be made according to their technical, managerial, leadership or any other background and is incumbent upon the decision of the directive board.

It is not the intention to analyse or criticize decisions of the yard's directive board giving preferential treatment on the deployment of external project managers and not utilizing own internally contracted project managers. A judgement of these decisions would go beyond the author's expertise and knowledge of the decision chains made on upper management level. Nevertheless the major advantages and disadvantages of this sort of management buy-in shall be mentioned on an objective approach and are presented in Table 4-1.

Advantages	**Disadvantages / Risks**
- *Retaining the continuity of the existing management structures* - *Desirable if lack of own managers (capacity) and/or own managers qualifications (quality)* - *Possible implementation of new / advanced management structures or technical background – may improve the existing management* - *May bring in a higher pool of clients/customers, professional contacts and specialists (deployment)* - *Possibility of gaining experience and training of own managers* - *Implementation of a certain level of objectivity towards decisions and relationships in within the yard – collegial relationships that might act as a sticking point may be overcome*	- *May have lack of business / technical knowledge and understanding* - *Poor knowledge of the exiting management / organisation – may lead to disruptions in the management and subordinate structures* - *No own equity involved in his deployment – lack of identification with the company and the company goals* - *Risk of working in own interests only / risk of disloyalty* - *Poor management, adaption and leadership skills may threat the success of a project* - *Demotivation of the current management and internally contracted personnel (due to higher responsibilities, higher salaries, lack of visible advantages etc.)* - *Displacement or poor monitoring of the performances of external managers may lead to same results and misinterpretation of the senior management*

Table 4- 1: Advantages/disadvantages of external contracted leaderships in project teams

As a matter fact the deployment of external project managers into leading positions such as a project organisation do have high potentials for the success of a project and a positive development of the company. Despite the positive effects such an implementation might have, there is a range of risks omnipresent if performances of leadership positions and respective specialists/labour introduced are not indicated and assessed on a similar level as it is approached onto internal subordinate structures. Performance indicators for example could be reflected by feedbacks of subordinate staff, the customer or contracted companies. Others could be project success related indexes such as compliances of schedules, costs, milestones achievements and least quality measures in within the technical executions. Thus it should be in within the responsibility of the directive board to monitor, to value and even to guide these performances and to create an adequate transparency for them and to the own mid- and low-level personnel. Especially in the construction industries, where identification is given by the means of a special product or service and where the provision of this performance is shouldered on the motivation and achievements of mid and low level structures representing the greatest stake of such companies, it is a necessity to reveal positive and negative outputs especially in terms of deploying management positions with external labour. If not adequately treated, negative outcomes of projects of any nature (financial, technical, organisational, etc.) as it was the case in the Enquest Project could lead to incomprehension, demotivation and envy of everyone involved and thus have effects on the quality of the performances and the product itself. On the other hand a deployment of purely internal staff might lead to similar developments and opinions among the subordinated personnel and might be argued by saying that flaws and mistakes in the organisation at least have been of internal shortcomings. Based on this discussion a healthy decision support is necessary regarding the deployment and the position of the project manager in case a buy-in of project managers and other labour seems inevitable. One solution might be the occupation of own staff either on superior or on parallel level of the respective key positions in order to preserve a level of control and monitoring or to invigorate learning and experiencing processes.

4.2.2 The Project Engineering Department (PED)

Officially the yard does not dispose of an engineering department, responsible for the design, calculation, engineering/designing, documentation and certification of drawings. The yard does have a group of specialists capable of accomplishing these jobs but these are, due to the capacity and size restrictions of this team, often limited to small projects, part projects or as a leading or supporting force of externally contracted engineering offices.

As it was the case in the two offshore projects and other projects executed earlier with a similar amount of engineering demand, external companies were contracted by the yard to carry out any engineering performance which was part of the preceding contractual agreements between yard and customer and which was not delivered or provided by the client. The conduct of such a department is subject to an engineering manager of the contractor who carries the responsibility over a number of specialists and designers for calculation, drawing/designing, documentation, customer contact etc. Usually a certain number of these specialists are situated site-near on the yard’s area and additional performances, if requested, are being retrieved from offices overseas and around the globe. The actual presence and allocation of these specialists site-near are of major importance in the ship repair and conversion industry. Performances to be delivered in this industry are based on given facts, situations and environments, which often do not reflect past design work, drawings, applicable regulations or even situations as described in the contract or the performance specifications. Thus it is of a must to continuously adjust any engineering and designing work to the real situations at site. Engineering in the conversion and repair industry is hence subject to a continuous, vivid and often reactive organisation throughout a project’s lifetime. On appeal this shows the difference to a new-built where a lot of the engineering performances are based on proactive and foregoing researches and achievements.

The main consumers of the engineering performances are the yard's internal and external contracted production and service trades. Clear structures, organisations and communication procedures, adjusted to the horizontal levels between these groups are hence inevitable for a neat and qualitative execution of any contracted work. It further reduces the risks of wasting resources such as project time and costs, specialists working time and capacities, material surcharges and accessory charges due to multiple executions of same performances.

Following improving performances shall be proposed based on investigations made on field engineering and production level.

1 **Division of Leadership**. This implies the division of the statuary leading responsibility of the engineering department between the regular external engineering leader and a yard internal engineering leader on project management level. The historical infrastructure given by an external engineering leadership only, has to be based on a very trustful and loyal relationship between yard and contractor which is often not given or hard to achieve, especially if performance indicators revealing someone's achievements are poor or badly implemented. So-called engineering responsibilities either directly carried out or assigned by the project manager often cover only one task out of a number of others and hence suffer from lacking attention. A neat definition of all the tasks an engineering department leadership comes along will reveal enough performances to define two fully valued and in fact two full-time jobs. Responsibilities could be assigned as shown in Table 4-2.

External Engineering Leader	Internal Engineering Leader
- *Direct contact to the project manager* - *Direct contact to the customer regarding engineering performances* - *Carries disciplinary directive and organisational powers towards his designers / engineers and specialists* - *Main responsibility for the quality, accomplishment, compliance approval and certification of any engineering performance as due to contract or as requested by the customer* - *Responsible for providing engineering performances, as required to the needs of the yard and the customer (documentation compliance of drawings, numbering, measures, etc.)* - *Responsible to accelerate or decelerate performances if*	- *Direct contact to the project manager* - *Direct contact to the senior management (directive board)* - *Carries interdisciplinary directive and organisational powers towards the designers / engineers and specialists* - *Main responsibility for the quality, accomplishment, compliance, communication and approval of engineering performances on horizontal project levels, i.e. field engineering, production, quality and management departments* - *Monitors / observes the performances of the external staff and reports to the PM* - *Brings in knowledge, experience and communication skills related to yard internal structures and organisations*

External Engineering Leader	Internal Engineering Leader
needed - *Deployment of special labour, e.g. offshore field related specialists*	- *Interconnects yards own key personnel for engineering tasks in order to prevent double work (‘Integrated Planning’)*

Table 4- 2: Division of responsibilities between external (contracted) and internal project engineering team leaders

2 **Specialists by Discipline**. This item basically induces the necessity to provide at least one primary engineer/designer per assigned or requested discipline (i.e. structural/steel, mechanical, electrical, etc.), the continuous allocation of these specialists near the site and the implementation of horizontal communication and planning procedures to specialists of other departments.

3 **Presence and Continuity**. This topic captures the necessity to obtain structures and contracts in within this department that preserve the presence and the continuity of adequate labour to serve the consecutive departments at any time and throughout the complete period of the project. Emphasis on this topic shall be made especially in terms of loose contracts made, the respective and continuous change of labour throughout a project’s lifetime and the respective necessity for induction and training of new engineers.

4 **Communication and Interaction Procedures** imply the inalienable need for a so called on-the-field-engineering support and the communication to the field engineering team, the production trades and the quality department. This in first instance postulates an adequate amount of supporting designers serving the main trades (steel, mechanical, piping, others), desirable with field experience and good communications skills, to cope on-time construction and design issues (i.e. sketches/drafts, basic calculations, updates of as-built drawings, and others), which are coming up on a daily base and as a natural outcome of a construction site of high variance and nonconformity. This supporting team is not part of the core designing/engineering group – could be in times of low capacities – but basically keeps continuous contact to key field personnel, observes/inspects the sites on his own or/and accompanied by field personnel, and captures changes and deviations in order to preserve compliance to existing and as built drawings. The main requirements for this is the presence of horizontal communication structures (main and only contacts to the production by name and department) and a priority assessment method, i.e. prioritisation indexes on a daily/weekly base in order to handle engineering performances based on their actuality and importance. This further constitutes a global understanding and assessment of large, continuous and varying construction sites in order to avoid or reduce multiple works. The authorised guidance of this engineering force team would further be subject of the internal engineering leader or/and yard leading team

Example: The repair of main structure of a tank at the very beginning of the project and the neglecting of certain communication and planning constraints or the unpreparedness of the actors involved can easily lead to the future situation of cropping the tank apart in order to provide space for a specific module. This induces not only the loss of capacities, profit and schedules but amplifies a poor quality management and preparedness to the client.

A planning policy based on the methods proposed by (Bai & Liyanage 2012b; Bai & Liyanage 2012a; Bai & Liyanage 2010) could support not only the assignment of actors to a number of tasks and responsibilities but to support the overall coordination and planning of all processes and and respective dependencies.

5 **Compliance** includes the conformity of all engineering performance according to customer and/or yard standards including issues like units systems (metric, Anglo-American units, etc.), types of drawings, attachments and calculations, outline, numbering system, documentation / filing, actualisation / updating, distribution, traceability and computer systems and others. Special attendance is further to be paid on the compliance of nesting drawings in order to ease and speed up processes of yard plants such as CNC-plants (Computerised Numerical Control), flame cutting or welding machines or any other automated plant that needs digitally worked off data.

4.2.3 The Field Engineering Department (FED)

The field-engineering department as it is lived on the yard is a very dynamic and progressive but often underappreciated team of specialists. Due to the multidisciplinary responsibilities and communication levels the job of a field engineer requires besides technical backgrounds and qualifications, high proficiency in communication (socio-cultural, managerial and foreign-language) and governance, creativity, stress-resistance and high abilities for anticipatory thinking and understanding of interconnected processes. Since the field engineer requires the communication between customer and classification representatives, project management, contracted companies and own trades, hence acting on a continuous interdisciplinary level, he/she plays an important managerial-technical key role in the project team. A definition of tasks and responsibilities as well as managerial and communicational procedures must exist and be continuously updated in a manner that every engineer thoroughly knows his requested performances, the communication levels and standards and finally how to react on deviations, i.e. who to contact for guidance and support.

Large projects come along with a huge amount of work, technical tasks of highest complexity, long periods of performance or a combination of latter named factors. The assignment/deployment of the field engineers takes place by the production leader – the distribution of work packs according to specialisation and work list takes place in consultation with the project manager. The distribution of single items/tasks is handled by the field engineers, based on preference, experience, skills or need. Every engineer then processes his assigned items on a fairly distinct level building up all horizontal, vertical and interdisciplinary connections he needs to accomplish his/her jobs. The problems accompanied are lying in within the constraints an engineer reaches on a certain planning level (overview and management of several parallel processes), lacking guidance and the continuous need for assessing daily appearing and rapidly changing performance indicators
The position of the field engineer hence represents a very sensitive and critical risk factor especially if the engineer is inexperienced (too young), demotivated (no visible effects from much work), unguided (no control) or incapable (no basic support structures). All of these

constraints are further cumbered by the high amount of performances requested and the resulting higher average working hours compared to other departments. In order to attack certain organisation, communication and responsibility flaws the improvement proposal comprises an implementation of a staff and line organisation in within the field engineering team distributing tasks and responsibilities on a qualitative approach, i.e. responsibilities are distributed on a variance of management and coordination tasks and are defined briefly as follows:

1 SFE – Sub Field Engineer "Specialisation"

Specialisation Types	
Steel/structural: hull, tanks construction/repair, upper structure, topsides/offshore (steel), equipment and facilities	
Communication Levels (basics; concretisation will follow in chapter 4.2.6.3	
↑ (up)	Main Field Engineer Specialisation (reporting, consultation, support) Field Engineer Leader (reporting, consultation, support) Reporting to any other superior structure only if requested
→ (parallel)	Assigned members of all departments according to horizontal performance levels Assigned members of customer's field engineering / surveying department Representatives of regulation & classification societies
↓ (down)	Directive/coordination power: - Contracted companies (foremen) - Trades (foremen)
Meetings:	Daily Production Meeting (with trades and contractors) Field Engineering Meeting (e.g. weekly base) Contractors / Classification / Trades / … (according to project on regular or on impulse base)
Tasks:	
- Coordination and communication of all tasks & work packs according to specialisation and work list description in consultation with main field engineer specialisation - Planning & execution of performances on a daily/weekly/monthly base according to communication levels - Guidance, coordination and execution of engineering issues (in cooperation with assigned engineering department members) - Guidance, coordination and execution of quality assurance issues (in cooperation with assigned QC-members - Guidance and assurance of documentation issues (in cooperation with assigned DCIP-	

members)

- Planning, coordination, guidance & observation of resources/performances, e.g. material, equipment, performances of trades and contracted companies (in cooperation with assigned QC, DCIP and Contract + Finances members
- Guidance, coordination and execution of safety issues (in cooperation with HSE department)

Table 4- 3: Main responsibilities and interactig levels of Sub Field Engineers "Specialisation"

2 MFE – Main Field Engineer “Specialisation”

Specialisation Types

steel/structural, mechanical, offshore, piping/marine systems, electrical, accommodation, equipment, paint, …

Communication Levels (basics; concretisation will follow in chapter 4.2.6.3

↑ (up)	Field Engineer Leader (reporting, consultation, support) Project Manager (reporting) Reporting to other department leaders only if requested
→ (parallel)	Assigned members of all departments according to horizontal performance levels Assigned members of customer’s field engineering / surveying department Representatives of regulation & classification societies
↓ (down)	Directive/coordination power to: - Sub Field Engineer Specialisation (reporting, consultation, support) Coordinative (but not directive power) to: - Contracted companies (foremen) - Trades (foremen)
Meetings:	Daily Production Meeting (with trades and contractors) Daily Customer Meeting Field Engineering Meeting (e.g. weekly base) Contractors / Classification / Trades (according to project on regular or on impulse base)

Tasks:

Coordination and communication of all tasks & work packs according to specialisation and work list description in consultation with Sub Field Engineer “Specialisation”, trades and contracted companies

All planning and coordination performances are concentrated on the support and guidance of the subordinated field engineers and include but are not limited to:

- Support in planning tasks (in cooperation with assigned member from the departments, trades and contractor or other external actors)

- Evaluation and monitoring of all planning work on a superior / on specialisation level and forwarding to PM, Planning Department, …
- Support and backing in technical and managerial issues towards any other actor (internally & externally)
- Main bureaucratic responsibility (emailing, checking of drawings / specs / work list and CO descriptions / inspection and testing papers / …)
- Planning, coordination, guidance & monitoring of resources/performances, e.g. material, equipment, performances of trades and contracted companies (in cooperation with assigned QC, DCIP and Contract + Finances members
- Support in guidance, coordination and execution of engineering, quality, safety and documentation issues (in cooperation with assigned interdisciplinary team members)

The Main Field Engineer is basically not involved in the real, day-to-day ‘on the field’ performances but is aware of every work item in terms of main decisions/agreements, schedules, locations, real situation (visits the construction on a regular base as a “tourist”). He acts as a guiding, supporting and monitoring instance of the SFE’s and is involved in the global planning of his specialisation and preserves the transparency to other specialisations and departments

Table 4- 4: Main responsibilities and interacting levels of Main Field Engineers "Specialisation"

3 DL – Field Engineer Leader (Department Leader)

Specialisation Types	
global understanding of all specialisations and field engineering performances	
Communication Levels (basics; concretisation will follow in chapter 4.2.6.3	
↑ (up)	Project Manager (reporting) Customer
→ (parallel)	assigned members of all departments according to horizontal performance levels assigned members of customer’s field engineering / surveying department representatives of regulation & classification societies
↓ (down)	Directive/coordination power of: - Field Engineer Leader (reporting, consultation, support) - Main Field Engineer Specialisation (reporting, consultation, support)
Meetings:	Daily Production Meeting (supportive, if needed) Internal Audits Daily Customer Meeting Field Engineering Meeting (e.g. weekly base) Contractors / Classification / Trades / … (according to project on regular or on impulse base)
Tasks:	

Coordination and communication of all tasks & work packs according to specialisation and work list description in consultation with Main Field Engineer "Specialisation", Sub Field Engineer "Specialisation", trades and contracted companies All planning and coordination performances are concentrated on the support and guidance of the subordinated field engineers and include but are not limited to: - Support in planning tasks of SFE's and MFE's (in cooperation with assigned member from the departments, trades and contractor or other external actors) - Evaluation and monitoring of all planning work on a production level and forwarding to PM, Planning Department, … - Support and backing in technical and managerial issues towards any other actor (internally & externally) - Main bureaucratic responsibility (emailing, checking of drawings / specs / work list and CO descriptions / inspection and testing papers / …) - Support in guidance, coordination and execution of engineering, quality, safety and documentation issues (in cooperation with assigned interdisciplinary team members) - Superior force of the Field Engineering Team regarding all managerial, organisational and technical issues on multidisciplinary level, i.e. clarification and communication of high-value issues and problems on upper management level (global schedules/planning, resources, costs, deviations, engineering, quality, customer etc.) The Field Engineer Leader represents the department leader and acts on the upper management level of the project but with emphasis on the needs of his department. He is aware of the main construction/work items, main decisions/processes, schedules, costs and liabilities. He is involved in the global planning of the production and preserves the transparency to every other department

Table 4- 5: Main responsibilities and interacting levels of Field Engineer Team/Department Leader

4.2.4 The Quality Department (QD)

The measure, which is to be introduced by this chapter comprises one the most important ones of this analysis, since it basically covers the most important barriers in within many of the current states limiting the production success. During the last half a year the yard is in the process of introducing and implementing a substantive quality assessment and control department, which is responsible for the maintenance of any quality measure connected with the technical and procedural execution of performances on the yard according to current applicable standards. This department further carries the assigned key functions of tutoring, supporting and advising any disciplinary level on the yard in terms of these standards. The completion and hence presentation of this department is to be awaited in the course of mid-year 2014. Since many of the assigned tasks, performances and processes already investigated on, are ready to be presented, the course of this thesis will assume an early state of QD implementation and will further concentrate on missing quality barriers in within the "old" yard environment and the two projects.

Quality is a measure applied on anything of concern (e.g. product, process, subjections) used to compare a number of inherent characteristics to a number of inherent requirements. (PRAXIOM 2014) The level of compliance between existing and targeted state and the definition of acceptance criteria and comparative measures can thus provide a classification of the observed “issue” on a pre-defined coarse scale either based on subjections (feelings, impressions, etc.) or fixed by default settings (regulations, standards, requirements etc.).

One main requirement in order to provide any service on the yard is the classification, certification and approval of the yards “Quality Management System” as to current applicable standards. These requirements have ever been and are certified by DIN EN ISO 9001 “Quality Management Systems” (currently DIN EN ISO 9001:2008), and are systematically and continuously updated according to updates of the norm. In order to preserve and optimise the quality of services on the yard and respective projects and to support the process approach underlying DIN EN ISO 9001 in the improvement of quality assurance and control in a company the following recommendations shall be made based on the introduction of a “Quality Department” with following defaults:

1. Main tasks:
   - Maintenance and application of the quality management system in the company according acc. to currently applicable standards
   - Tutoring, supporting and guiding of all departments acc. to applicable quality management system norms
   - Introduction of standardised and globally utilised tools and defaults to support the compliance of performances in within yard departments according to currently applicable quality management system norms. Proposals of tools and defaults should be but are not limited to :
     a. Introduction of a ‘Quality Plan’ (QP)
     b. Introduction of process instructions for ‘Quality assurance in the project’ (incl. revision, planning, coordination, surveillance, assessment, control and approval of quality matters)
     c. Introduction of a revised ‘Documentation System’ with standards for collection & filing, outline, contents, numbering and referencing (department, responsibilities involved)
     d. Introduction of continuous ‘Quality Assessment Audits’ on global level
     e. Introduction of standards for ‘Inspection and Test Plans’ (ITP), ‘Material Identification and Traceability’ (MIT) and final inspection/approval processes
     f. Personnel and professional capacities to provide the deployment of quality assessment and control teams on projects (either directly or by guidance) capable of processing at least above stated points a. – e.

2. The minimum requirements for specialists deployed in within this department should be but are not limited to:
   - Quality Manager (Head of department)
   - Quality Engineer
   - Quality Surveillance / Inspector
   - Quality Documentation control
   - NDT Manager / coordinator

The main barrier as part of the up-setting of a project organisation and the investigations of this field is the introduction of a project's specific (internal) 'Quality Assessment and Control Team' (QACT) either consistent of staff from the yard's quality department or under the auspices and control of latter. Further barriers in within the processing of a project are as follows:

- Implementation of the QAC team in the contract revision and specification period (creation of performance specification and Item Work List) of the project phase
- Neat implementation of the QAC team into interdepartmental relations (hierarchic assignment of levels) and the clarification of one's responsibilities and tasks
- Implementation of the QAC team into integrated operations and prioritisation management (ITPs, MITs, others)
- Neat, applicable and useful integration of the QAC team and the production assets
    - "Cooperative work with same goals"
    - Adequate flexibility in the support of the production assets (enhanced cooperation between QAC inspectors, field engineers and trades)
    - Control, revision and information collection and approval of the performances on production level
    - Control, revision and main responsibility of documentation related to performances on production level
    - Control, revision and main responsibility of final approvals and compliances of performances on production level

4.2.5 Documentation / Planning / IT / Competence (DCIPD)

A neat and complete documentation is not only the most invidious task, but also the most important one in order to verify the compliance, completeness and quality of a service or product as agreed to contract. In terms of performances as carried out on a yard it is the final main base for receiving the respective compensation by the client. Since the main product at BVR is a technical service the discussion of solution proposals shall be limited to the technical level only, which is on appeal the field with the highest improvement potentials.

4.2.5.1 The Documentation Team

In order to allow for a traceable and complete documentation on global project level the proposal shall be made for the establishment of a distinct 'Documentation Team', binding fixed representatives of all departments. Herewith the documentation responsibilities should be fully aware of all documentation constraints as well as the arising documentation outputs in within each department - thus experiences regarding the specific fields are inevitable. However, this position primarily acts as a recipient of information and is hence dependent on the legwork of every single position in within the other departments producing any kind of documentary output. The reason for implementing such a group into a discrete department is to obtain a central documentation database (1) and more important to keep the main documentary work self-containing from any department internal subjections (2). Latter captures the approach to encourage a better flow of relevant information between the departments and secondly to prevent the case that the documentary works are resting on the subjective assessment of only one department. A main acceptance of staff from the management, the field engineering and the quality department regarding a regulation of this kind should be tutored continuously by the project or senior management since neat filing and documentation are equally important for each of these departments. Wishes for better control or no-confidence votes could be regulated by assigning the documentation team out of the group of specialists of the respective departments. This particularly implies a centralised control of the documentation team by the DCIP Leader but on appeal a decentralised interdisciplinary acting radius of the single members of the team.

4.2.5.2 The Planning Team

A similar approach is designated for the introduction of an ‘Integrated Planning Team’ and IP planners. Although not responsible for the autonomous planning of procedures this team carries the responsibility to realise the integration and planning processes – thus yard’s/project’s Integrated Planning Operations – by collecting and processing data and information discussed with key personnel on appropriate levels and different departments/ responsibilities. Besides the realisation and maintenance of the project’s integrated planning this team carries necessary capabilities, capacities and knowledge in the utilisation of IT supported planning and visualisation tools such as MS Project, Primavera, SRP-supported solutions to support and serve planning and scheduling visualisations requested either by the client or any departments within the yard/project organisation.

4.2.5.3 The IT-Team

As the title allows presuming, the IT-team is a group of specialists handling all issues regarding the facilitation and maintenance of IT hard and software on project level. Due to high deployment rates of labour at busy times using computers and computer based systems as a main working tool, there is a continuous need for IT supports both, in the provision of the technical hardware and in the assistance of software and special programs. Currently IT support is limited to the service provision of the global yard’s IT-department. ‘Global’ in this context comprises the combination and allocation of all sectors of Blohm + Voss (BV Naval, BV Industries and BV Repair) at the location in Hamburg.

In order to refer back to the subject of missing IT support and the necessity of an intelligent implementation and use of modern technologies for data acquisition, assessment, visualisation, planning and distribution (Chapter 2.1 Integrated Operations), this is the team creating and in the second step incurring the base for it. The main focus of this team is in the introduction, realisation and maintenance of a highly efficient IT-system necessary to support Integrated Planning on the yard since the “utilisation of advanced infrastructures and Information, Communication Technology (ICT) provides an opportunity to the group of engineers, specialists, and planners through better visualisation, communication and work management to improve the competence of the planning process, thereby improving the stability and reliability of plans.” (Bai & Liyanage 2012a) The systems recently used at the yard are outdated, too specific or complicated/weak and do not allow an adequate insight to everyone involved in large projects. In addition to this and in order to support on production level the global IT market offers a huge range of engineering project support, documentation management and traceability software for welding and construction performances, easily adjustable to the needs of the company by means of software modules/packages. The idea of implementing such structures is a thought worth, since many of the existing solutions tackle the special and high demands on BVR production level and thus expose high potentials of raising the value of the yard if neatly implemented. Hereinafter listed software systems (modules/packages) are and could be, but are not limited to the interests for BVR production and construction level:

- Material traceability
- Material takeoff
- Procurement
- Material / equipment scheduling
- Welding
- Progress tracking
- Weight control
- Pipe tracking
- Document management
- Planning management (adequate tools)
- Information procurement management
- Visualisation techniques
- Others, …

(Items "Material traceability" to "Document management" — Source: (Example MATRIX): **"Engineering Project Support** http://www.matrix-eps.com/)

4.2.5.4 The Competence Team

The appointment of a Competence Team is grounded in the need for continuously required technical information and support connected with the performances of a project. Not only this team has to support the colleagues of its department but to build up and maintain a central and informative cloud environment to support all members of the project. Ideally this team consists of specialists and engineers from project or field engineering and quality control/assessment streams with good knowledge of the yard internal structures. Information of relevance could for example contain the following:

- Fast access and pool to general applicable regulations and classification documents
- Fast access and pool to project specific regulation and classification documents (e.g. offshore, cruise ships, marine, yacht, etc.)
- Access to major contractual regulations, decisions and developments
- Specialists support (e.g. offshore and offshore company internal papers and processes, such as traceability, differentiation between marine and topside structures, lifting procedures, risk analysis + assessments, documentation, quality, safety, etc.)
- Support of trades in terms of technical questions, language problems, compliances of technical drawings and formats and similar
- Collection of consistent template documents of any kind (technical, management)

All of the above mentioned and necessary information shall be provided and maintained and made accessible online to every assigned position of the project team.

4.2.5.5 Traceability support

The two offshore projects have clearly revealed the yard's unpreparedness in terms of the traceability performances on production level. This comprises all maintaining, controlling and documentation performances starting from engineering/designing, certification, installation and final approval of any new, old or repaired component and element on board the offshore vessels. Difficulties of reaching these performances are grounded not only in the correct definition, meaning and assignment of traceability levels but simply in the lack of an existent traceability management system. With the course of both projects huge effort was put into detailed excel documentation sheets in order to keep track of elements inserted (incl. reference to material, position, welding, NDT, dates and others). The problems here were routing in the divergences of the two projects (due to different agreements) and that single documentation performances were created based on current needs, by different levels and with different outlines and according to project requests/needs. Thus these templates supported current necessities of certain teams and departments but did not meet project global attention and utilisation. The following items shall help as a proposal of performances by a traceability management system in order to support steel and repair works as carried out on the yard.

1. Definition and assignment of traceability levels (on general level and in respect to specific project requirements)
2. Material traceability
    - Engineering/designing
    - Procurement
    - Certification
    - Take-off
    - Scheduling (dates), installation and tracking/processing of intermediate steps and inspections (before/after installation, before/after welding after welding, before/after painting, final inspection)
3. Welding traceability
    - Welder details, dates
    - Welding processes and details
    - NDT performances
4. Weight control
5. Progress tracking
6. Concurrent and final document management
7. Planning support tools (division of areas by traceability levels, assignment of standards welding teams according to traceability level, division of large construction/repair areas into smaller sections)

Many of these issues could easily be introduced with simple tools such as existent Microsoft tools (Excel, Access and Project) but templates have to be created according to the needs of the yard in a pro-active (before-project), standard and globally utilised manner. A different approach could be the introduction of systems developed by service companies specialised on the traceability management of production and construction assets as for example Pinnacle Business Solutions Ltd and its development of "MatriX - Engineering Project Support".

An advanced step in the utilisation of traceability tools on BVR production and construction level could be the introduction of structural steel marking solutions, which is a technique, thoroughly used in many other industries (such as steel fabrication, piping + system fabrication, mechanical part fabrication, etc.). The idea behind this is technique is the allocation of a code (barcode, QR-code or similar) to any item/element – which is to be newly fit, replaced or repaired – right from the beginning of an engineering, planning and/or repair process. The marking/tagging of steel parts could be a necessary facilitating tool for tracing thousands of different steel items as occur on large and complex projects. It further support the assessment and control of quality compliance and to help to control overhasty repair performances. The system should be designed in a manner that new information can continuously be added to the assigned code and respective item according to the current position and processing state (design, fitted, welded, tested, etc.). A certain amount of specialised service companies offer a wide range of different systems and application methods (printing, laser, cutting, sticking, etc.), which could be applied according to the environment of each construction site. Table 4-6 shall provide a short overview of the traceability life-time of a random construction item (e.g. steel bracket) and the consecutive steps of information addition and completion according to item's processing. At the very first step we will have the design of a random item followed by direct assignment of code.

Engineering / Designing Process

Possible data on the code:

- Project / technical drawing / position and other position indicating references
- Main dimensions, type + grouping references
- Material and welding details
- NDT (non-destructive testing) specification
- Intermediate and final inspection constraints
- Conservation (painting) specification

Procurement / Inquiry process

Additional data on the code:

- Supplier and material certificate
- Delivery date and storage place
- Steel plate reference (1^{st}, as to order)

Takeoff (steel cutting + preparation phase)

Additional data on the code:

- Steel plate reference (2^{nd} / actual/given distribution at the yard)
- Allocation place
- Additional adjustments / changes

Installation / welding / painting / termination

Additional data on the code:

- Dates (installation, welding, termination)
- Welding and welders details (welder number, energy / heat introduction surveys, intermediate and final NDTs)

- Inspection / and final approval papers and responsibilities

Table 4- 6: Possible consecutive data addition steps in within the traceability lifetime of a random construction item

4.2.6 Re-Evaluation of descriptions, processes and procedures

4.2.6.1 Re-evaluation of the process for repair and conversion of ships

The applicable yard standard ‘4.1 Process for repair and conversion of ships“ and many other supportive and applicable yard regulations provide an overview on general agreements and structures of processes related to the performances the yard offers. The main issue regarding these papers and as was already mentioned earlier is the difficulty each and every position in within the yard faces is to traces one’s own role, tasks and responsibilities. A number of reasons for this are lying in:

1 Outdated collection of information (theory to reality)
2 Poor structure of the standards (separation of main disciplines, traceability of information)
3 Poor diagrams (to support the understanding)
4 Missing references to other necessary and supporting standards
5 Poor presentation and tutoring of these standards (a number of persons in the company are not aware of these papers or haven’t studied them yet)

The scope and quality of information provided in these papers are not false but need compulsive rethinking, restructuring and correction according to the current needs in the processing of repair projects. The implementation of integrated planning at this stage could help support the success of the evaluation and implementation of new standards since it requires the evaluation of “a detailed process design with clear roles and responsibilities, which [!] provides better cooperation and communication between disciplines, reducing potential pitfalls due to misunderstanding” (Bai & Liyanage 2012a)

4.2.6.2 Re-evaluation of job & responsibilities descriptions

Clear and comprehensible descriptions and specifications of every job in within a company are of major importance in order to assure that everyone knows his tasks, his position in within the organisation and how to behave and act upon the various situations he faces. Not only must these descriptions be easily accessible to everyone in within the company but also they must be established in a manner that no one feels harassed or degraded but also not defined in manner that responsibilities are stiffened to total stagnation, i.e. a certain level of flexibility must be given. The provision of traceability on existing jobs and positions executed within an organisation contribute to the understanding of own tasks, the responsibilities of colleagues from other internal or and external departments have, supports decision finding by screening the right contacts and finally acts protectively by providing clear instructions for one’s responsibilities and sphere of influence. It must be stated that such descriptions, more or less, do exist, either as discrete documents or as part of process descriptions. The problem is that these papers are based on obsolete standards and procedures, provide too much room for interpretation or are simply hard to trace on specialists level. The daring approach should be to evaluate updated job descriptions for every single position in a logical and understandable (i.e. not management language) manner and to provide these on a platform reachable to everyone (intranet, blackboard, etc.). Hereby should one should differentiate between two main cases.

The first step is to provide information on a general internal level. This implies job and responsibility description as well as communication and planning functions on generous level for every fixed position on the yard. These could further be highlighted with organograms and direct assignment (name, department, contact, picture, etc.) and could for example represent the picture for standard “daily business” projects. The following points should be included:

1 Position definition
2 Name, department, contact, picture, …
3 General description of responsibilities and tasks (who, what, where, how, when)
4 Communication and Interaction (up/parallel/down, which hierarchic level, meetings, emailing etc.)
5 Planning (planning level: up/parallel/down)
6 Guidance for non-conformities / deviations from job description (how to react, who to contact, e.g. as part of a spread sheet)

The second step is the implementation and adjustment of these positions into a project organisation. The base for this is a preceding evaluation of the work list items and the scopes, investigation of the required positions, personnel capacities and respective deployments, and finally the assignment of positions, tasks or work list items by name (based on a project internal organogram). Every position is further supported by an adjusted job description based on the existing generous one and hence should include the following project specific items:

1 Position definition
2 Name, department, contact, picture
3 Description of responsibilities and tasks (who, what, where, how, when) in within this specific project. Additionally specific job assignment (e.g. work list item or variation number) should be included, incl. level of responsibility, planning, communication.
4 Communication and interaction (up/parallel/down, which hierarchic level, meetings, emailing etc.) in within this specific project.
5 Planning (planning level: up/parallel/down)
6 Guidance for non-conformities / deviations from the original job description (how to react, who to contact, e.g. as part of a spread sheet)
7 Substitution positions or secondary contacts by name and contact details
8 Approval (e.g. by signing) by assigned staff that description is clear and understood.

The last step is the provision of this information to everyone involved in the project and in within the company, the customer’s organisation and to every contracted company on an adequate IT environment such as intranet or SRP-systems or as part of the process design of IP. Obviously this implies a certain amount of preceding effort and continuous maintaining work throughout the project’s lifetime but rated on the fact that large projects last up to two years including a tremendous iteration of personnel involved. A neat assignment and definition of jobs, position and actors as part of an operational system are the basis inevitable basis for any process in within such a vivid and fast changing environment in order to succeed on the long run.

In order to ease the evaluation of the positions the documents should be compiled as spread sheets in order to allow for handwritten adjustments and completion and could then be digitalised and published on a fast track.

4.2.6.3 Communication Structures & Procedures

Special attendance is to be paid on the definition of communication levels. This includes the establishment of communication chains based on the managerial and field related performances as well as the tools used (such as mobile phones, emailing, meetings, etc.). The base for this follows the principles of a military organisation structure, but shall enhance soft structures of communication. The intention herewith is not to limit the exchange of information but to clearly separate the sphere of influence and key responsibilities but to support and protect every single position in within the project organisation and to enhance communication chains on specialist level. Further it is a tool that attacks the problem of flawing command chains since everybody is easily aware of the directives he has to follow and those he can pass on.

Communication passages should be defined on a general description of positions and management levels as well as on explicit level for every single job in within the organisation. Here it should not be the approach to define every single contact, since the project organisation usually grows in complexity throughout the development. Having in mind that the organisation might face continuous changes, the approach is to define an inviolable main structure at the beginning and further assign the necessary key contacts and key roles for every position and party involved to support shifting roles or newcomers in the project.

As part of this chapter three main communication levels shall be introduced and briefly described.

<u>Communication Level 1: "Disciplinary" Sub Management (SFE)</u>

Definition:

The DMM level represents the main communication level by discipline specific issue, i.e. assigned items as part of the work list or field items. The communication of these items takes places on the necessary interdisciplinary tracks needed to accomplish the jobs, i.e. assigned engineers, managers, specialists of all departments, the customer and contracted companies.

Communication Tools

General:	Direct, Email, Telephone, Intranet / IT Environment, …
Meetings:	Production Meetings (daily)
	Others (regular or irregular)

Key Role(s) – "Disciplinary Sub Managers, e.g. Disciplinary Sub Field Engineer Steel 'Hull + outfitting'

- Represents his/her field / item performance towards Department Leader, Main Disciplinary Management, PM and assigned customer representatives
- He is the coordinator of his assigned item/field/work packs in terms of execution, schedule, quality, compliance and budget
- Guides, monitors and coordinates subordinate structures (assistance)
- Guides, supports, monitors and coordinates subordinate structures in terms of schedule, technical, budgetary issues, etc.
- Informs subordinate management regarding general agreements and developments on contractual level
- Example Field Engineer Steel 'hull + outfitting':
    - = classical "Field Engineer"
    - he coordinates items or work packs according to work list and contract based on the main milestones defined by the upper management
    - keeps track of schedules, budgets and planning terms on item level disciplinary (discipline related trades, engineering, quality team, etc.) interdisciplinary terms (intersection to other trades – electrical, mechanical, paint, piping, etc.)
    - he carries the main responsibility for quality, compliance, schedule, safety and clear communication between production players involved

Table 4- 7: Communication level 1: 'Disciplinary" Sub Management

<u>Communication Level 2: "Disciplinary" Main Management (MFE)</u>

Definition:

The DMM level represents the main communication level by project specific disciplines, i.e. project engineering, field engineering, quality, documentation, contract + finances. Further cooperation procedures are defined towards project external actors, i.e. assigned representatives of the customer, external departments, discipline relevant contractors, etc.

Communication Tools

General:	Direct, Email, Telephone, Intranet / IT Environment, …
Meetings:	Internal Audits (daily, weekly), if it seems necessary
	Others (regular or irregular)

Key Role(s) – "Disciplinary Main Managers", e.g. Disciplinary MFE 'Steel'

- Represents his/her discipline & respective performance towards Department Leader, PM and assigned customer representatives (supported by Level 4 positions, i.e. "Disciplinary Sub 1, Disciplinary Sub 2, … in terms of detailed issues)
- He is aware off all main performances, decision and budgets carried as part of his

disciplines / work list items

- Guides + monitors performances of his discipline and consults with department leader + reports to PM
- Reports to PM, Customer and other project external departments; forces items / issues / problem the subordinate management struggles with or exceeds their responsibilities/capacities
- Guides & supports subordinate management in terms of schedule, technical, contractual issue
- Informs subordinate management regarding general agreements and developments on contractual level
- Example Field Engineer Steel ‘Steel’:
    - He knows all main construction sites + visits them on a regular base as a tourist
    - Keeps track of schedules, budgets and planning terms on disciplinary (e.g. for naval / structural: tank repairs, upper structure, special conversion, expedited structures, etc…) interdisciplinary terms (steel, mechanical, piping, electrical, etc.)
    - Guides and supports the subordinate engineers/labour in technical, schedule and managerial issues (communication problems of all kinds with contractors, other departments, etc.)

Table 4- 8: Communication level 2: 'Disciplinary Main Management’

Communication Level 1: “Upper Management” (DL)

Definition:

The UM defines the joint venture of all main actors from the departments on global contractual, production, process and planning level. It further assigns the team that acts on the direct interaction level with the main representatives of the customer.

Communication Tools

General:	Direct, Email, Telephone, Intranet / IT Environment, …
Meetings:	Internal Audits (daily, weekly)
	Daily Customer Meeting (daily)
	Others (regular or irregular)

Key Role(s) – “Department Leaders” (e.g. DL ‘QD’, DL ‘FE’, others)

- Represents his/her department & respective performance towards PM and main customer representatives (supported by Level 3 position, i.e. “Disciplinary Main 1, Disciplinary Main 2, … in terms of detailed issues)
- Guides + monitors performances of his department and reports to PM
- Reports to PM, Customer and other project external departments; forces items / issues/problems upwards, the subordinated management struggles with or exceeds

in their responsibilities/capacities • Guides & supports subordinate management in terms of schedule, technical, contractual issue • Informs subordinate management regarding general agreements and developments on contractual level

Table 4- 9: Communication level 3: 'Upper Management'

4.2.6.4 Introduction of non-conformities guidelines

Many positions in within a project organisation here at the yard face a certain level of variance regarding the change of performances and the sphere of influence. This room for manoeuvre and flexibility is apparently a very necessary and important term in a vivid and continuously changing working environment. Neglecting an assessment of the effectiveness, the feasibilities and capacities of doing so has been proven by many executed projects. Backgrounds for these deviations are lying within an uncountable number of unforeseeable deviations of the original work scopes and contractual agreements as well as changing capacities of deployed labour and the yard environment (docks, lay berths, workshops, etc.). On the long run non-conformity management on the yard faces a missing or flawing preparedness in partly very simple organisational and procedural establishments. It basically is not established

At the instance of these given conditions non-conformity guidelines should be assessed for every position involved in the company and the specific projects and be hence implemented as an elementary part of the job descriptions. The outline of such guidelines could follow the structures of a flow chart or a written format based on a FAQ-List (Frequently Asked Questions) covering all main areas and fields each and every position is facing continuously as part of its action radius. This clearly postulates a specific amount of preparatory work, continuous update and maintenance but could help to support major decision chains and behavioural habits of the staff. Further it could protect every position from allotted workload that either goes beyond one's capacities, qualification or influence.

4.2.7 Planning and Prioritisation Management

4.2.7.1 Planning Management – Integrated Planning

This chapter is aiming for an implementation proposal of a planning and prioritisation environment based on the introduction of Integrated Planning made in Chapter 2.1.2. In order to limit the scope of this work the key idea behind Integrated Planning and its implementation at BVR shall be developed exemplary for the activities of the Field Engineering Department with special emphasis on the naval/structural field only. As an example the work packs and performance fields of the *Enquest Producer* shall be adopted in rough means.

Hence following division for the Field Engineering Team/Department and in specific for the specialisation "structural/steel", will be developed:

Management Level	Description of planning responsibilities + tasks
FE Department Leader Level (DL) “department level”	All items as mentioned in table: 4-9 (naval/hull, mechanical, piping/systems, electrical etc.)
FE Naval/Hull Main (MFE) “discipline level”	All items acc. to table 4-8 and others than mechanical, piping systems, electrical, ship utility systems, power and heat generation but all interactions with steel/hot works, welding, painting, etc.
FE Naval/Hull Sub(s) (SFE) “item level”	All items acc. to table 4-7 and distribution/assignment of items: 1. FE – Repair and Lifetime Extension Jobs (tanks, structures) 2. FE – Outfitting + Equipment (main foundations, safety + rescue equipment, mooring, cranes, etc.) 3. FE – Systems Support Structural (foundations, clasps, breaches for mechanical electrical, ship utility systems, power and heat etc.) 4. FE – Offshore Steel 5. FE – Expedited Works (to contracted construction companies) 4. FE – HVAC 5. FE – Paint 6. FE – Interior 7. FE – …

Table 4- 10: Division of Field Engineering Team

The planning levels are distributed on the same order as presented for the communication level (Ch. 4.2.6.3)

<u>Level 1 – FE Naval/Hull Sub “SFE” (e.g. Repair and Lifetime Extension Jobs)</u>

Level 1, as presented by Figure 4-3 defines the basic or conventional status, i.e. operational / production level. Trades, contractors and departments are planning their work processes for the next period based on the coordinated constraints of the “Sub Field Engineer” of assigned discipline and item(s) (here: Naval/Structural - Repair and Lifetime Extension Performances). The planning, description and distribution of work and procedures are communicated either by directives of the SFE (“key function”) or by cooperation with the groups on a short term plan, i.e. daily, weekly basis. The SFE carries directive powers towards trades and contractors. The major communication tool is the daily production meeting run by the Main Field Engineer. The MFE acts as a supportive, consulting and directive instance to the SFE, carries directive powers to subordinates only in preceding consultation with the SFE.

In order to obtain adequate measurability, quantitative performance indicators such as daily/weekly schedules, working hours, construction progresses, safety measures and otherwise are implemented and assessed between SFE, MFE and respective delegates of other departments. Hence the field engineering level presumes a basic budgetary overview of items performances. Based on the outcomes critical work packs are assessed, compared and prioritised upon given constraints and serve the superiors for further assessment.

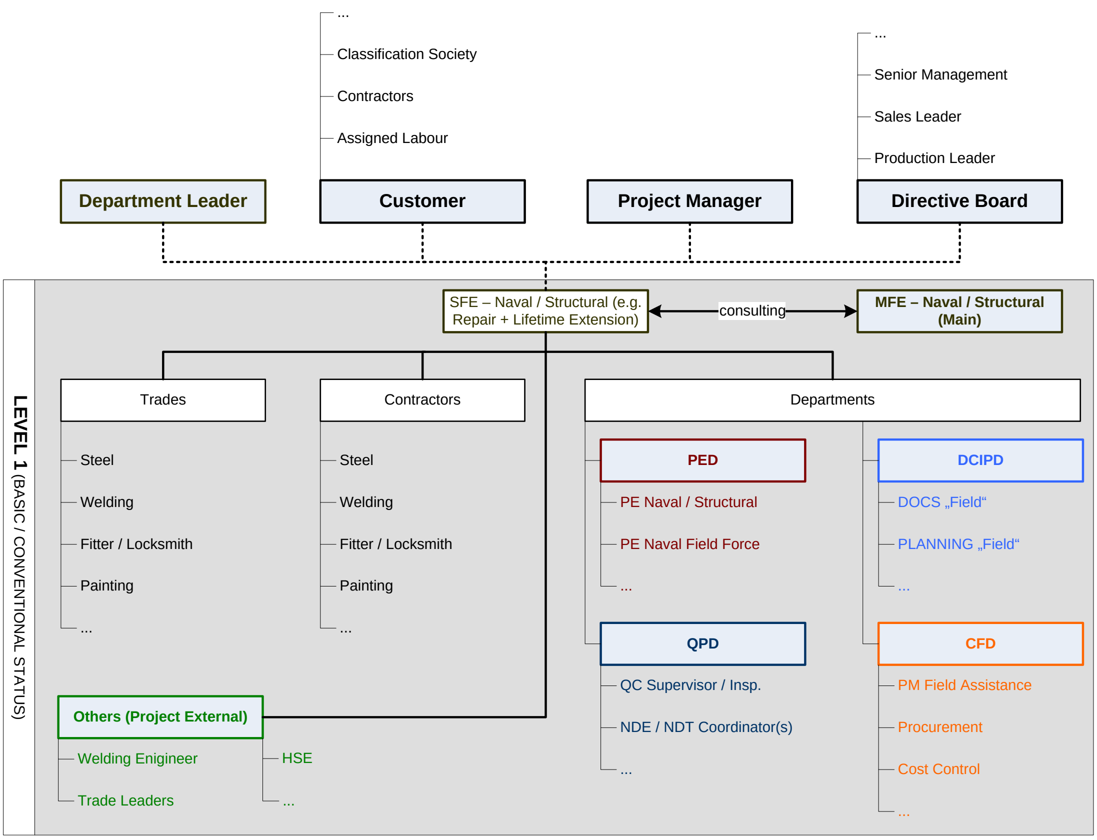

Figure 4- 3: Integrated Planning (BVR) - Level 1

<u>Level 2 – FE Naval/Hull Main “MFE”</u>

Level 2 as to Figure 4-4, is the minor intermediate state, i.e. tactical level. The approach for integrating work processes are visualised by the helps of a matrix organisation to capture interaction on item and on discipline level. Hence this level is divided in two steps, the item performances (2.a) and the discipline performances (2.b). Level 2.a concentrates on the assessment of interactions between item related performances (i.e. single items or constructions/production sites) and all SFE’s involved. In terms of very critical construction sites interdisciplinary performances (items works from mechanical, electrical, etc.) or major tasks of other departments could directly be implemented in the matrix. Interactions of items are gathered, valued and put into item-wide horizontal plans in order to prioritise integrated work processes. Performance indicators on this level are item-related dependencies and respective schedules, budgets, construction progresses, main delivery dates (material, equipment, etc.) and future tasks on medium term plan (monthly base). It shall help to evaluate constraints that might limit capacities and to coordinate requirements and conflicts. A major communication tool should be a regular (e.g. weekly) meeting.

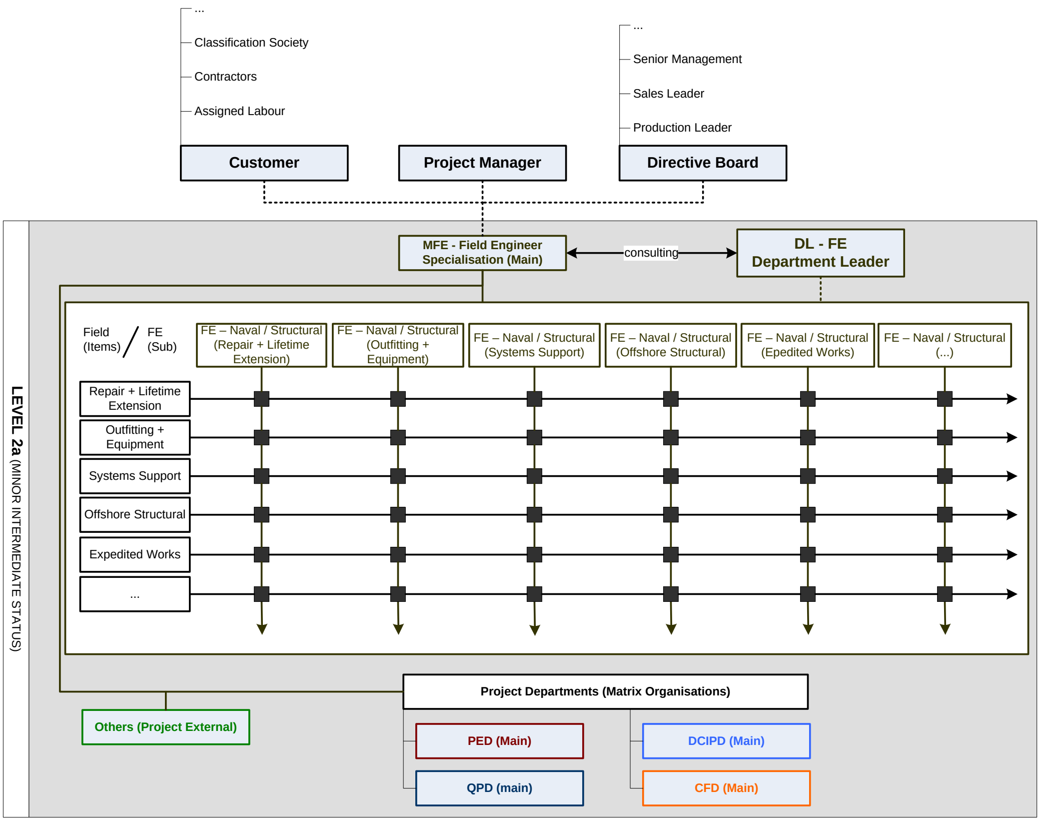

Figure 4- 4: Integrated Planning (BVR) - Level 2a (item level)

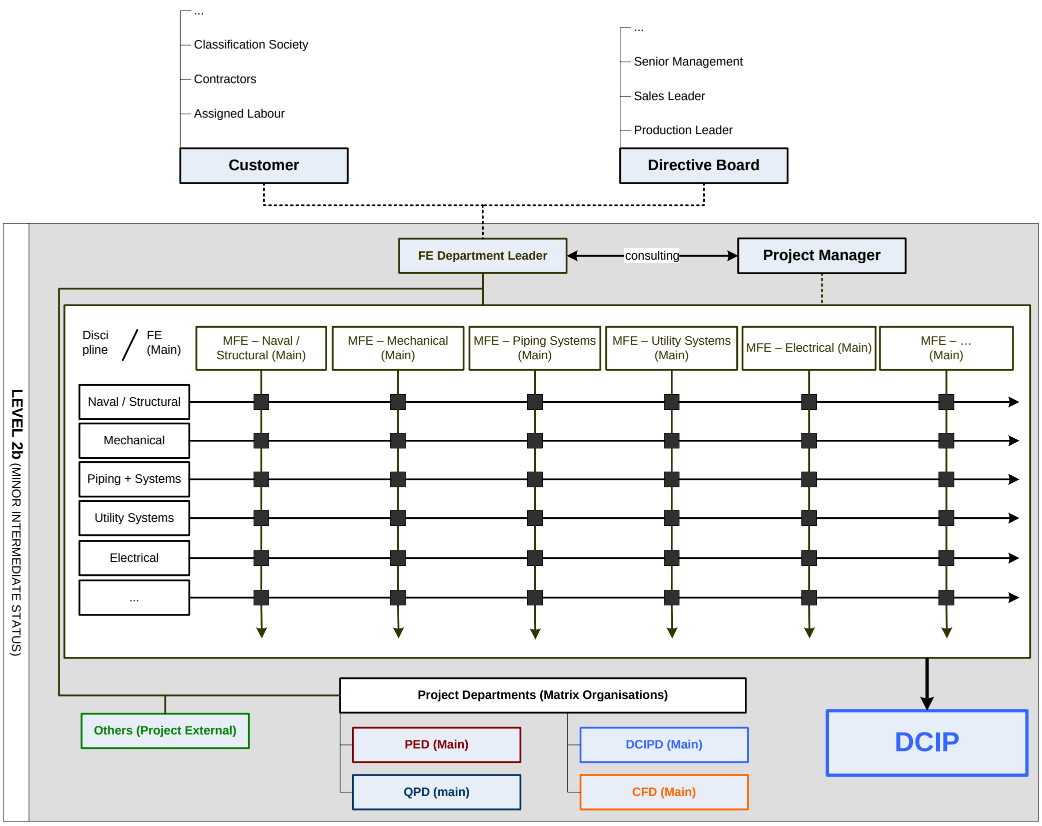

Figure 4- 5: Integrated Planning (BVR) - Level 2b (discipline level)

In level 2.b (Figure 4-5) coordinative tasks are brought to tactical interdisciplinary planning. Key data assessed in the field-related matrix assessment is brought into interdisciplinary correlation, valued and aligned by discipline-wide horizontal plans. These horizontal structures further help to prioritise integrated work process on global production/construction process and expenditure scale, creating medium and long-term plans, involving information about costs, time, quality and risks. Regular meetings (e.g. discipline internal weekly, daily customer) shall help to assess necessary performance indicators such as main milestone, global schedules, cost assessments, decisions and developments, capacities and otherwise.

Level 3 – FE Department Leader "DL"

Level 3 as visualised by Figure 4-6, is the main intermediate status and seizes the long-term plan as assessed above. In chapter 2.1 the definition of this level amplifies the integration of all planning to Onshore Centers (OC). A BVR analogue of such OC's was presented in Chapter 4.2.5 by the means of implementing the Documentation, Competence, IT and Planning Department (DCIPD). Level 3 as proposed for the project organisation at BVR implies two main steps. In first instance as visualised by the matrix in Figure 4-6 an evaluation of interdepartmental connections, developments, states and decisions between all departments on upper management level is carried out. All information and data as bechanced from preceding evaluations is brought into project global context and interacting activities. It further serves to assess the status of schedules, costs, current production statuses, capacities in terms of labour, material and other indicators to value the achievements of a project at any given state and time. Level 3 requires the implementation of a regular (weekly or monthly) assembly of the PM, the department leaders and only if required key personal from the below assigned management levels. It thus describes the internal audit that serves as the main internal information event for the PM. Due to continuous feedbacks from subordinated structures, the department leaders play a key role on superior management level either by appalling of, or by pushing through needs, problems, malfunctions or improvement proposals carried to him by the lower management structures of his respective department.

The key department in within this level is the DCIPD which facilitates the required IT environment to collect, present, visualize and maintain all information and data on global, departmental, disciplinary and field-wide level to reflect and present all main performances to everyone involved. Not only it carries the response to allow real time support and dynamic coordination tools for the project but also creates traceability and feedback character for lower structures regarding own appals directed upwards and the decisions made on superior management level.

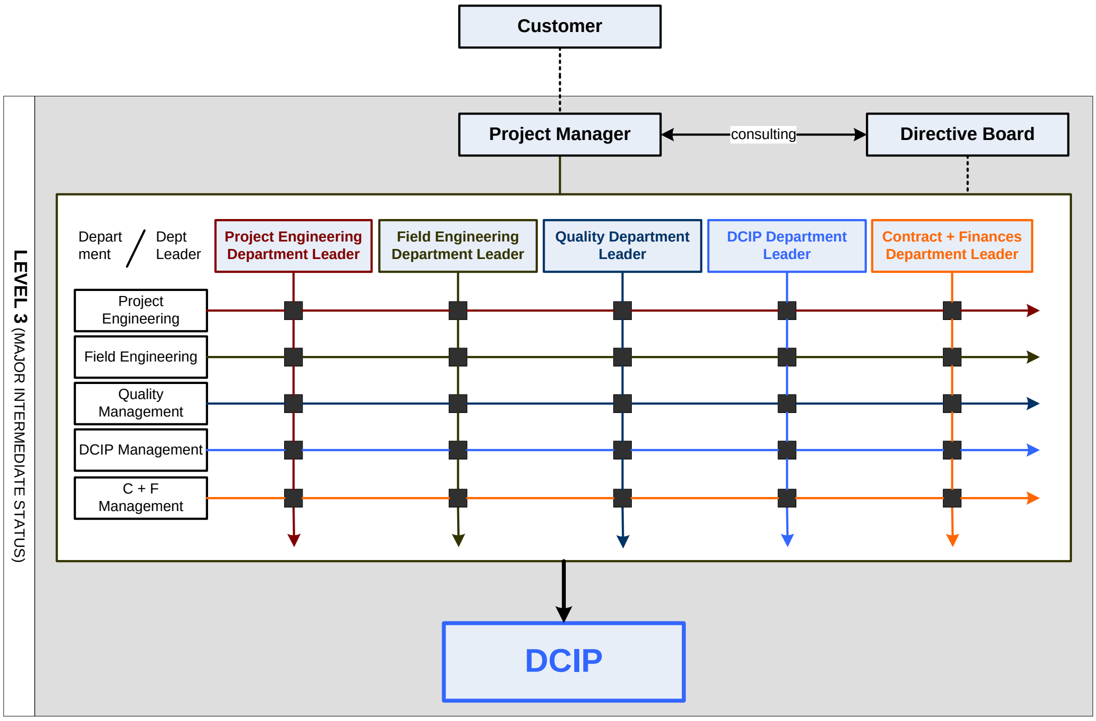

Figure 4- 6: Integrated Planning (BVR) - Level 3

As part of this department following tools and devices could help to monitor and visualise information as required for the yard, but are not limited to the examples presented:

<u>GENERAL LEVEL / PROJECT LEVEL</u>

- contract / work list / performance specs
- organisation structures, departments, labour involved and assignment of responsibilities
- global planning and schedules, milestones, delivery dates future tasks etc.
- procedures and job description collection + interlinkages and allocation by name and items, FAQ's
- important requirements and requests by the customer and the directive board
- personal/private information distribution platform in order to enhance communication on a private level such as declarations, billings, feedbacks, recreational activities and similar
- otherwise

<u>Project Engineering Department</u>

- engineering and designing guidelines and procedures as to customer and/or yard needs
- department organisation structure, responsibilities and assignments
- collection, sorting, filing and updating of all approved and applicable drawings and calculations, by creator, item/field and recipient

- performance indicators: comparison actual state / required state of engineering performances, schedule-keeping, deployed labour

Field Engineering Department

- field engineering and coordination guidelines and procedures as to yard required standard
- department organisation structure, responsibilities and assignments
- contractors involved
- performance indicators: comparison field schedules / global schedules, costs, current production states (by percentage), repair rates, quality rates, safety rates, feedbacks, otherwise

Quality Department

- quality control and assessment guidelines and procedures as to yard and customer required standards
- department organisation structure, responsibilities and assignments
- declaration of compliance to applicable Quality Standards
- Documentation Mnagament (clear organisation, procedures, assignments and templates as to requirements of customer and declared Quality Standards)
- Planning Management (clear organisation, procedures, assignments and templates as to requirements of customer and declared Quality Standards)
- Surveying and Inspection Management (clear organisation, procedures, assignments and templates as to requirements of yards production, field engineering and declared Quality Standards)
- NDT Management (clear organisation, procedures, assignments and templates as to requirements of yards production, field engineering and declared Quality Standards)

DCIP Department

- department guidelines and procedures as to yard needs
- department organisation structure, responsibilities and assignments
- Documentation Management = main source for any document, template, drawing and similar
- Planning Management = main source for all planning and scheduling presentation on project and global yard level by means of adequate visualisation tools
- Competence Management = main source and support on technical and managerial level (building up a cloud management of project relevant document, guidelines and regulations, information sources, field-related procedures, templates and improvement proposals)

Contract and Finance Department

- engineering and designing guidelines and procedures as to customer and/or yard needs
- department organisation structure, responsibilities and assignments
- information distribution of costs, procurement, schedules, change management, schedules
- performance indicators: cost constraints, actual states of items and fields, procurement management indicators (delivery dates, costs, quality, suppliers, external vendors and partners and otherwise)

Level 4 – Project Manager Level

This level is defined as the "relatively advanced status" and implicates the progressive focal point on the cooperation with external vendors and partners. Due to competition constraints and the huge amount of work large conversion/refit projects bring along both, the yard and the customer are encouraged to hire a certain high amount of external vendors and partner companies. Major issues of the partner management, comprises terms like prices and surcharges, construction and repair standards/regulation, safety standards, schedules and the clear definition of interacting procedures and behaviour between yard and customer representatives. A point of explicit importance is further a re-evaluation of responsibilities between the yards coordinative positions and the leadership of the partner companies (yard and customer wise). Latter broaches the attempt to define adequate and adaptable levels of responsibility and liability of project coordinators (especially field engineers) in terms of quality, safety, civil and budgetary performances of external partners. Related to the field engineers the approach is to limit risks uprising due to high amounts of other responsibilities. The approach is not to limit these liabilities but to rethink and redistribute them adequately among a higher amount of players in order to prevent accidents with victims and especially historical situations (accidents, casualties) where single positions have been denounced by open media as a reaction on pour knowledge and bad research.

Figure 4-7 gives a brief overview of the major players and interactions involved in this level. Due to the contractual nature of this level the main responsibility is in the hand of the project management, consulting with the directive board and supported by the subordinated management structures. He is encouraged to clearly define the separation of own, customer's and joint partners and guide the appointed items as described above.

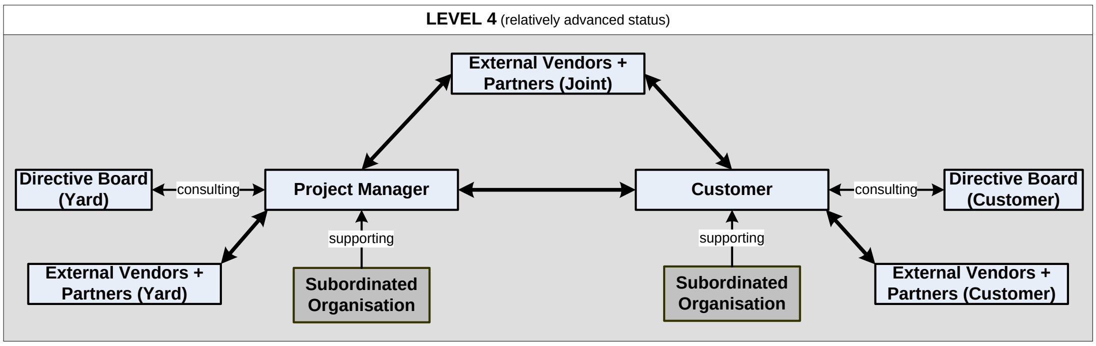

Figure 4- 7: Integrated Planning (BVR) - Level 4

4.2.7.2 Prioritisation Management

This chapter aims at presenting examples of comprehensible prioritisation management techniques to support decision-making and feedback evaluations for easy, fast and daily usage. Across all phases and periods of a project the respective actors face the need for the prioritisation of decisions, which could be solved by means of importance, consequences and also risk assessment/analysis techniques. A major difficulty one faces in such assessments is the estimation of weights underlying the decisions to make. This explicitly concerns the judgement of tasks and decisions that face pilot experiences or a high level of complexity. Latter captures the involvement of a high amount of stakeholders of which each represents own priorities. (Scheibmayr 2009) therefore states that in such situations generally all requirements are assigned with highest possible priorities. This could be a natural reaction of a stakeholder to appoint his statements and to make sure that respective matters are considered. According to (Scheibmayr 2009) not all of these demands can or should be considered since many decisions ground in the lack of resources, poor cost-benefit ratios or the time needed to bring certain demands "to market". Following simple prioritisation techniques shall be presented and briefly explained, whereby the first three methods are each supported by an example.

1 The Likert Scale Technique (LST)
Main Source of Information: (GCCCMU 2013)

The likert scale technique is a bipolar scaling method and provides likelihood scale data, which measures either a positive or a negative response to a given statement. The basis is a questionnaire serving data, based on scaling. A typical scaling could be based on a five-level score, e.g.:

1 Strongly disagree
2 Disagree
3 Equal (neither agree or disagree)
4 Agree
5 Strongly Disagree

Example:

A certain improvement or change in within an internal project process requires the feedback of the players involved (e.g. 150 team members). The task of each member is to rate the positive effect of this change based on personnel subjections of the old situation, the situation during the implementation time (mix of old and new) and the new situation. The question could be: "Do you think that the given process had/has a positive effect on the overall project processing?" Each of three experienced situations shall be rated according to the pre-defined template of table 4-11.

Situtation / Scaling	1 Strongly disagree	2 Disagree	3 Equal	4 Agree	5 Strongly agree
“old”	X				
“old + new”			X		
“new”				X	

Table 4- 11: 'Likert scala data' - Table 1

The outcome is a rating represented by the percentage values of all votes according to each major situation (Fig. 4-12), but inducing the main problem that the information gained, is fairly hard to interpret and in fact not very informative.

Situtation / Scaling	1	2	3	4	5	Total
“old”	…%	…%	…%	…%	…%	→ ∑ = 100%
“intermediate”	…%	…%	…%	…%	…%	→ ∑ = 100%
“new”	…%	…%	…%	…%	…%	→ ∑ = 100%

Table 4- 12: 'Likert scala data' - Table 2

This issue could be solved with the introduction of so called value features, i.e. the allocation of values to the different scaling levels. Each major situation is now assessed on its own by taking the amount of votes in respect to the scaling and multiplying it with the assigned value. This results in single numbered averages of each major situation, which makes the comparative and representative task between these situations much more accessible. Figures 4-13 & 4-14 serve for further understanding.

Scale	“Value”		“Nr. of Votes”	4	“Product”
1	5	x	50	=	250
2	4	x	35	=	140
3	3	x	35	=	105
4	2	x	20	=	40
5	1	x	10	=	10
		∑ =	**160**	**∑ =**	**545**

Table 4- 13: 'Likert scala data' - Table 3

The average rating for the old process situation is hence 545 / 150 = 3,63. If we repeat the calculation for the other two process situation and randomly assume a result of 1,22 for “intermediate” and 2,35 for the “new” situation (Fig. 4-14) we could clearly see the contrast between the three different states and receive a pretty clear and objective feedback result on the question of concern stating that the old system had the best (most positive) effects on investigated process.

Situation (process)	Average rating on positivity
“old”	3,63
“intermediate”	1,22
“new”	2,35

Table 4- 14: 'Likert scala data' - Table 3

2 The Cumulative Voting (CV)

Main source of information: (Cochrane 2012)

A different tool that can be used to analyse on feedbacks is the cumulative voting technique. It is also known as the “100 coins” method. The basic idea behind this tool is the allocation of a hypothetical sum of points (or coins) across a certain amount of elements that need to be prioritised. The total amount of points – let’s say it is ‘100’ – and hence the priority to each element is defined a the certain amount out of 100 points assigned. With the use of this method relative values are created and despite the possibilities served by the “Analytic Hierarchy Process” even zero-values can be assigned to a discrete number of elements as long as a sum of 100 across all elements is reached.

Example:

Given: A number of requirements is to be rated based on coins out of 100.

1 Rating of Requirements		**2 Assort (high → low)**		**3 Cumulative sorting**	
Req.	**Value**	**Req.**	**Value**	**Req.**	**Value**
R01	25	R03	33	R01	33
R02	5	R05	30	R02	63
R03	33	R01	25	R03	88
R04	7	R04	7	R04	95
R05	30	R02	5	R05	100
Total:	**100**	**Total:**	**100**		

Table 4- 15: ‘Cumulative voting’ - example calculation

The main advantages of this method are lying in within its easy and fast application and the possibility of generating ratio data. Disadvantages are grounded in the restricted amount of elements that can be used. The method becomes hard to tract when one has large numbers of requirements (e.g. 100 requirements and only 100 coins). Another disadvantage is that some elements might be neglected due to failed pair wise comparison of requirements (which is a basic and main necessity of AHP to obtain a result at all). The results of table 4-15 can now be used to create a chart in order to compare relative against cumulative value against allocated points.

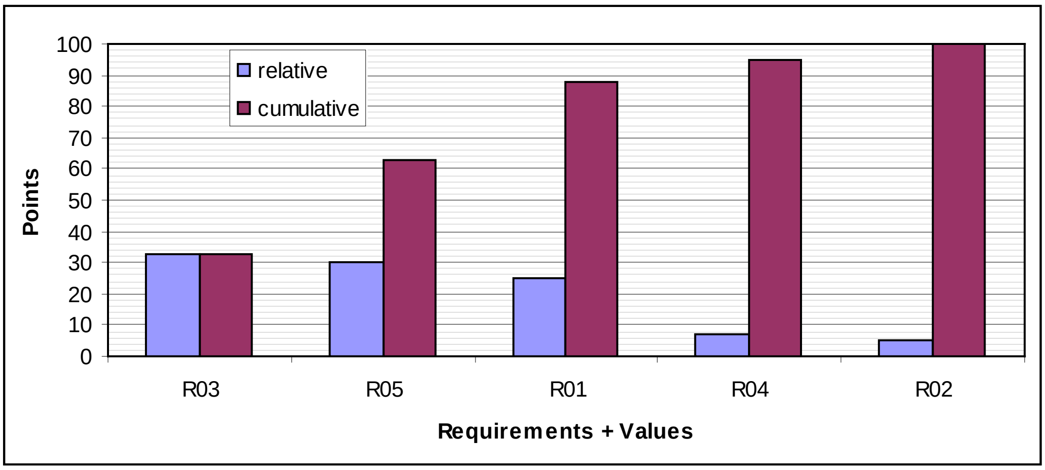

Figure 4- 8: ‘Cumulative voting’ - example result

The advantage of such a chart is that for this specific example one can easily see that almost 90% of all priority is already distributed among the requirements one (R01), three (R03) and five (R05). The other advantage of the relative values as stated earlier, is that one can also easily calculate performance ratios between the different requirements. The comparison of requirement three (R03) and two (R02) would then give:

$$\frac{R03}{R02} = \frac{33}{5} = 6{,}6$$

Hence requirement three (R03) is 6,6 times greater than requirement two (R02), which is a good and easy-to-handle measure to proceed on future decisions.

3 The Analytic Hierarchy Process (AHP)

Main information source: (BPMSG 2010)

The analytic hierarchy process is a method which uses pair wised comparisons of requirements by weighting these on a coarse scale in order to derive ratio scales. The main goal is to define performance indicators and from these by combination evaluate one key performance indicator. As input one has to define a number of main requirements of criteria, sub-criteria, and if further required subordinated criteria. These measures can be both, actual measures (weights, prices) or subjective opinions (feelings, preferences). As outcome one will receive ratio scales resulting from a calculation of eigenvectors and the ‘consistency index’ resulting from the eigenvalues. The main steps of the AHP are as follows:

1. Definition of the objective
2. Definition and structuring of requirements (main criteria, sub-criteria, alternatives, etc.) and assort by group
3. In each group, all elements are compared pairwise on a scale in respect to the objective
4. Arrangement of results in a matrix, calculation of eigenvectors and eigenvalues (calculation of weighting + consistency ratio), results are found by several iterations of the matrix
5. Evaluation of the given alternatives to the weighting
6. Ranking
7. Cost-benefit relation

Example:
The task is to order a certain amount of steel plates spread upon the three main requirements “classification stamp”, “integrity” (steel grade) and “delivery”. The subordinated criteria are defined and assorted by required preference as follows (table 4-16):

Sub-Criteria			
Classification Stamp	Integrity (steel grade)	Delivery	
• LR (Lloyds Register) • DNV – GL (Det Norske Veritas – Germanischer Lloyd) • BV (Bureau Veritas) • ABS (American Bureau of Shipping)	• Grade 1 • Grade 2 • Grade 3 • Grade 4	1 2 3	Immediate (all) 1st week one half, 2nd week other half 2 weeks (all)

Table 4- 16: AHP Example - Table 1 (sub-criteria listing)

Hence the ideal objective for this task and project would be defined by the following constraints:

Classification:	Lloyds Register
Integrity:	Grade 1
Delivery:	Immediate (delivery 1)

The following four most suitable alternatives are given after placement of inquiries to available steel suppliers.

Sub-Criteria / Alternatives	**1**	**2**	**3**	**4**
Classification Stamp	Lloyds	Lloyds	DNV GL	BV
Integrity	Grade 1	Grade 3	Grade 3	Grade 3
Delivery	Delivery 2	Delivery 3	Delivery 1	Delivery 1

Table 4- 17: AHP Example - Table 2 (alternatives listing)

Solution:
For the easiness of calculation an excel-sheet template was created and the final solution is attached to Appendix V. Further the original excel sheet template will be added to the CD-Rom for review allowing for the re-calculation of personnel preferences. To this calculation added, one will find additional measures (costs per item & number of items) in respect to the classification society. These costs comprise the cost per one item (steel plate) and respective re-stamp costs (since the main requirement is LR & re-stamping of steel from other societies undergoes certain financial and political differentiations). As an outcome of the subsequent preferences made, the total amount of items necessary and the price indicators, we receive a ranking of given alternatives and two charts revealing the cost-benefit relations between these alternatives. Chart 1 shows relative values of benefits and cost assigned to every alternative. Chart 2 assorts all alternatives on a typical cost (total) versus benefit (relative value) chart. These results now allow for clear choice of one or more alternatives based on the financial, schedule, technical and preferential constraints of the project.

4 <u>The ‘Importance Factor Technique’</u>

The presentation of this method serves the completion of the topic around integrated processes and integration planning in this work. The information presented below is entirely based on the article by (Bai & Liyanage 2010) and shall not only reveal an easy to handle prioritisation tool but also to support a potential implementation of IP processes on the yard. Importance Factor Technique (IFT) is not the official named and commonly known and applied method but is defined as such in this thesis.

The idea behind this method is the calculation of an ‘*importance facto*r’ based on the allocation of priorities. Two main parameters here serve as rudimentary measures: *independency* and *consequence*. “*Independency* is a measure that indicates the level of influence that a given requirement has on the other requirements across the defined set of criteria”. (Bai & Liyanage 2010) Hereby particular attention is to be made on the requirements, which have significant influence, since these can have denoting interferences in the continuous progress of integrated planning. “Consequence on the other hand is a parameter to describe the level of contribution that a given requirement is expected to have on the IP process in terms of planning time and resource consumption.”

(Bai & Liyanage 2010) The attribution of a consequence level hence defines the expectation of sizable benefits, pre-assigned requirements might generate in respect of time and resource savings. Figures 4-18 & 4-19 show the specification levels for independency and consequence as presented in the article.

Independency	1	Extremely independent requirement without any influence on other requirements
	2	Minor influence on/relation to other requirements
	3	Moderate influence on/relation to some requirements within/between criteria
	4	Major influence on/relation to a series of requirements among criteria
	5	Common requirements for lots of data

Table 4- 18: IFT - Definition of independency levels (Bai & Liyanage 2010)

Consequence	1	No obvious benefits
	2	Minor benefits
	3	Moderate benefits
	4	Major benefits
	5	Obvious step change

Table 4- 19: IFT: Definition of consequence levels (Bai & Liyanage 2010)

The level of independency and the level of consequence and thus the relation between these two requirements are now specified by means of an importance factor and a calculation matrix (Table 4-20 similar to the matrix structure also used in a qualitative risk analysis. The derived score now pictures the level of importance any requirement has on the success of the investigated planning process. When assorting the results to the total list of requirements, the reviser or planner receives a good basis to prioritise tasks in respect to the continuity of the process.

In order to provide a small example for the application of this method we will have a look at chapter 3.2 and Appendix III – Table A-III-1: *Risk Assessment (general issues)*. We will assume that the yard's directive board is planning to attack all points from G01 until G07 in the near future by means of improvement/change management. A planner has to create the first draft for a sequence based on the importance of improvements/changes of general issues in within yard standard procedures..

		Level of independency				
		1	**2**	**3**	**4**	**5**
Level of consequence	**1**	**1**	**2**	**3**	**4**	**5**
	2	**2**	**4** *(G02.02)*	**6** *(G03.02)*	**8** *(G03.03)*	**10** *(G01.05)*
	3	**3**	**6** *(G01.07)*	**9** *(G01.03, G02.01)*	**12**	**15**
	4	**4**	**8**	**12** *(G04)*	**16** *(G05, G06.02)*	**20** *(G02.03, G06.01)*
	5	**5**	**10** *(G01.06)*	**15** *(G01.04)*	**20** *(G03.01)*	**25** *(G01.01, G01.02, G07)*

Table 4- 20: Matrix - evaluation of importance factors in terms of treatin current standards procedures at BVR, adapted by (Bai & Liyanage 2010)

No	**Description (improvement task)**	**IF**
G01.01	Re-evaluation of standards for organisation structures, standard procedures, job/position descriptions, etc.	**25**
G01.02	Re-evaluation of standards for actions, communication, planning	**25**
G07	Introduction of a Quality Assessment + Control Department acc. to standards	**25**
G02.03	Introduction and implementation of yard + project related planning processes	**20**
G03.01	Re-evaluation and implementation of general documentation organisation standards	**20**
G06.01	Re-evaluation and implementation of standards for the Field Engineering Dep.	**20**
G05	Assessment of open points within safety management system	**16**
G06.02	Re-evaluation and implementation of standards for trades + contractors	**16**
G01.04	Introduction of specialists consultation during the project phase	**15**
G04	Introduction of yard global IT management system	**12**
G01.05	Re-evaluation and implementation of feedback + communication exchange standards	**10**
G01.06	Re-evaluation and implementation of standards for the preparation of ITLs	**10**

G01.03	Assessment and treatment of behaviour habits	**9**
G02.01	Re-evaluation and implementation of general standards for engineering and planning	**9**
G03.03	Introduction of project related IT support systems	**8**
G01.07	Re-evaluation and implementation of time management standards	**6**
G03.02	Re-evaluation, assessment and implementation of consistency of yard documentation	**6**
G02.02	Re-evaluation and implementation of project related engineering processes	**4**

Table 4- 21: Solution ranking presentation - evaluation of importance factors in terms of treating current standards procedures at BVR

By the help of this table the planner could now prioritise the improvement tasks in within yard and/or project processes by mean of groups and milestones according to the values of the importance factors and the colour coding presented in Table 4-21 or could initiate even more detailed investigations for every specific task.

The article of (Bai & Liyanage 2010)further recommends a periodical reassessment of this study in order to account on the developments of certain requirements and to assess the level of achievements. Such a re-assessment could be a good approach when working on subsequent risk assessment loops, after certain measures have been implemented and have provided new data on the process of concern. In summary one can state that this method provides a comprehensive and fast approach to analyse current states and future plans and could be a suitable tool to support decision-making process during future risk analyses or projects carried out on the yard.

4.3 Summary of investigated barriers and safety measures

Barriers and mitigating measures are summarised according to the division of the preceding chapter 4.2 in consecutive numbering with the following numbering system:

Table 4- 22: Indexing of summarised barriers

Numbering		**Definition**
Capital letters	A, B, C, …	4.2.'#' Chapter level (main topic)
Numbers (dot)	.1, .2, .3, …	Sub-element
Numbers (hyphen)	-1, -2, -3, …	Sub-sub-element

Table 4- 23: Summary and indexing of barriers and reference to respective chapters

Chapter Reference	**Barriers**	
	INDEX	**Description**
4.2.1	**A**	**Standard Project Team' (project level)**
	A.1	**General issues**
	A.1-1	Introduction of a neat and clean organisation at the earliest possible state of the project

Chapter Reference	Barriers	
	INDEX	**Description**
	A.1-2	Fewest possible changes in within the organisation structures throughout the lifetime of the project
	A.2	**Introduction of Project Manager**
	A.2-1	Introduction of yard's own Project Manager (PM) or 'Division of responsibility and tasks between external contracted and own PM (carrying primary leadership of project)
	A.2-2	Division tasks between project managers; e.g. on financial, technical, organisational streams
4.2.2	**B**	**Integrated Project Engineering Department' (project level)**
	B.1	**Division of leadership**
	B.2	**Specialists by discipline**
	B.3	**Presence and continuity**
	B.4	**Communication and interaction procedures**
	B.5	**Compliance**
4.2.3	**C**	**New Field Engineering Team, as to 4.2.3 (project level)**
	C.1	**Sub Field Engineer "Specialisation Level" (e.g. single items subordinated to steel works)**
	C.2	**Main Field Engineer "Specialisation Level" (e.g. steel)**
	C.3	**Field Engineer Leader "Head of Field Engineering" (steel, mechanical, electric, …)**
4.2.4	**D**	**Quality Department**
	D.1	Introduction of Quality Plan (QP)
	D.2	Introduction of process instructions for 'Quality Assurance in the project'
	D.3	Introduction of 'Documentation System'
	D.4	Introduction of 'Quality Assessment Audits'
	D.5	Introduction of standards for 'ITPs' and 'MITs'
	D.6	Introduction of positions (Q-Manager, Q-Engineer, Q-Surveillance/Inspection, Q-Documentation control, NDT-Manager
4.2.5	**E**	**Introduction of DCIPD**
4.2.5.1	E.1	Introduction of 'Documentation Team'
4.2.5.2	E.2	Introduction of 'Planning Team'
4.2.5.3	E.3	Introduction of IT Team
4.2.5.4	E.4	Introduction of 'Competence Team'
4.2.5.5	E.5	Introduction of 'Traceability Support Management'
4.2.6	**F**	**Revised 'Yard Standards'**
4.2.6.1	F.1	Revised 'Process and conversion of ships'
	F.1-1	Implementation of specialists into revision and quotation of items (project phase) and creation of performance specification / list of quantities / Item Work List / schedules
	F.1-2	Adjustment and implementation of dynamic and useful cooperative structures between project management, engineering department, quality department, DCIP, field engineering and trades

Chapter Reference	Barriers	
	INDEX	**Description**
4.2.6.2	F.2	Revised "Job & Position Descriptions"
	F.2-1	Implementation of specialists into revision and quotation of items (project phase) and creation of performance specification / list of quantities / Item Work List / schedules
4.2.6.3	F.3	Communication structures and procedures'
	F.3-1	Continuous feedback audits (during projects)
	F.3-2	Final feedback audits (after projects)
4.2.6.4	F.4	Non-conformity guidelines'
4.2.7	**G**	**Introduction of 'Integrated Planning and Prioritisation Management' (project level)**
4.2.7.1	G.1	Introduction and implementation of 'Integrated Planning'
	G.1-1	In 'project phase'
	G.1-1	In 'field phase'
	G.1-1/1	On discipline level (e.g. Field Engineering "Steel"
	G.1-1/2	On department level (e.g. Field Engineering)
	G.1-1/3	On inter-departmental level (project global)
4.2.7.2	G.2	Introduction and implementation of 'Prioritisation and Risk Management'
	G.2-1	Project Phase Level
	G.2-2	Field Phase Level
	G.2-2/1	On discipline level (e.g. Field Engineering "Steel"
	G.2-2/2	On department level (e.g. Field Engineering)
	G.2-2/3	On inter-departmental level (project global)

Appendix IV ‘Barrier Allocation’ provides a further assignment of the investigated barriers above respectively to the present standard procedures as presented in Chapter 3.2.

5. CONCLUSION

The conclusion of this thesis in terms of the topic, the contents, the investigation methods and hence the results gained will built on the evaluation of the 3 main objectives brought up in chapter 1.1 at the very beginning of this project work:

1 The investigation on BVR project execution sequences

A main focus here was put on the gathering, definition and discussion of major flawing states in within applied standards and procedures, which limit the success of project processing and accomplishing. The target herein was to provide a limited but adequate amount of information around and solution proposals on topics and states which are currently of highest interest for the company in order to be included into prospective change management. An investigation of flawing disciplines on two recently executed and large offshore projects of diverting performance requirements, scopes, and structures and challenges was carried out to complete the picture on failure modes based on latest experiences.

Failure in the context of this work was defined as the “failure of project” which is to be treated as the main consequence and as the sum of failures in within the four core values: profit gain, the compliance with schedules, the assurance of quality standards and the compliance and assurance of safety standards each of which represent one sub-consequence. A specification of and the limitation on these four outcomes or resulting events supported the identification and designation of initiating events each of which stands for the standard and current experienced flawing states within the company and projects as mentioned above.

The overall investigative approach required the limitation to the major states and topics as to presented in this work and should provide an adequate amount of information to gain a general impression and knowledge to support investigative teams of respective streams and departments in posterior analyses and assessments.

2 Layout proposal for the implementation of a BVR production risk analysis

Herein one target was to prepare the topic of the thesis, the contents to be investigated on and the application and structure used, into a condition of a first simplified but reflective, commonly known and applied risk analysis process structure. By this a first layout of a risk analysis process on project and production level was created for the company, which can be used to initiate further risk analyses based on single disciplines discussed or needed or by a precedent implementation of investigated corrective measures which were devoted as part of this analysis.

The target of this project was to examine on a good number of different disciplines in within the company and the project organisation in order to provide an overall reflective picture of flawing events, respective causes and consequences inquired the necessity of limiting the information to a certain extent, hence limiting the evaluation of the risk picture. Thus and in order to obtain an adequate risk picture the project work concentrated on the

- Limitation on major (critical) flawing states, already implying a high risk on a predefined number of consequences and,
- The introduction of a simple coarse scale (low, moderate and high) in order to score and to differentiate on the number of events and risks

As part of the determination of corrective measures some chapters in within chapter 4 ‘Discussion and evaluation’ of barriers and recovery measures have been evaluated based on a job safety analysis dividing jobs (operational barriers to be implemented) into sub-jobs. Exemplary chapter 4.2.5.5 ‘Traceability support’ shall be referred to, which commands a collection of jobs to be integrated consecutively in order to support a traceability support management system but without performing a risk analysis for each task as it would require in a complete risk analysis.

In order to support the risk analysis of disciplines in the thesis’ context and to reveal a highly important and deficient state in the progression of projects at the yard the background and benefits of Integrated Planning and Prioritisation Methods was introduced and applied on outcomes of the risk analysis process.

3 Recommendation for the future course of risk analysis at BVR

The results of this project can be used in the course of two different ways based on the needs and the intentions of the yard and as part of the change management.

(a) A continuous and more detailed analysis of risks based on the results of this project. A good approach herewith would be the introduction of Failure Modes and Effects Analysis (FMEA) which helps to examine on failures and their effects on the whole system based on the relation and the dependencies to other components of the system. Resulting safety measures could then be evaluated on the necessity and applicability an introduced to the change management.

(b) Based on Table 4-21 and the evaluation of the importance factor of major disciplines in within current states, the company has been provided with a good and reflecting picture of which states should be considered urgently in order to improve on general issues and projects and to provide a new basis for a future risk analysis root.

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APPENDICES

Appendix I - PROCESS OF REPAIR AND CONVERSION OF SHIPS (AS TO APPLICABLE YARD REGULATIONS)

Description of: "The Repair and Conversion of ships"

(based on: IMS-handbook, Process Description 4.1, information from BVR-intranet)

Table of Contents

1. Approval Statement

The intention of this document is to provide a brief overview of the general procedure of "Repair and Conversion of ships and similar structures" as it is currently handled at Blohm + Voss Repair GmbH. It is a restructured assembly of restated and inherited information from several currently applicable yard standards (IMS-Handbook, Process Description, Intranet) and translated into English.

The contents of this paper are not to be treated as my own intellectual property, although input of own experience has been made in some points. In this manner the document is to be read and approved on correctness by the Head of IMS and to be treated as an external source of information only, which I will use to refer to in my actual work.

Responsibility	Implementation	Approval

2. Purpose

The purpose of this document is to provide an overview of the procedure of processing repairs and conversions of ship and similar structure at Blohm + Voss Repair GmbH from acquisition, production to completion.
Abbreviations

3. Abbreviations

n.a.

4. The Project Phase

The project phase is defined as the processing time of a request for repair/conversion without having a contractual order yet issued by the prospective customer. The main goal in within this period is to generate a quotation based on price calculations that is conform to the requested performance and to the present market situation.

Based on a list of shipping companies and historical data, customer requests are treated in terms of the requested service / work and its performance characteristics and the yard’s expected capacity utilization for the requested performance period. It is in within the authority of the senior management to decide whether or not further comprehensive calculations and the submittal of a proposal shall be initiated.
If a request matches the yard’s criteria and interests the project phase is launched with the announcement of a project manager, who from this point on represents the yard’s main contact in terms of technical, financial and schedule wise inquiries for this specific project phase.

4.1 Performance Specification (Leistungsspezifikation)

The background of this specification is to define the requested scope of performance and service in order to obtain clarified conditions for a further order processing, if it shall result in a commission. The basis for the assessment of this specification is the customer’s own specification, which at first instance is checked upon national and international guidelines. The second step provides the the customer’s requested general terms and conditions of repair are evaluated in order to define all necessary technical performance characteristics. The results of the preceding investigations are finally assembled to an own performance description and on appeal define the main organisational structure for the list of quantities to be created.

4.2 Calculation

With the initiation of a kickoff meeting the project manager convenes the assigned project team and presents the results of the preliminary research in terms of guidelines, general repair conditions and special technical requirements. The service and work packs are hence distributed among the assigned team members respectively to their technical background for assessment and calculation. The calculation is based on the list of quantities and is sub-divided into:

- Subcontractor services (included by mean of inquiries),
- Material costs and
- Labour costs

4.3 Engineering

Engineering work is only carried out during this phase unless it is absolutely inevitable for the assessment of a quotation. Usually drafts provide sufficient information for a description of the technical feasibility of a product and its cost assessment. It is generally in the responsibility of every person involved in this stage to report any risks and concerns regarding the engineering and hence the manufacture to the project manager. He will evaluate and address these points of concern at the up-following offer meeting.

4.4 Offer Preparation and Meeting

Based on the list of quantities created, the project manager now drafts the official letter of offer. The total calculation is put together into a total cost comparison sheet that shall underlay all expected expenditures and impacts respectively.

The project manager presents his letter of offer, the cost comparison sheet and all the offer implied risks and concerns to the Head of Sales and if required to the Senior Management for evaluation. In return he receives guidelines and margins for the evaluation of prices in terms of changing overhead rates or price reductions. In addition the project manager is provided with targets for later renegotiations with the customer. This room for manoeuvre given to the project manager though shall not be exceeded without pre-consultation of the senior management.

4.5 Order Negotiation and Verification

During the up following order negotiation the customer representative and the project manager discuss and evaluate all existing service/work packs and all additional changes and adjustments on behalf of the customer. Changes or additional adjustments of the offer – if such occur – and herewith-resulting overhead and/or reduction rates can be changed upon project manager's assigned room for manoeuvre.
In case of an order intake the PM now verifies that contents of the intake comply with the performance characteristics and parameters agreed upon and issues the official written order confirmation to the customer. This officially terminates the "Project Phase" and hence initiates the "Object Phase" or "Field Phase" of this specific project.

5. The Field Phase

As a next step after the confirmation of the order intake, the project manager is responsible to create the Order and a so called Work List in the yard's computer system (ABAS) in order to allow for earliest possible resource-related accounting of items. The work list generally is a substantial replica of the performance specification without the contracted price indications.

5.1 The Organisation

Due to yard's internal definition, the "Object Organisation" represents a temporary internal organisation focused on the execution of an order and acts as a classical project organisation. Throughout the period of accomplishment this organisation is superior to the yard's organizational structure.

5.1.1 The Project Manager

The project manager is to be assigned by the Head of Sales and in most cases is – but not necessarily must be the same – as was during the project phase. In any instance he is the main authority in regards of technical, financial and schedule wise inquiries and hence carries statuary authority towards all subordinate personal. As a result of his budgetary responsibility he monitors the whole project on item level and reacts upon cost budget changes and/or overrun costs upon input of the field engineers and the calculators and the production employees, especially in terms of recognizable or foreseeable deviations.
The project manager assigns the project team, which in general is consistent of representatives from the calculation, engineering and production departments. This assignment generally takes places in consultation with the Head of Sales and the Head of Production. The size of this object team in terms of personnel requirements is set upon scope and nature of works to be carried out and usually consists of:

- field engineers (mechanical)
- field engineers (steel)

- controllers (settlement clerk)
- foreman and headmen (steel, welding, piping, mechanical etc.)
- engineering manager (if necessary)

In general small or medium-sized projects consist of one field engineer (steel), one field engineer (mechanical), one controller and the fore- and headmen of the required trades.

5.1.2 The Field Engineer

The field engineer is the main technical coordinator of the work to be carried out. He again carries statuary authority towards subordinate personal of the different trades and the sub-contractors.

Upon the scope and the positions of a work list which is created by the project manager and which is based on the customers specification, the field engineer takes main responsibility and communication for all schedule wise and technical coordination between the subordinate departments (trades, workshops), yard’s own suppliers and subcontractors, the representatives from customer’s side and customer’s subcontractors, and representatives of the classification authorities.

By the helps of assigning so called Position Managers or Area Managers all of the work and service items in within the work list are distributed among the involved field engineers based on their technical background and on historical standard procedures.
Despite the above stated responsibilities another main task of the Position Managers is to know the budget of his items, to consecutively monitor the costs related the performances and to report to the project manager in case of (foreseeable) deviations.

5.1.3 The Foreman / Foremen

Each main department of the production (steel/welding, piping, electrical, mechanical, etc.) is supervised by a senior foreman who as the head of each trade holds the main responsibility for the deployment of subordinate foremen, craftsmen and their quality of the work. The assignment of the foremen generally takes place upon his assessment and knowledge of the employee’s experience, current capacities, the complexity of work to be carried and if necessary upon special requests and/or recommendations of the projecting management (incl. project manager, field engineers, production leader, production and welding engineer, etc.).

If a foreman is assigned with a specific work item he determines the daily placement of personal in consultation with the field engineer and verifies if temporary employment for specific items is necessary. If temping appears to be necessary he organises the required personnel together with the head of the trade and the human resources department and finally takes care of the accounting/monitoring of the performances of all of his assigned workers.

5.1.4 Controller

For every order/project one or several settlement clerks are assigned from department Controlling/Purchase who is/are responsible for the controlling of the project throughout its field phase. He directly reports to the project manager and informs him about the state of the project and about the state of utilized and tied-up resources of the project. His main job is to keep all necessary field-related information, in terms of additional orders and order reductions updated in the system and to prepare the information for the future invoice template.

5.1.5 Engineering Manager

In the case of engineering requirements the senior sales manager assigns an engineering responsibility for all of the required engineering work to be carried as of scope of the project. Based on the extent of the necessary work and the size of the project the function of the engineering manager can either be assigned to someone from the yards own engineering department, the field engineering team or to the project manager himself. In any case the engineering manager will be the main person in charge for all schedule wise, technical and regulatory performance of all engineering and design tasks, such as:

- internal and external approvals of technical drawings
- communication with and approval by the customer
- creation and approval of drawing lists and keeping them up-to-date

5.2 Engineering

5.2.1 Engineering Preparation

The evaluation of the required scope of engineering performance for a particular project/object is to be done by the project manager. Upon scope of the performances to be provided he assigns an engineering manager and necessary engineering designers according to the required to field work in consultation with the senior sales manager. In this sense it is up to the project manager to undertake the work by himself or assign engineers of different subjects, such as:

- steel construction
- machine engineering
- interior design
- piping
- electrical design
- etc.

It is within the responsibility of the designers to determine the design requirements upon the performance specification and to formulate them into requirements and presets for external engineering offices.

5.2.2 Numbering, Assembly Directory and Application Lists

The yard has a standardized internal numbering system for ship repairs and conversions consistent of following consecutive numbering categories:

- category (type of order)
- order / project
- item / position
- subassembly
- serial
- pages (consecutive)
- revision index

The standardized list of assemblies is usually applied to larger projects that are processed on the yard. If for any reason the customer prescribes to implement his own overview of assemblies (own numbering directory) a cross-reference list is created by the project manager or the responsible designer in order to document upon both, customers and yard's directory standards.

Every designer/engineer issues his own drawing list applied to his area of authority. This application list shall provide adequate information regarding the drawings to be made and the respective documentation number. This list further serves a part of the commissioning documents for external engineering offices.

5.2.3 Own and Subcontracted Engineering Tasks

Due to the relatively small amount of permanent employees the yard's own engineering department consequently reaches limited engineering capacities especially for larger projects. If though the engineering and design job shall be carried out with internal employees, the assigned engineering manager forwards all necessary design requirements and the application list to his designers and the engineering tasks are then usually structured up to the following main categories:

- basic design
- detailed design
- workshop drawings
- part lists

Generally all substantial and extensive engineering tasks are sub-contracted to partner companies. The respective designer constructs a requirement request in consultation with the engineering manager, which shall contain all necessary engineering requirements and the application list. The engineering tasks usually follow the same structure as mentioned above.

5.2.4 Clearance and Approval of Drawings

All drawings and calculations performed by internal or external designers have to be presented and approved by the engineering manager who decides upon clearance of the performance. If for any reason the engineering manager has carried out these tasks, the work is to be approved and cleared by the project manager.
Approvals and clearances necessary to be obtained from the customer are organised by the engineering manager involving the project manager.
Any engineering performances (internal or subcontracted) which require external tests and clearances prescribed by classification societies are organized by the yard's main engineering responsibility. All contacts and collaborations with the class are either communicated through our own designers, the project manager and if necessary other main functionary engineers as well as representatives from subcontracted companies and the owner.

5.2.5 Clearance for production, revision and filing

The final clearance for production is released by the engineering manager based on the completeness of all necessary drawings, calculations and necessary technical documents. If concerns and risks regarding overhead rates or changes of scope become visible or predictable he shall directly inform the project manager. If for any reason drawings have to be changed or adjusted after the commencement of the field phase, it is within the responsibility of the engineering manager or his assigned designer to communicate these deviations to the production departments. In any case the field engineers shall be informed explicitly.

Any changes necessary to be made, before or after commencement of the production, are to be monitored by the engineering responsibility, marked according to latest version and re-distributed to the assigned authorities. Classification relevant documentation or drawings that require re-inspections are to be forwarded directly to the respective accrediting inspection bodies for rechecks.

Upon completion of the project all engineering performances are to be stored and filed according to the assigned drawing number and directory.

5.3 Procurement of Material and External Services

The purchase of material is carried out from within the field team with the use of a purchase requisition procedure. The purchase requisition is checked upon terms of prices, suppliers and often delivery capacities by the purchasing department before turning them into an official order. The ordering of material can generally be done by the foremen, the field and project engineers but in consultation with the project manager.

5.3.1 Purchase Requisition

Usually it is the area manager, who generates the required purchase requisition for his field of duty by referring to existing enquiry documents. Procurement of material of special kind or complexity is to be specified by the helps of enquiry specifications of the customer, the subcontractors and lists of catalogues in order to limit the expenses.
External Services are to be strictly distinguished between performance and performance period. The project manager issues an associated specification based on the subcontractors offer.

5.3.2 Requisition / Ordering

Upon the comparison of the prospective suppliers and after obligatory price negotiations the purchase department finally places the order for requisition. The purchase department is free to request any new or different supplier in order to arrange for deliveries or trial orders as long as the product delivered complies with the requested specifications and requirements. The Purchase is further responsible to have at least two suppliers for deliveries and services of common regularity. The “Acceptance of the Coordination” (see chapter 2.4.2 for further explanation) as part of the procurement of the service, has to be ingredient to the performance contract.
In the occasions of sudden demands of material or services, exceptional regulations ensure the option for fast-track orders. Fast track order can directly be executed at the respective supplier through the area manager or the foreman on the basis of a purchase requisition. The material is to be collected in a timely manner in order to ensure the production flow. In retrospect fast-track order are still to be treated as a common requisition order and to be handed over to the purchase department timely and as early as possible.

5.3.3 Incoming Material Receipt and Control

The goods receipt takes place with the arrival or sending of material and equipment. The delivery is checked against the delivery note and upon the completeness and integrity of the package. In case of perceived failures/damages the delivery is to be rejected in consultation with the requester. In the occasion that a ship has not yet arrived at the yard, retained deliveries are to be stored temporarily at the goods receipt store and the project manager is to be informed. Otherwise the requester is to be informed and the material is to be forwarded to the respective department or an assigned storage place.

In case of customer supplies the receipt departments accepts the delivery and directly informs the project manager. If such deliveries occur while the ship is at the yard they are directly forwarded into customer’s responsibility, i.e. board crew or assigned storages exclusively executed by the customer. A copy of the delivery note is to be forwarded to the project manager for any type of delivery.

The complete and timely goods receipt control lies in within the duties of the requester. He can instruct the respective department but will always stay in the responsibility of accomplishment. The main intention of the control is to confirm the correctness of the delivery note and the technical integrity of the delivery. Failures that could appear after installation or commissioning are excluded from this inspection.

Material and equipment, which have not undergone the control, are not to be cleared, either to production or to payment. The requester receives a copy the delivery note, checks and signs for compliance and forwards the paper back to goods receipt department for documentation purposes.

5.3.4 Invoice Verification and Accounting

Every incoming invoice to the finance and accounting department is reviewed in terms of pricewise and substantial correctness paginated and registered in the computer system ABAS. Copies of the invoice are then forwarded to the Controlling/Purchase Department for pricewise and to the requester for substantial review. The approvals for regularity are hence registered in ABAS and the invoice is set clear for payment.

The Finance and Account department is obligated to contact the respective project manager, and if necessary the head of the controlling/purchase department, when in doubt.

5.3.5 Warehouses and Storage Facilities

Based on the expected amount of material/equipment delivery for a project, the project manager is permitted to initiate the establishment of storage facilities. By consulting the head of production, area, location and size of the storage facility are to be assigned and the necessary warehouse employees to be deployed.

As already mentioned deliveries will now arrive at the yard’s receipt department, checked upon compliance, cleared for customs and forwarded to the respective storage facility, which is then responsible for the further handling.

5.3.6 Inspection Documents, Operating and Maintenance Instructions

All material certificates and performance certificates are processed to the purchase department and forwarded to the requester. The requester transfers the document to the trades. Certificates of contractual relevancy are forwarded to the project manager.

Operating and maintenance documents obtained in the course of repair or installation of plants and equipment are to be forwarded to the respective area manager who files all incoming documents throughout the field phase. The complete documentation collection is finally handed over to the project manager who adds it up to the final delivery documentation handed out to the customer.

5.4 Production Control and Execution

5.4.1 The Work Item List

The work item list is set up by the project manager at the very beginning of the field phase and is based on the offer specification and if necessary enhanced by the customer's own specification. It describes all contractual agreed service and work items in terms of position numbers in a manner that the production trades, departments and partnered companies are able to accomplish their work.

Each position of the work list is assigned to a position manager who holds the main responsibility that this particular service or work pack is taken care off either directly by himself or by communicating and coordinating it to further departments, including external services and sub-contractors. Along with this responsibility it is further the duty of the position manager to keep track of the budget, the process and quality of the work and to inform the project manager about any deviation from the item's original description as stated in the work list.

5.4.2 Acceptance of Coordinator

As mentioned earlier each service and work pack stated in the work list, its coordination, audits and the final approval are generally obliged to position management functions, generally assigned among the field engineering team. This applies to most of the items stated in the work list. Examples where the coordination and main responsibility must or can be assigned to others, i.e. not necessarily field engineers to a certain or full extent are:

- docking- and undocking procedures → docking department ("head of docking")
- certain standard docking services → docking department, mechanical department, electrical department
- maintenance of plants such as (docks, workshops, cranage etc.) → maintenance team
- procurement, certification and auditing of welders and welding equipment → welding engineer as main authority

The coordination work of a position manager ("Coordinator") implies the following main tasks but is not entirely limited to his own authority:

- evaluation of the item positions prior to commencement of work
- clarification and communication of the work items and deviations at any time of the project with:
  - project management
  - customer and authorities representatives
  - departments/plant involved
  - external services and sub-contractors
  - production scheduling and inspection planning
- ensure that all production and manufacturing labour involved is able to work according to their needs, i.e. create a work flow, perceive deviations/problems/risks and reduce clashes between the items in order to reduce time delay
- safety relevant work and procedures

The acceptance of coordination of the yard's internal structures follows a generally accepted, standardized and/or historical procedure usually in accordance with the manager's main field work.

The coordination of external services and sub-contractors is handled via the document *“Acceptance of Coordinator”*, which is of contractual character. Based on this document the field engineer clearly defines the type of work and schedules to be done by the partnered company and stipulates his coordinative responsibilities towards the contractor. In return the representative of the respective company names the main responsibilities during the execution of service and accepts this particular field engineer as the only coordinator and main contact for all technical and field related works. On appeal the field engineer is responsible to tutor and instruct the main representative of a contractor in terms work safety issues, common repair regulation upon the applicable guideline *“Sub-Contractors Manual Blohm + Voss Repair GmbH; Safety Regulations – Operating Instructions, Contractual Terms and Condition, December 2012s*”. The contractor representative signs the document *“Confirmation of the "Terms and Conditions for Working at Sites of Blohm + Voss Repair GmbH"* whereby he accepts the terms and confirms to instruct all of his labour (including further sub-contracted teams) involved upon given yard’s safety and repair standards.

5.4.3 Scheduling / Planning

The Production Planning is based on the work list. The position manager plans the execution of all items allocated to him in close correspondence with the yard’s foremen, the responsibilities of sub-contractors and if further necessary the engineering manager, production manager, welding engineer or any other authority needed to accomplish the work. The main intention is to ensure that every party involved knows what to do, who to contact, what his schedule is, and to clarify uncertainties and foreseeable clashes in order to set up a global schedule. Milestones for this planning process are set by the project manager in terms of docking and undocking dates, main trials, deliveries and other event during the projected field phase.

If the scope and/or complexity of work and the projected repair period demand for a Main Schedule Plan each preceding item schedule is contributed into one main and interdisciplinary follow up chart. Respectively to the boundary conditions preset by the project manager further milestones are pictured in order to emerge high priority construction items in terms of:

- complexity (both technical and organisational issues)
- engineering efforts
- delivery dates
- inspections, tests and trials
- labour capacity, dock capacity
- time and foreseeable weather constraint

This Main Schedule will then be presented to the project manager for approval and hence forwarded to the customer.
Based on preceding agreements with the customer and classification authorities the position managers involved generate a Test and Inspection Plan in consultation with each other and any other trade involved. This plan shall briefly appoint the main extent and boundaries for the testing and inspection of items in order to capture the standards requested by the customer and classification societies, to provide an overview by setting milestones and thus to schedule and prepare the labour involved in these tests.

The final Production Sequence is generated through the exhaustive coordination tasks of the field engineers and shall ensure a fluent and safe progress of all repair and service tasks carried out by the yard’s own production trades and the sub-contracted companies. It shall be noticed that the field engineers although carrying the managerial authority in terms of schedules, sequences, work flow, quality and safety issues only have conditional influence on the detailed planning of the execution procedures, i.e. the detailed planning of the technical execution, the timely approach and the quality of the labour and the work lies within the responsibilities of the foremen. Further it is the foreman only, who is managing the daily personnel deployment planning and the adjustments of the personnel capacity needs in consultation with the field engineer but according to the authorisation of the head of his department and the human resources department.

A very similar agreement applies to the cooperation with sub-contractors. The detailed planning of the execution is the responsibility of the company's main representative, including the deployment of personnel, capacity planning, certification of personnel and material used and the compliance with all deadlines. The field engineers have to monitor this detailed plan, obtain changes in terms of non-compliance and to ensure that the subcontracted company is able to work up to its needs and to provide a quality that complies with the yard and the customer standards. In order to be billed for the performed services the field engineer signs a certificate of performance whereby he approves that the sub-contractor has fully accomplished all assigned work in the highest possible quality. Thus all unfinished items or acknowledged shortcomings are not signed and are to be discussed with the project manager and the purchasing department in order to assess new contractual arrangements.

If for any reason items are to be changed from own production to subcontracting it is within the responsibility of the field engineer to prepare a new performance specification and to send out a request for demand. These changes in the planning finally have to be checked and approved by the project manager and the head of the department before subcontracting can be initiated.

5.4.4 Meetings

In order to keep track of the work, evaluate progresses, problems or additional information delivered by the customer Progress Meetings are held internally. On the managerial level the project manager convenes a meeting on a regular base (daily, weekly etc.), invites the coordinating key functionaries of the project, organises the procedure and discussion and keeps track of the minutes of meeting. Since these meetings usually are of contractual nature, all relevant documents have to be checked and approved by the project manager prior to be handed out for further use.

Bigger projects have proven the necessity of progress meetings especially on the production level and are formerly known as Production Meetings. The meeting is chaired by a field engineer who shall be announced at the very beginning of the project. Along with the coordinating engineers / area managers this conference consists of the foremen and subcontractor representatives of all trades working for the yard on this project. The lead engineer convokes the meeting usually on a daily base, organises the discussion, ensures that problems and inquiries are communicated and keeps track of the minutes of meeting.
A Daily Meeting is held on the nature of the progress meeting described above but comprises representatives of the customer and customer's subcontractors, including classification society representatives, along with the coordinating yard team.

5.5 Quality Assessment

5.5.1 Assessment of Subcontractors

The assessment of the performance of subcontractors is based on a continuous monitoring and final approval of the accounted field engineer. The certificate of employment signed by the engineer confirms the contractual correctness and quality of the provided work upon compliance of following points:

- quality requirements
- service provision within the prescribes time limit
- submission of required inspection and testing certificates
- submission of required maintenance and service instructions
- evaluation of pending issues
- evaluation of required yard provision/services
- evaluation of man-hour logs on a daily base (man hours ←→ progress ←→ quality)

5.5.2 Internal Assessments

These are internally implemented assessments of either qualitative or quantitative (i.e. prevention of warranty and recourse claims) background and can be executed without the attendance of the customer representative. These inspections are run in collaboration with the field engineer and the trades. Outcomes and results are implemented into the Inspection and Test Plan and can be part of the final documentation if instructed by the project manager.

The filing of these assessments is within the responsibility of the field engineers is to be sorted according to project, field and position.

5.5.3 Assessments of and with the Classification Society

Since classification societies are contracted by the customer/owner, area managers are constrained to have all inspections and tests to be discussed and approved by the customer prior to presenting them to the classification representative. Based on the documents (survey records, inspection test records etc.) issued by the yard the classification societies usually create the documentation for the customer. Inspections and tests are generally carried out in the presence of the area manager, his foreman, the societies representative and a customer representative (inspector, board officers / engineers etc.) – in case of subcontracted work – the main representative of the company. Necessary survey and inspection papers are usually signed by all parties (yard, customer, classification and if applicable paint inspector) directly on the site upon completion and correctness of the job. Pending issues or remarks as well as intermediate inspections are identified as such in the inspection papers and shall be represented if requested.

5.5.4 Inspections with the Customer / Owner

Every area/position manager is responsible to have his assigned work list items/positions to be inspected, approved and signed by the owner’s representative. As mentioned earlier this usually takes place in presence of the classification representative for items that are of class approval relevancy.

Generally it is further within the responsibility of the area manager to present services performed by sub-contracted companies to the customer, but usually in attendance of the subcontractor’s main foreman.
In order to have items approved upon completeness and correctness the area manager is encouraged to print out the work list item description and to have it signed by the customer

representative. All signed work list items are then to be handed over to the project manager, who will check for completeness of all items towards the end of the project and if necessary hints the area manager at open or pending items.

5.6 Changes of Performance / Service

Changes of performance and service implement new contractual agreements with the customer and therefore are to be recorded in a written form. Regardless of whether changes will implement overhead rates, reductions or cost-neutrality for the customer, standard procedures for acquisition, assessment and enrolment shall guarantee uniform structures in the processing of the so-called change orders (CO).

1. Every employee is committed to address acknowledged or presumed changes of performance directly to the responsible field engineer. In any case, doubted issues are always to be reported to the field engineer.

2. The field engineer is responsible to check and to assess all changes upon agreed scope of work as stated in the work list and to inform the project manager if changes are to be likely. He issues a change order application in the yard's computer system to ensure safest possible treatment of the CO-processing

3. If special circumstances require early commencement of work the decision to start without having a CO can be made by the project manager. He though has the responsibility to catch up on contractual agreements as early as possible and to issue a new work list position in order to allow for timely recourse-related accounting of the item. In exceptional occasions the field engineer is also entitled to have work commenced in accordance with following constraints:
   - the project manager and the sales manager could not be reached via telephone
   - existing CO-application in the system
   - customer has signed the CO-application
   - commencement of work can not be postponed to the next day due to the schedule or the effectiveness of the work flow

   The project manager has to be informed personally about the new situation as fast as possible in order to issue a new work list position.

4. Every single change of performance is expressed via a Change Order. The CO describes the additional necessary performances to be carried out and the evaluated respective costs. It is then handed over to the customer for revision and is to be treated as commissioned with the signature of the customer representative. Upon written confirmation the project manager issues a new work list position / item and confirms the clearance for processing.

5.7 Acceptance Documentation

The Acceptance Documentation is to be compiled by the project manager throughout the duration of the field phase and is handed over to the customer against proof at the end of the project

The final documentation contains the following main documents:

- inspection and test records
- drawings
- part list, bill of materials and certificates
- calculations
- operating instructions
- maintenance instructions
- safety instructions
- etc…

5.8 Billing / Invoicing

5.8.1 Accounting of costs

Throughout the duration of a project the controlling department keeps track of all incurred costs through the assessment of working hours, subcontracted service and material costs. The generated cost sheet provides a consistently updated overview of the project status on item level and the respective liabilities. The cost sheet is the main reference for the final invoicing at the end of a projects lifetime.

5.8.2 Invoice texting

Based on the commissions of the work list and the change orders, the controlling department generates an invoice containing detailed descriptions of the work performed. This invoice is presented to the project manager for agreement and approval and serves as a calculation base for later negotiations with the customer.

5.8.3 Invoice Negotiation

If necessary, the head of the controlling department calls for an invoice negotiation meeting with the customer and is encouraged to consult the project manager to this meeting. The invoice negotiation serves the purpose to present every single performance of the yard and the respective settlement amount. As part of this meeting it is the responsibility of the controlling to provide the complete verification of all customer issued commissions.
If within the invoice negotiation meeting and for any reason, the customer shall not agree on served performances or generated costs, the head of the Controlling department is empowered to respond to justified claims within his project margin and in consultation with the project manager. In terms of significant discrepancies the senior management is to be informed and consulted.

5.9 Debriefing of Projects

All projects that have been executed significantly below the calculated list of quantities are to be debriefed under the auspices of the head of controlling/purchasing. The project manager, the field engineers and all personnel that participated in the calculation of this project are to be invited.

The main task of the controlling is to reveal the deviations and to evaluate the respective backgrounds in order to assess systematic errors of the production and calculation departments.

Appendix II - PROCESS DESCRIPTION OF A STANDARD BVR PROJECT

Blohm + Voss Repair

Process of Repair and Conversion of Ships (Current State)

Process Instruction

<u>Important Note:</u>
The printed document serves exclusively for the information, is not an approved and applicable yard standard and is not subject to any update information service. Contents of this document are intellectual of property of Blohm + Voss Repair GmbH and are to be treated confidentially.

1. Approval

Responsibility	Implementation	Approval
(RQ)	(RF)	(RQ)

(RV)

2. Purpose

n.a.

3. Scope

n.a.

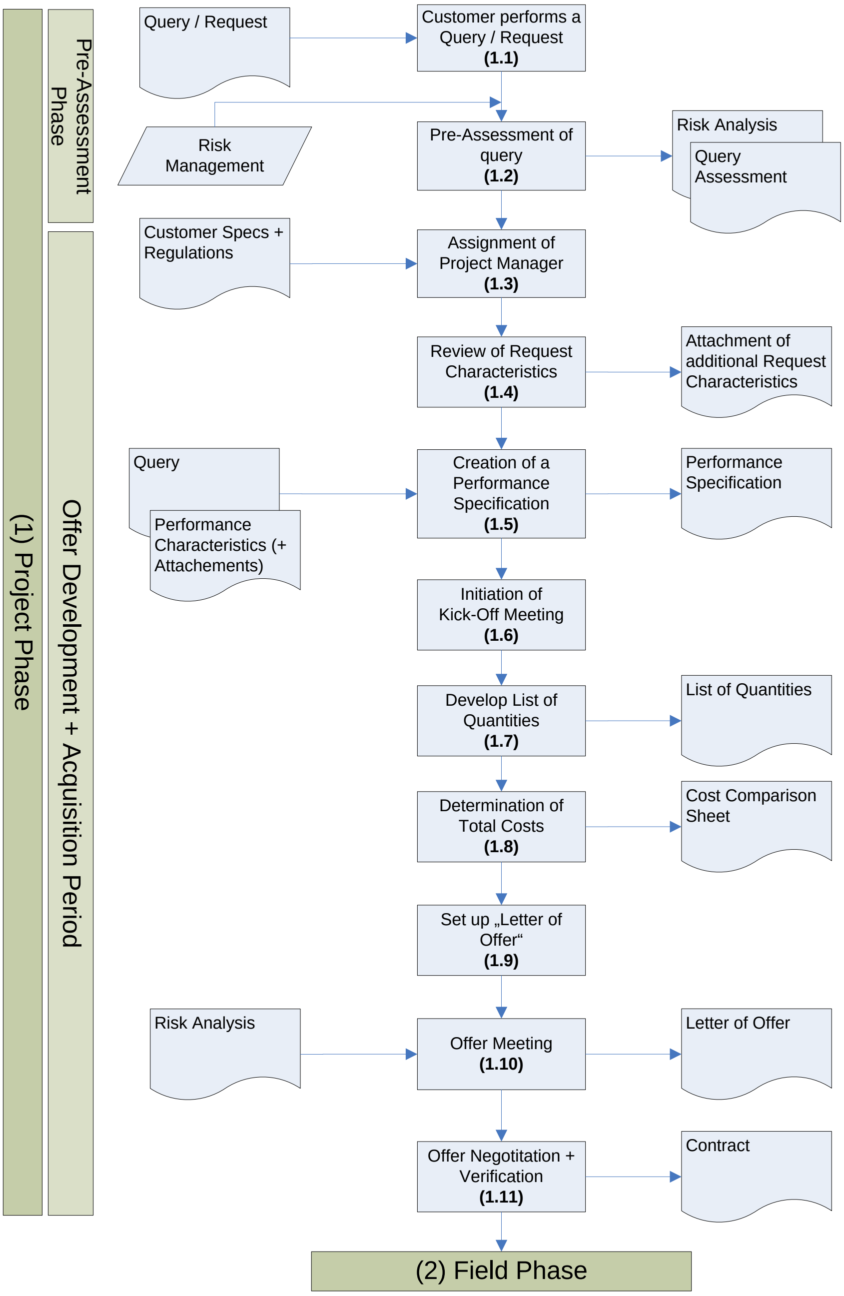
4. Abbreviations & Definitions

The Project Phase (Definition):
The project phase comprises the period of processing a request or query for repair/conversion without having a contractual order yet issued by the prospective customer.

The Field Phase (Definition)
The field phase comprises the period of processing given that a contract is signed for a repair, a conversion or a new-built. It introduces all necessary steps of pre-assessment, evaluation, execution and finalisation on management and production level of any kind of project initiated on the yard.

5. Method

5.1 Short Overview – Project Phase (1)



Step	PR	C
1.1		
1.2		
1.3		
1.4		
1.5		
1.6		
1.7		
1.8		
1.9		
1.10		
1.11		

Abbreviations:

PR: Performance responsibility

C: Contributing

SM: Senior Management

HS: Head of Sales

PM: Project manager

FE: Field Engineer

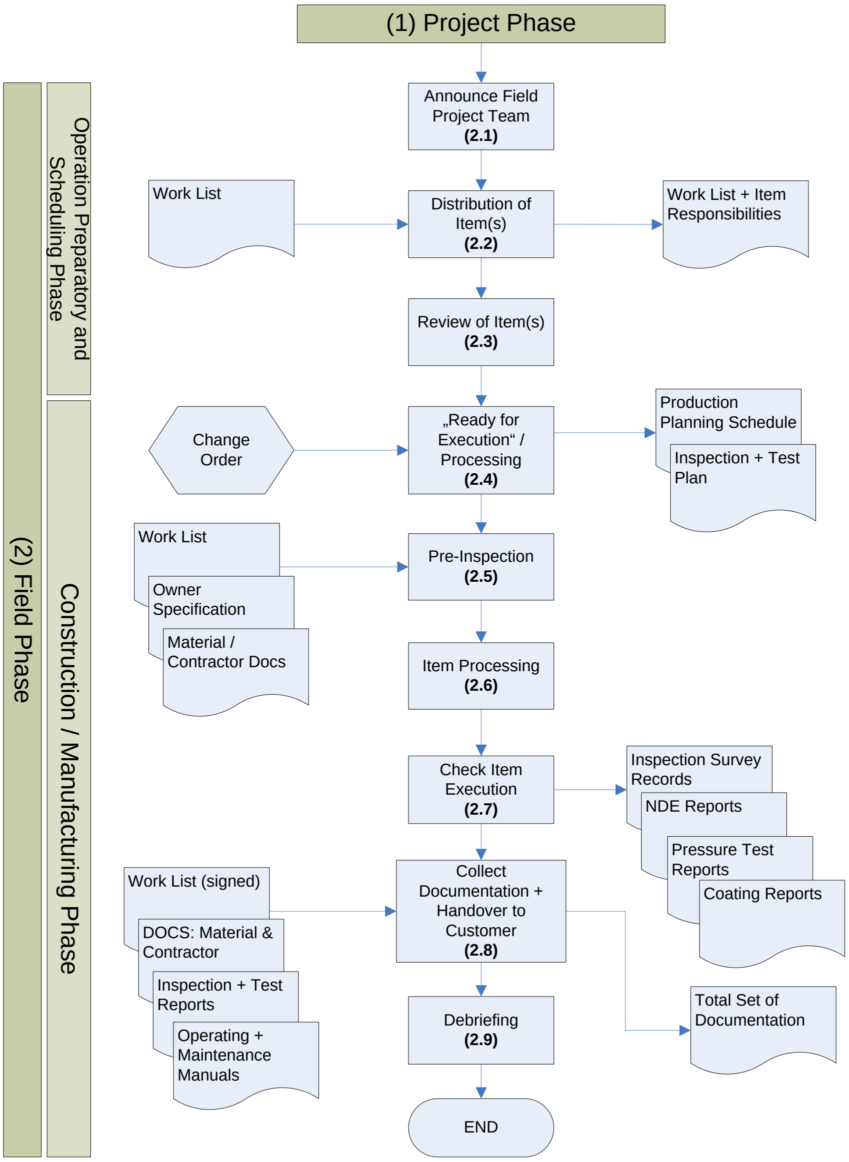
FM: Foreman

E: Employee

Remarks:

- NONE -

5.2 Short Overview – Field Phase (2)



Step	PR	C
2.1		
2.2		
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		

Abbreviations:

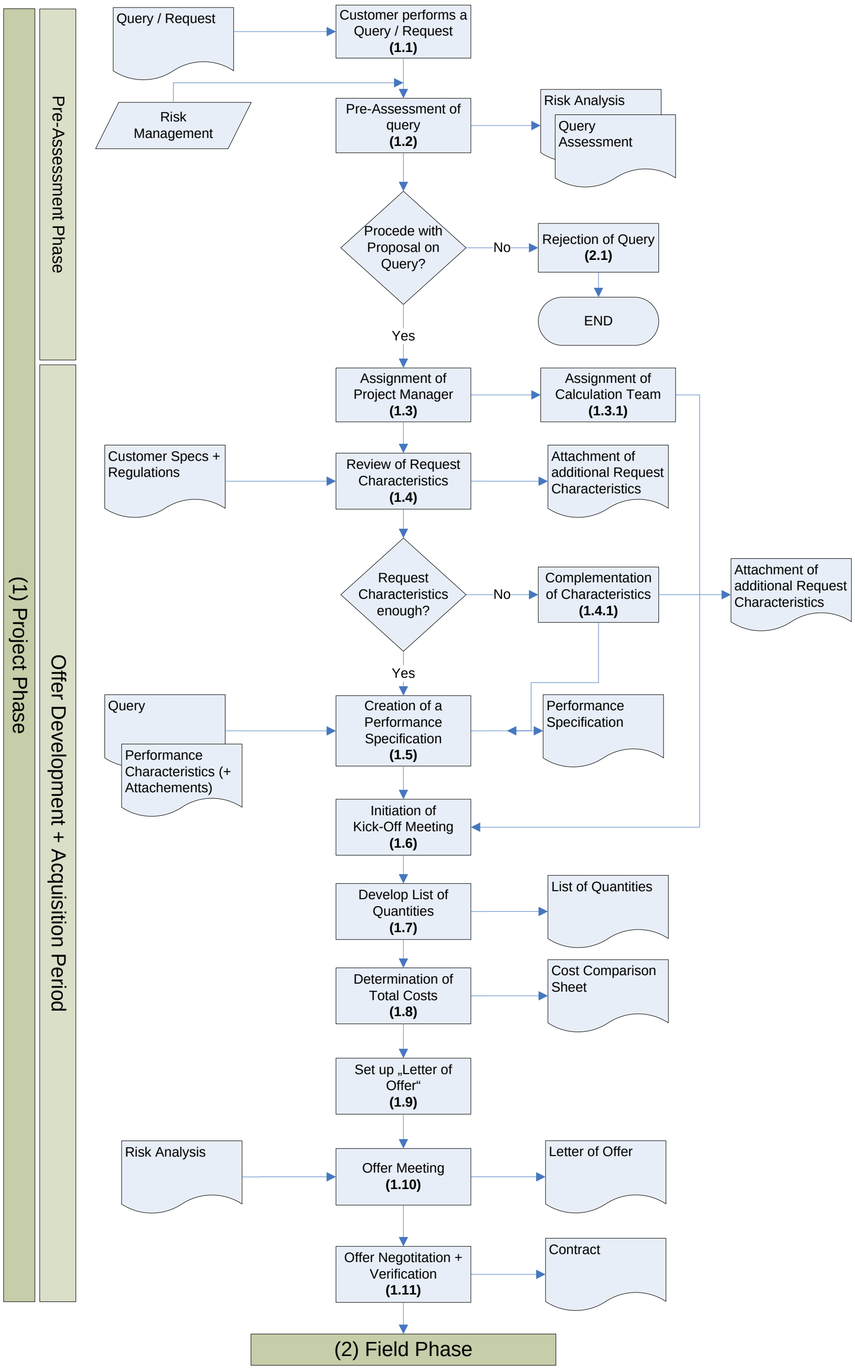
PR: Performance responsibility
C: Contributing

SM: Senior Management
SM: Senior Management
PM: Project manager
FE: Field Engineer
FM: Foreman
E: Employee

Remarks:

- NONE -

5.3 Process Diagram – Project Phase (1)



Step	PR	C
1.1		
1.2		
1.2.1		
1.3		
1.3.1		
1.4		
1.4.1		
1.5		
1.6		
1.7		
1.8		
1.9		
1.10		
1.11		

Abbreviations:

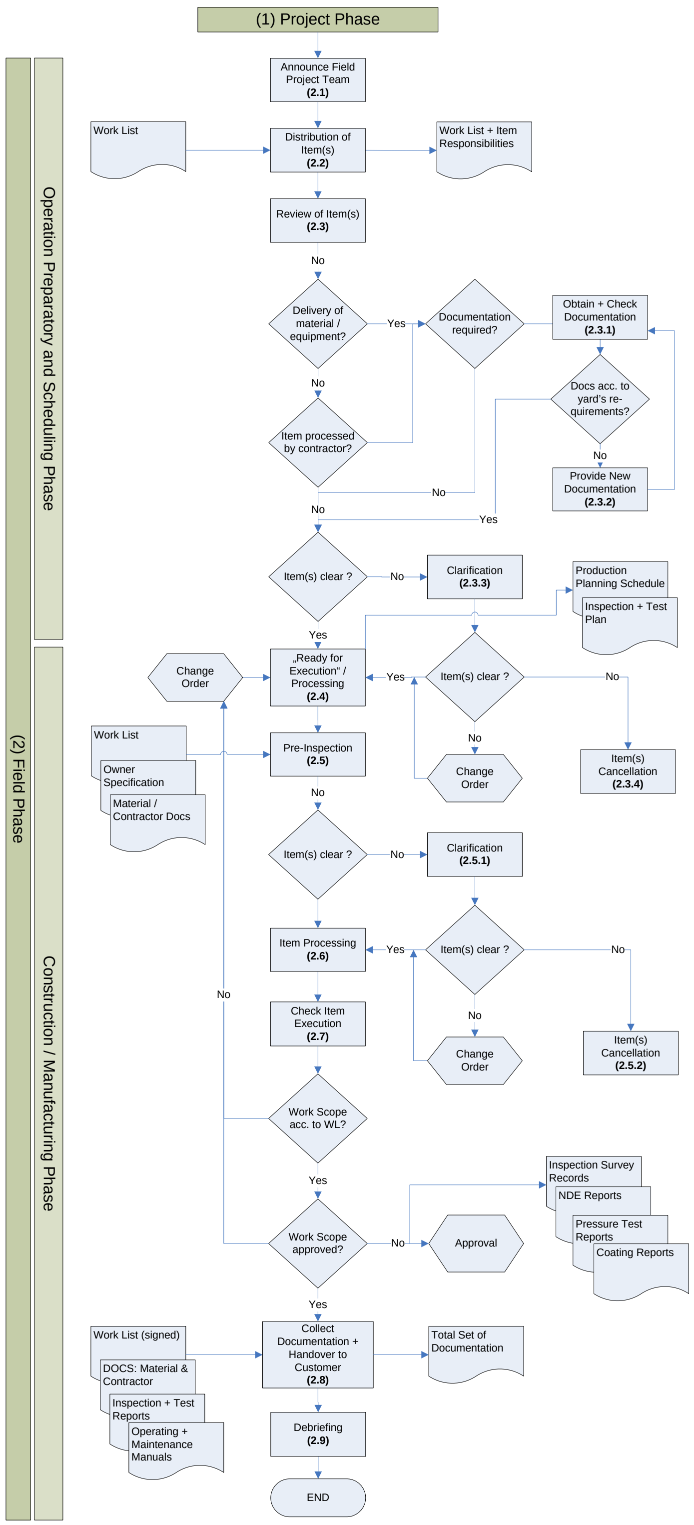
PR: Performance responsibility
C: Contributing

SM: Senior Management
HS: Head of Sales
PM: Project manager
FE: Field Engineer
FM: Foreman
E: Employee

Remarks:

- NONE -

5.4 Process Diagram – Field Phase (2)



Step	PR	C
2.1		
2.2		
2.3		
2.3.1		
2.3.2		
2.3.3		
2.3.4		
2.4		
2.5		
2.5.1		
2.5.2		
2.6		
2.7		
2.8		
2.9		

Abbreviations:

PR: Performance responsibility
C: Contributing
Project manager
SM: Senior Management
HS: Head of Sales
PM: Project manager
FE: Field Engineer
FM: Foreman
E: Employee

Remarks:

- NONE -

6. Process Description

6.1 PD / Project Phase (1)

Step	(1) Project Phase	
1.1	**Input:**	**Query / Request**
	A prospective customer performs a verbal or written query request to the yard, stating his matters of interest, performance characteristics and his designated timeframe for repair. A common procedure is the handover of an “Owner’s Specification” describing all terms of concern.	
	Output:	**- / -**
1.2	**Input:**	**- / -**
	Based on a prioritisation assessment of the customer, the evaluation of the requested performances and the yard’s capacity for the appointed time period the Senior Management decides upon further calculations and quotations to be initiated.	
	Output:	**Risk Analysis and Query Assessment** **Rejection Letter (if necessary)**
1.2.1	**Input:**	**- / -**
	Queries which do not fit above stated patterns for further assessment, i.e. too risky, no capacities, bad experiences etc. are rejected or postponed in a written form by the senior management or the project manager.	
	Output:	**- / -**
1.3	**Input:**	**- / -**
	With the approval of the SM for further assessment work the Head of Sales assigns a responsible project manager who from this point on is “(…) the yard’s main contact in terms of technical, financial and schedule wise inquiries for this specific project.” VERGLEICH. The project manager assigns a team of calculators.	
	Output:	**- / -**
1.4	**Input**	**Customer Specification + Regulations**
	All request characteristics are now reviewed again in direct contact with the customer in order to obtain a complete understanding of all points of the query. This includes the requested performance characteristics, the performance period and a detailed capacity assessment, the evaluation of national and international guidelines and the general terms and conditions of repair issued by the customer.	
	Output:	**Annex of additional Request Characteristics**
1.5	**Input:**	**Query/Request, Performance Characteristics + Attachements**

Step	(1) Project Phase	
	Based on the investigations above and the provided customer's documentation the project manager develops the **Performance Specification** which "(…) on appeal defines the main organisational structure for the **List of Quantities** to be created." VERGLEICH	
	Output:	**Performance Specification**
1.6	**Input:**	**- / -**
	The PM initiates a kick-off meeting, invites the members of the calculation team and presents the results of the preceding investigations. Work packs are distributed among the team members for assessment and calculation.	
	Output:	**- / -**
1.7	**Input:**	**- / -**
	The List of Quantities is based on the performance specification and implies the calculation of every single item in terms of subcontractor services, material/equipments costs and labour costs. The quotations are created by the calculators under the command and instructions of the project manager based on standardized rates for materials and man hours.	
	Output:	**List of Quantities**
1.8	**Input:**	**- / -**
	All determined costs are now brought "(…) together into a total cost comparison sheet, that shall underlay all expected expenditures and impacts respectively". VERGLEICH	
	Output:	**Cost Comparison Sheet**
1.9	**Input:**	**- / -**
	Based on all preceding investigations and created documents the PM drafts the letter of offer in order to present it to the senior management.	
	Input:	**Letter of Offer**
1.10	**Input:**	**Risk Analysis Outcomes**
	In the offer meeting the PM present the letter of offer, the list of quantities, the cost comparison sheet and evaluated risks and concern to the senior management for approval. With the approval of the management, the PM is designated with a room for manoeuvre for any pre- and post-contractual agreements and negotiations with the customer.	
	Output:	**- / -**
1.11	**Input:**	**- / -**

Step	(1) Project Phase
	Based on the prescribed framework of the SM, the PM now presents his letter of offer to customer. Changes or adjustments of the contract are adjusted according to PM’s assigned room for manoeuvre. In case of agreement and order intake the PM send’s out the official written offer confirmation. Herewith the project phase is terminated and the field phase initiated. In this course the PM now creates the order and the Yard Work List in the yard’s computer system in order to provide contractual information to the trades and to allow for timely accounting of performances.
	Output: **Contract**

6.2 PD / Field Phase (2)

Schritt / Step	(2) Field Phase
2.1	**Input:** - / -
	The PM announces the official field project team in consultation with the head of sales and head of production. This team usually consists of a project manager and/or a project engineer, field engineers, calculators, foremen, engineering managers and designers.
	Output: - / -
2.2	**Input:** **Work List**
	The PM and the Field Engineers come together in an internal meeting for information exchange and to decide upon the distribution of responsibilities of the work list items. It is further discussed about designated partner companies, special requests of the customer and the main responsibility of engineering performances if requested. Every work list item is ascertained by name of the involved field engineers.
	Output: **Work List + Assigned Responsibilities**
2.3	**Input:** - / -
	This is the actual preparatory assessment phase of the field engineers and the production trades. Based on the milestones this period is necessary to clear up all boundary conditions of the items contained in the work list, including the informative contents of the descriptions, the assignment of the responsible trades, nature and scope of the work, technical inquiries, locations, transports and transport routes, inspections, material/equipment, sub-contractors, engineering performances, deployment of additional craftsmen etc.
	Output: - / -
2.3.1	**Input:** - / -
	In within this period the placement of all orders of material and equipment is done which is clear at this point or needs a specific delivery forerun. Documentation (specifications, certificates etc.) of the deliveries - if required - are checked upon requested compliance to the yard standards.
	Output: - / -
2.3.2	**Input:** - / -
	If the documentation deliveries do not comply, new documentation shall be delivered, obtained and re-checked until satisfactory of the yard.
	Output: - / -

Schritt / Step	(2) Field Phase
2.3.3	**Input:** - / -
	This step defines a post-revision of every item in order to check if everything is clear (material/equipment ordered, trades/subcontractors known and instructed etc.) to start with the work. If not, more research shall be initiated (e.g. by email/telephone, visiting the site/ship, etc.). If changes in the scope of work become recognizable a change order is created. This pertains for both, additional and reduced performance issues.
	Ouput: - / -
2.3.4	**Input:** - / -
	The yard or the customer can cancel single items if no agreement is found on e.g. prices, overhead rates, standards, changes in scope or execution of the work.
	Output: - / -
2.4	**Input:** **CHANGER ORDER**
	This is the phase shortly before starting the jobs or before arrival of the ship. Most of the items should be clear to every participant in order to start the work on each single work list item.
	Output: **Production Planning Schedule, Inspection + Test Plan**
2.5	**Input:** **Work List, Owner Specification, Material/Equipment + Contractor Documentation**
	The pre-inspection of an item (damage, component, engine, etc.) is usually carried out by the customer representative together with the field engineer and/or the foremen to obtain a picture of the work to be done. The classification society is invited to areas of respective authority. These inspections include the following: (1) quoted items as part of the contract, (2) items or areas of assumed or reported damage, which are only possible to be inspected in dry dock conditions (e.g. shell damages, special components/engines that can be switched off and similar) and (3) issues requested by the classification societies. If everything is clear the work is started. Additional items are calculated and quoted in form of a change order and presented to the customer.
	Output: - / -
2.5.1	**Input:** - / -
	Clarification is needed if inspected areas reveal additional or less work to be carried out, false or inchoate descriptions of the original specification are visible or if additional requirements are set up by the customer or the classification representative. All these issues are usually dealt by new calculations and the quotation of a change order.
	Output:
2.5.2	**Input:** - / -

Schritt / Step	(2) Field Phase	
	The yard or the customer can cancel single items if no agreement is found on e.g. prices, overhead rates, standards, changes in scope or execution of the work.	
	Output :	**- / -**
2.6	**Input:**	**CHANGER ORDER**
	This is the main work / repair phase. Contracted performances are carried according to all agreements with the customer representative and the classification societies. The foremen (own trades and partner companies) are responsible for the quality of the workmanship according to applicable regulations and contracted scope. The field engineers are responsible for the quality of work according to the regulations and the requests and remarks of customer and classification representatives. Changes in the scope or schedules are to be directed to the project manager in a timely manner and to be discussed with the customer.	
	Output :	**- / -**
2.7	**Input:**	**- / -**
	Upon every completion of performance an inspection is carried out in order to check on completeness and compliance to contract and regulations. This can take place on board/site or in the yard's workshops and usually requires the attendance of customer, field engineer, foremen and classification representatives. Intermediate inspections are also a common procedure. By signing a survey record every party confirms the compliance to all requirements. Remarks are added if required and post-inspections can be agreed on, if necessary. These survey records are generally signed on compliance by the field engineer, the customer, the classification and the paint inspector (if applicable).	
	Output :	**Inspection Survey Records, NDE Reports, Pressure Test Reports, Caoting Reports**
2.8	**Input:**	**Work List (signed), Documentation of Material and Contractors, Inspection + Test Reports, Operating + Maintenance Manuals**
	During the field phase all upcoming documentation (such as material certificates, technical drawings, operation and maintenance instructions, survey and inspections records etc.) is collected, filed and handed over to the project manager. He compiles all the documents and forwards it to the customer at the end of the project, obtains all necessary finalizing signatures/approvals and closes the project.	
	Output :	**Complete Set of Documentation**
2.9	**Input:**	**- / -**
	Debriefings are usually held for projects of significant loss of profit or crucial organisational problems. The head of sales and purchase initiates and hosts these meetings and usually invites the project manager(s), the calculators, field engineers and the engineering manager for discussion and clarification.	

Schritt / Step	(2) Field Phase
	Output: - / -

7. Applicable Documentation

Description	Item	Description	Item
Process:		n/a	
n/a	5	n/a	5
n/a	5	n/a	5
Form:		n/a	
Vertragsprüfung	1	n/a	1
n/a	2	n/a	2
n/a	2 / 6	n/a	2 / 6
n/a	3	n/a	3
Mechanical Completion	6	n/a	6
n/a		n/a	
n/a	- / -	n/a	- / -

8. Process Indicators

The following process indicators will be determined once annually:

- Number of deviations
- Number of non conformitys
- Number of change order's

Appendix III - RISK ASSESSMENT (RISK ANALYSIS FORM)

Table of Contents

Table A-III-1: Risk Assessment (general issues)

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
G01	Organisation (general issues)							
G01.01	Structures / Procedures / Jobs Description	Poor and/or outdated Yard Standards Poor Communication Lack of personnel capacity Lack of performance indicators	Possible <u>high</u> effects on main sub-consequences: COSTS (loss of profit) SCHEDULE (failure of delivery) QUALITY (failure on management + technical) SAFETY (failure) Special issue: Influence on all subsequent Events (1,02 – 1,07)	3.2.1.1	all	High flexibility in the deployment of labour, tasks, structures and processes.	“Unclear understanding of one’s responsibilities, tasks and sphere of action in within the company or the project organisation.”	HIGH
							Flawing hierarchical structures and poor line-ups of project organisation	HIGH
							False/weak distribution of responsibilities and tasks	HIGH
							False decision and/or interpretation/understanding of important facts	MODER.
							Tracking of inadequate or false performance indicators	MODER.

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	 (Value)
G01.02	Action / Communication / Planning	Poor and/or outdated Yard Standards Poor/weak standards for communication passages and standards Poor/weak standards and structures for planning and scheduling tasks Lack of performance indicators (costs, schedule, quality, safety)	Possible high effects on main sub-consequences: COSTS (loss of profit) SCHEDULE (failure of delivery) QUALITY (failure on management + technical) SAFETY (failure) Special issue: Influence on all subsequent Events (G01.01 – G01.07)	3.2.1.2	all		“Unclear understanding of one’s communication and planning tasks in within the company or the project organisation.”	HIGH
							Poor, false or no communication between key personnel	HIGH
							Poor, false or no decisions by key personnel	MODER.
							Tracking of inadequate or false performance indicators	MODER.
							Multiple performances (loss of time, costs, resources, etc)	HIGH
G01.03	Behaviour + Habits	Grounded in the historical needs for the execution of projects Poor and/or outdated Yard Standards	Possible high effects on main sub-consequences: COSTS (additional) SCHEDULES (extensions)	3.2.1.3	all (spec. field phase 2.0)		Neglect of project success relevant constraints	MODER.
							Neglect of quality issues	HIGH
							Neglect of safety issues	HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
		Flawing Communication No or few performance indicators Lack of time and capacity to handle many problems	QUALITY (not adequate) Moderate effects on: SAFETY (accidents, victims) Special: Inconsistent / incomplete Item Work List Requirement of introducing high amount of changer/variation orders				Neglect of appraising costs and resources Neglect of global project processes & conception (interdisciplinary level)	MODER. MODER.
G01.04	Neglect of Specialists Advice	Standard Processes & Procedures Inquiry for fast flexible quotation period Lack of personnel capacities Poor performance indicators Flawing subjective	Possible high effects on main sub-consequences: COSTS (additional) SCHEDULES (extensions) QUALITY (not adequate) Moderate probabilities on:	3.2.1.4	1.4-1.5 + subseq. 1.7-1.9	Fast and flexible quotation of items. Keep engineering / production requests out of focus. Moderate	“Inconsistent / incomplete Item Work List” Misinterpretation / misunderstanding of customer requests False and/or inadequate quotation of items in terms of costs, schedules and scopes	HIGH HIGH HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	(Value)
		decisions Yard political reasons Lack of parallel planning (communication) structures	SAFETY (accidents, victims) Special: Inconsistent / incomplete Item Work List Requirment of introducing high amount of changer/variation orders			quotation/offer might rather be signed by customer. More room for manoeuvre.		
G01.05	Feedback / Communication	(?)	Possible <u>moderate</u> effects on main sub-consequences: COSTS (additional) SCHEDULES (extensions) QUALITY (not adequate) Moderate probabilities on: SAFETY (accidents, victims)	3.2.1.5	all		Misunderstanding of one’s performances quality (good/ bad performance? how to improve?) No guidance / learning / experiencing for new projects De-motivation of labour	HIGH MODER. HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	 (Value)
			Special: No or few feedback meetings (during and after projects and performances)					
G01. 06	Item Work List	Initiating Events “G01.01 – G01.05” Others: Poor language and/or professional skills Poor background information sources Lack of preparation time; Stress Lack of capacities	Possible <u>high</u> effects on: COSTS (loss of profit and/or resources) SCHEDULES (endanger of delivery dates) <u>Moderate</u> effects on: QUALITY (technical execution, reputation loss) SAFETY (accidents, hazards)	3.2.1. 6	(1,4- 1,9) 2,0		False, incomplete, poor execution of performances due to loose quotation of items in terms of costs, schedules & scope Extension of schedules Increase of work performances Loss of profit, time, capacities	HIGH MODER. HIGH HIGH
G01.	Schedule	Initiating Events:	Possible <u>high</u> effects on:	3.2.1.	(1,4-		Neglect of safety of	MODE

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
07	keeping (time constraint)	“G01.01/ 02/ 04/ 05/ 06” Changes in contract Customer Request (nature of repair project) Unforeseen deviations from original situation. External constraints (capacity, weather, customer changes, classification request etc.) “Time ←→ Quality ←→ Safety” conflict	SAFETY (accidents, hazards) QUALITY (poor technical quality, poor documentation quality, loss of reputation)	7	1,11) 2,6		personnel Neglect of performances quality	R./ HIGH HIGH
G02	Engineering + Planning							
G02. 01	General (poor or not properly implemented)	All initiating Events of “G01” No/poor physical environment of engineering and planning departments/instances No need for engineering	Possible <u>high</u> effects on: SAFETY (possibility of severe accidents due to false planning during refit works / possibility of severe accidents due to poor engineering performances during refit works and afterwards when ship in service; e.g.	3.2.2	(1,4-1,8) 2,1-.2,4		Important engineering + planning tasks are overseen/neglected and/or not treated adequately, resulting in high risks of poor quality, schedules, safety and cost issues Engineering + planning tasks are assigned and	HIGH HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
		+ planning performances (department) No personnel capacities False interpretation of engineering and planning structures/tasks/performances Engineering + planning performances were of minor scope at the beginning of a project	structure integrity failures) QUALITY (poor quality outcome when flawing engineering/planning performances) SCHEDULE (loss of main schedule, inadequate consecutive planning of performances leading to single item planning and safety problems) COSTS (false engineering / planning could lead to higher costs; multiple / false performances, loss of schedule, etc)				dispatched to existent project members leading to overload of the labour Engineering + planning tasks are handled on subjective, single streamed actions (“no parallel evaluation” with flawing effect on the traceability and consistency of performances)	 HIGH
G02. 02	Engineering	External company and external leadership of department (no/poor internal control) Poor compliance to needs + standards of the yard	Possible <u>high</u> effects on: COSTS (increase of costs and resources) Production trades often start earlier resulting in	3.2.2	(1,4-1,8) (2,1-2,4) 2,6		Loss of control of engineering performances Engineering performance absorb to much time and/or	MODER. HIGH HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	(Value)
		Poor organisation and lack of structure / labour / knowledge No adequate external information input (e.g. from customer, directive board, classification societies, etc.) No / poor parallel structures to other disciplines / departments (field, trades, project, quality, …) Poor / false prioritisation + importance measures (lack of performance indicators)	multiple works on one spot since engineering is still in changing process Production cannot start since engineering is not finished yet QUALITY (poor engineering performances due to false calculations/drawings/updates can lead to poor production performances) SCHEDULES (possibility of extension in time of single items and global project plan) <u>Moderate</u> effects on: SAFETY (due to several and subsequent safety instances - HSE, Field				capacities, are incorrect or useless Concentration on the wrong performances No or weak parallel communication to other structures (especially, production, engineering, …) No timely cooperation work between engineering and production (production trades have to wait for engineering performances to be finished)	 HIGH HIGH MODER./ HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
			Engineers, foremen - but risk for severe accidents during refit and after refit project exist)					
G02.03	Planning	Unclear structures / responsibilities for planning + scheduling Lack of personnel capacities Poor external information input (customer, directive board, PM, etc.) Lack of experience Uncertainty of external constraints (yard global, capacities, weather, etc.) No parallel structures to other disciplines + departments Poor supporting tools (IT, performance indicators)	Possible high effects on: COSTS (due to false planning leading to multiple works, collision of schedules, extension of work processes, waiting times) SAFETY (collision of parallel and highly critical processes, e.g. accidents) SCHEDULES (poor planning leads to failure of schedule on single item and/or global project level) Moderate effects on:	3.2.2	(1,4-1,8) (2,1-2,4) 2,6		Misguidance of planning/scheduling tasks of single items or global project Failing the schedules False planning of subsequent or parallel processes Loosing overall goal / approach Failure in deployment of labour – overload and stress (exhausting the personnel)	HIGH MODER. HIGH MODER. HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
			QUALITY (due to number of subsequent control instances, e.g. PM, Field engineers, foremen, QAQC, …)					
G03	Documentation Management							
G03. 01	Organisation	All events “G01” Lack of experience or training of staff	Possible high Effects on: QUALITY (poor documentation management implies low quality standards) Moderate Effects on: COSTS (difficulties in tracing costs) SCHEDULE (difficulties in tracing schedules, extension of documentation performance at the end of a project due to poor pre-work Low Effects on:	3.2.3	(1,4-1,8) (2,1-2,4) 2,6-2,8		Weak or no control of documentation work Poor or no documentation work Loss/waste of capacities and resources (multiple documentation work, subsequent works to be performed, etc.)	HIGH MODER./ HIGH HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
			SAFETY					
G03.02	Consistency	Events “G01.01-03, G01.05, G01.07, but also G02, G04, G06, G07”	same as G03.02	3.2.3	2,6-2,8		Loss of control / overview of project documentation work	HIGH
							Flawing traceability	HIGH
		No training of engineers and managers					Mistakes (technical, managerial, quality, …)	MODER.
							No recall value (for customers and BVR staff)	HIGH
G03.03	Traceability + IT	Events “G01.01, G01.02, G01.03, G01.05, G01.07”	same as G03.02	3.2.3	2,6-2,8		same as G03.02	
		but also G02, G04, G06, G07						
		No adequate IT system						
		No / poor easy-to-handle support software						
		No communication between personnel + other disciplines / departments+						

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
		Huge amount of data No personnel capacities						
G04	IT Management							
	IT support management / system	(a) Not Existent (b) If Existent Poor tools No training of users False treatment by staff Implementation of false software, programmes, performance indicators Influence of single users on global and critical files	Possible high effects on all streams: COSTS QUALITY SAFETY SCHEDULE	3.2.4	“1 – 2” (project + field phase)		“Limitation of all performances in within a company or a project organisation”	HIGH
							Loss of structure / overview of performances, schedules, costs, …	MODER.
							No or poor information exchange	MODER.
							Lack of information support to any department and discipline	HIGH
G05	Safety Management							
	HSE and safety management system	All events within “G01” + no personnel capacities or wrong deployment of	Possible high effects on every sub-consequence: SAFETY (high	3.25	“2” (field phase)		No consideration of highly critical processes (poor safety precautions / preparedness)	HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
		personnel + false performance indicators + false risk assessment and analysis of risks + consequences (wrong tools, no experience, no time, wrong input) + inexperienced personnel (no training, no communication, large construction sites, complex repair performances, …)	probabilities for accidents, injuries, victims due to low safety precautions) QUALITY (low safety constraints + control tempt to encourage low quality of production; to finish as fast and easy as possible) SCHEDULE (high safety standards and efforts usually comprise higher efforts in safety implementation increasing time for certain performances / low safety constraints + control tempt to encourage rushing of production trades) COSTS (low safety standards bring lower costs (and vice versa)				Accidents (incl.victims) Overreaction on every process (too high safety precautions) → collision of processes lead to total	MODER. MODER.
G06	Production							

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	Risk (Value)
G06.01	Field Engineer	All Events “G01” No experiences No competences Too many responsibilities (tasks) Misguidance or no guidance by superior and/or external structures (customer, classification, PM, trades / subcontractors and others) No communication on parallel structures	Possible <u>high</u> negative effects on all sub-consequences: SAFETY QUALITY SCHEDULE COSTS	3.2.6	2,3-2,7		Weak, incomplete or no execution / treatment of single items / tasks Misguidance of production trades/subcontractors Neglect / loss of overview of single items and even highly critical items Work overload / burn-out Highly wrong decisions	MODER. HIGH HIGH HIGH MODER./ HIGH
G06.02	Trade + Subcontractors	All Events “G01” No competences No capacities Cooperation with external contracted labour	Possible <u>high</u> negative effects on: SAFETY QUALITY <u>Moderate</u> negative Effects	3.2.6	2,3-2,7		Weak, incomplete or no execution / treatment of single items / tasks Misguidance of craftsmen Neglect / loss of overview of single items and even highly critical	HIGH MODER. HIGH

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk (Threat)	(Value)
		Lack of control instance (quality, field, foremen, PM, …)	on: SCHEDULES COSTS				items	
							Work overload / burn-out	HIGH
		Misguidance by superior structure					Highly wrong decisions	MODER.
		Behaviours + Habits					Creation of dangerous situations (safety problems)	HIGH
		False pre-calculation of performances						
G07	Quality Assessment + Control							
	Assessment + control of quality issue (production, execution, safety, quality management, etc.)	All Events “1,00 – 6,00”	Total Failure on all sub-consequences and main consequence	3.2.7	“1 – 2” (project and field phase)	More Details when assessing the projects.	Failure of single item in terms of quality	HIGH
		Non-existance of a QA/QC department and/ or Quality Management Systems					Failure of company / project	MODER.
		No personnel capacities						
		Inexperienced / untrained labour						
		Complex repair / refit environment						
		External misguidance (customer, directive						

Appendix III

Table A-III- 1: Risk Assessment (General Issues)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Project Process Refer.	Remarks	Risk	
							(Threat)	(Value)
		board, …)						

Table A-III-2: Risk Assessment (Enquest Producer)

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
E01	Management and Organisation							
E01.01	Organisation	No elementary / fixed and continuous project team throughout the lifetime of the project Huge amount of project players, resulting in blown-up structures and misunderstanding of single tasks and responsibilities External specialists deployment	Continuous change & adjustment of organisation charts, teams, team compositions and positions Reactive introduction of positions / teams / departments as well as procedures / processes according to corresponding conditions, customer requests or contractual agreements Partly total reliance of external advices / experiences	3.3.2.1	G01		Neglect of highly critical production/ planning/ safety/ quality/ … issues Continuous disruption of work/production processes Loss of time, costs, capacities Problems on project team management level (PM – Field – Quality – others)	MODER. HIGH HIGH HIGH
E01.02	Work scopes / performances	High deviations (in scope and frequency) between written performance	Created additional needs for engineering, planning, quoting, preparation etc.	3.3.2.1	G01 (spec. G01.05-06)	Solutions: Change Order / Variation Orders	Additional work/performance to be carried out (incl. shift of costs, schedules,	HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
		specifications and actual state on board. Engineering performances not ready yet or could not keep up with the production Command of „showing action“ from superior management Poor planning + communication on horizontal structures between engineerin, field, production and quality Unpreparedness in terms of quality, engineering, safety, NDT	(resulting in high number of change / variation orders) Difficulties in evaluating subsequent dependencies of single construction site to other sites or other performances such as additional engineering, redesigning, material, progresses, ... Many jobs were started on unfinished facts, engineering and designing was carried out parallel resulting in high rates of multiple works on single spots			to define deviations in work scope Neglect of “acceptable” additional works, i.e. start on repair of large areas keeping in mind that throughout the course additional minor adjustment have to be made Introduction of additional project teams and structures	plans) Repair works start before engineering is accomplished and fail compliance Single spots or complete areas are touched (repaired, built) several times De-motivation of labour → resignation → poor quality of performances / accidents	 HIGH HIGH MODER.
E01.03	Labour (deployment)	Not enough personnel capacities on the yard (in terms of manageable scopes of performances and knowledge) Continuous deployment/termination	Deployment of specialists from naval and offshore engineering industries Huge amount of project labour in high times with high demand for	3.3.2.1	G01, G04, G05, G06, G07	External deployment is needed to fill the yard’s capacity lacks on large projects External labour	Distribution / redistribution of performances on existing labour (overload) Incooperation time for new employees puts	MODER. HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	(Value)
		or shift work (2 weeks on/off) of external specialists + engineers throughout the whole project lifetime	coordination; if not: loss of overview and misunderstanding of tasks and roles in within the team			can accompany knowledge, experience, guidance and new ideas.	additional workload on organisational structures and existing staff.	
		Newcomers required time to settle to this tasks and had to be incorporated	Fixed and new staff have to arrange divisions or new redefinitions/descriptions of jobs, processes, planning procedures, communication paths – loss of time, capacities			External labour comes along with a certain objectivity on yard internal processes and structures.	Project newcomers are not aware of their tasks, existing staff is confused about the own responsibilities	MODER.
		Missing project specific position, process, communication, planning + processes descriptions					Loss of control of newcomer’s performances (loss of time, capacities, resources)	HIGH
		Poor control of performances of newly deployed labour (lack of control instance, adequate responsibility description and performance measures)	Many position are filled with externals, of which other internal key functionaries are not aware of, or not aware of their tasks and roles, multiple work, poor communication of tasks, schedules, resources				New staff is kept within a task not capable / not qualified / not motivated to accomplish	MODER.
		Restriction in time to assess the qualities of newly deployed personnel	Yard / yard’s directives (as the main contractor) looses control of certain performances + project teams / departments are				Contracted external leadership positions could have potentiated negative effects on project relevant issues, team and departments (due to lack of knowledge, experience,	HIGH
		Partly introduction of						

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of")	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
		externally contracted leadership positions in elementary teams and departments Partly communication barriers (language) between externals and own staff (especially on production level)	misguided Demotivation of internal labour ("the ones identifying with the yard"), resulting in resignation, resulting in poor performance quality				performance indicators, control, motivation)	
E02	Production and Quality Control							
E02.01	Quality Assessment and Control	Lack of preparedness regarding offshore quality standards "Missing QAQC" and concurrent difficulties when implementing a quality department (1) Poor execution of performances in all areas (but mostly on production level) in the first run	QA/QC department, consistent of external staff only Loss of time and capacities until a level of good communication and cooperation was established quality control and asset performances were partly forwarded to the contracted NDT team (although in the	3.3.2.2	G01 G07	Good communication and cooperation between trades, field engineers and QA/QC members External staff (Head of QA and assistance) was a good help for the yard in terms of quality control	Delivery of poor quality on all streams Since the project and the production are initiated (hence quality control standards in development) delivery of poor standards especially on production/manufacture level Testing of different approaches, papers,	MODER. HIGH HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
		(2) Required time to learn and experience the quality standards requested (but time is restricted) (3) Introduction of a QA/QC department and concurrent structures, positions, standards, papers and implementation into the production processes	responsibility of the yard) Neglect of neat, compliant and conclusive documentation performances – resulting in immense effort on subsequent additional work at the end of the project			and assessment	certificates leads to many different documentation standards and loss of recall value (and loss of overview)	
							Yard needs learning time in project specific courses and needs to learn to implement these (ITP's, inspection records, lifting procedures, variation orders, QA/QC docs, safety standards, etc.)	HIGH
							Deployment of external labour to built up a QA/QC Team	HIGH
							Inadequate support of NDT company / team	MODER.
E02.02	Production trades + assets	Difficulties in reaching / approaching requested quality standards in technical executions (steelwork, welding, testing) and safety	Many jobs / items / construction sites have been processed several times or many sites have countered with multiple adjustments.	3.3.2.2	G01 G03 G06 G07	Good acceptance of and cooperation with quality department staff	False or poor execution of performances (steelwork, welding, piping, …)	MODER.
							No experience or no support in improving	HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
		issues due to: Lack of QA/QC support Lack of experience Poor performance indicators Lack of parallel cooperation and planning structures Partly lack of control and overview Overload of staff Demotivation of staff Time constraint (due to a very long project lifetime the time constraint plays a big motivational role to teams continuously fighting against problems with decent results)	Increase of costs + schedules Loss of resources, capacities Loss of trustworthy in the abilities of the yard Loss of trust into decision makers/leaders				quality issues Loss of control of performances on production level (in terms of process, working hours, quality, safety, …) De-motivation of labour results in resignation results in poor performance + quality	 MODER. / HIGH HIGH
E02.03	Client (problem)	Unpreparedness and faint of the	Long decision and process chains due to	3.3.2.2		Client was unconscious in	Misdirection + Misguidance of the	HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
		customer/client Inexperience and lack of integrity from client side	(re-)evaluation needs. Yard follows the customer's false defaults. Multiple works needed. Potentiating of failures (first customer, then yard)			several items (especially, scope and complexity of performances to be done)	yard on all disciplines.	
E03	Synchronic processes and prioritisation management							
E03.01	Planning + Scheduling	Poor planning policy / department. Poor standards of planning techniques.	Pre-dominant reactive planning towards fixed milestones and events.	3.3.2.2	G01 G02 G03		Failure of keeping schedules (single item level) Failure of keeping schedules (project level) Creation of critical collisions of processes, milestone, …	HIGH MODER. HIGH
E03.02	Planning + Safety Problem	Huge amount of trades acting on small area. Difficulties / lack of support in horizontal planning of performances	Stopping of performances on specific areas for a specific time Stopping of single trades.	3.3.2.2	G01 G02 G03	Critical hazards with bad injuries or victim have not been reported.	Safety critical collisions of different trades or contracted companies (e.g. horizontal performances of hot works and paint works)	HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
		False performance + prioritisation measures	→ waiting time, extension schedules and increase of costs				Hazards (fire, victims, injuries)	MODER.
E03.03	Prioritisation towards external assets	Maintenance of other projects ongoing on the yard. Timely prioritisation of special projects (e.g. cruise ships) due to limited time	Temporary shifting of engineers, foremen, craftsmen to priority projects → throughout this time less performances on the long-term can be carried out	3.3.2.2	G01		Client's project management of long-term project feels neglected / de-prioritised Neglect of critical performances.	MODER. HIGH
E04	Integrity and preparedness							
E04.01	Quality measures	Lack of experiences and lack of labour	Deployment of huge amounts of external specialists Training/learning & incorporation time is necessary Dependent on guidance by client	3.3.2.4	G07	Good support in technical, organisational, etc. on field (offshore) related issues by external specialists	Total reliance on external specialist Multiple works (until quality standards reached) Loss of time, costs, capacities	MODER. HIGH HIGH
E04.02	Documentation performances	Poor yard standards Lack of experiences and lack of labour	Bad documentation throughout the lifetime of the project Huge amounts and	3.3.2.4	G03		Bad documentation performance (final docs) Loss of time, costs,	HIGH HIGH

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
			efforts to be put in the final phase (collection of all necessary and relevant documentation)				capacities (especially towards project end)	
			Implementation of project related doc standards (time + capacity consuming)				Neglect of important, critical item documentation	HIGH
			Departmental + disciplinary implementation of doc styles acc. to needs (failure of recall value)				Bad documentation might lead to price reductions by the client	HIGH
			Dependent on guidance by client				Loss of overview of project documentation	MODER.
							Multiple documentation performances	HIGH
E04.03	Traceability performances	Lack of experiences and lack of labour Lack of client's experience	Huge efforts put into traceability management but with missing globally accepted utilisation tool s (mix of many different templates)	3.3.2.4	G02-G07		Poor traceability environment at the beginning attributes highly to total consistency	MODER.
			Training / learning + adaption time needed				Loss of time, costs, capacities	HIGH
			Partly reliance on				Multiple work	HIGH
							Hugh personnel and documentation	MODER.

Table A-III- 2: Risk Assessment (Enquest Producer)

Nº	Initiating Event („Failure of")	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table: A-III-1 Refer.	Comments	Risk (Threat)	Risk (Value)
			client's advices guidance				performances needed	
							Misleading by client	MODER.
E04.04	Safety performances	Lack of experience	Training / learning time needed to adapt to client's (offshore) safety standards	3.3.2.4	G05		Continuous discussions with client safety representatives	HIGH
							Stopping of construction sites (until safety re-established) → loss of costs, time, capacities	HIGH
							Hazards (accidents with minor to moderate injuries)	MODER. / HIGH
							Hazards (death / killing)	LOW

Table A-III-3: Risk Assessment (Petrojal Banff)

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
B01	Management & Organisation							
B01.01	Project Organisation (general issues)	Too small / poor BVR project team during first half of project life time	A lot of work distributed on few – later on more (but still too few)	3.3.3.1	G01		Neglect of highly critical production/ planning/ safety/ quality/ … issues	MODER.
		Deployment of totally external ‘Quality Department’	Continuous problems between the quality department, the field engineering and production trades + the client				Continuous disruption of work/production processes	HIGH
		Unclear distribution of main engineering responsibilities					Loss of time, costs, capacities	HIGH
		Unpreparedness towards very experienced and targeted customer (in all terms)					Problems on project team management level (PM – Field – Quality – others)	HIGH
B01.02	Work scopes / performances	Combination of possible and different reasons for failing (unpreparedness, forcing, poor abilities,	Occurrence of cracks after repairs	3.3.3.1	G01 (spec. G01.05-06)	Solutions: Change order / variation orders to define deviation in work scope	Loss of profit, schedule, reputation	HIGH
							Single spots or complete areas are touched (repaired,	HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of")	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
		prioritisation management, underestimation, lack of dock capacities, etc.)				Introduction of additional project teams and structures	built) several times	
							De-motivation of labour → resignation → poor quality of performances / accidents	HIGH
B01.03	Labour (deployment)	Deployment of entire external Quality Department (incl. leadership, inspectors, controllers, assistance, etc) Deployment of external engineering	No clear assignment of standards → continuous clarification/discussion needed No/poor or complicated communication between externals and own labour Communication structures not orced/maintained or assigned properly Necessary incorporation time external staff Yard gives the quality assessment out of hand (later into management level)	3.3.3.1	G01, G04, G05, G06, G07	External deployment is needed to fill the yard's capacity lacks on large projects External labour can accompany knowledge, experience, guidance and new ideas. External labour comes along with a certain objectivity on yard internal processes and structures.	Bad/no communication → bad performance → bad quality → loss of time/ profit/ capacities	HIGH
							Incorporation time for new employees puts additional workload on organisational structures and existing staff.	HIGH
							Loss of control of newcomer's performances (loss of time, capacities, resources)	MODER.
							New staff is kept within a task not capable / not qualified / not motivated to	HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
							accomplish	
							Contracted external leadership positions could have potentiated negative effects on project relevant issues, team and departments (due to lack of knowledge, experience, performance indicators, control, motivation)	HIGH
B02	Production + Quality Control							
B02.01	Quality assessment + control	External people with no experience in yard structures, communication levels and necessary parallel contacts No training, maintenance of cooperation between external people and production (assignment of cruel	Incorporation time needed No/poor communication to production key functions Mislead/misguidance of the production assets Basically separation of quality assessment from the yard organisation	3.3.3.2	G01 G07	Partly no or very poor communication towards production trades.	Testing of different approaches, papers, certificates leads to many different documentation standards and loss of recall value (and loss of overview)	HIGH
							Obstruction of production performances	HIGH
							Yard needs learning	HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
		authorities to the quality department) Introduction of highly scientific quality procedures Bad control/maintaining of the department performances by higher management levels Later (leadership of department) was taken by BVR project manager	Continuously introduction of new templates/ inspections flow charts → no continuous and globally utilised standards Field engineering faced loss of control regarding all quality issues				time in project specific courses and needs to learn to implement these (ITP’s, inspection records, lifting procedures, variation orders, QA/QC docs, safety standards, etc.)	
							Loss of control of production performance by key personal	MODER./ HIGH
							Production key personal and trades misguided, confused	HIGH
							Production personal de-motivated, resigning and hence delivering poor performance quality	HIGH
B02.02	Production trades + assets	Not totally aware of communication paths towards own management, engineering and	Many jobs / items / construction sites have been processed several times or many sites have countered with	3.3.3.2	G01 G03 G06	Partly total failure of cooperation between production trades and quality	False or poor execution of performances (steelwork, welding, piping, …)	HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
		quality department Lack in the quality of discipline related performances (construction, welding, grinding, etc.) Not aware of the high quality requirement by the customer	multiple adjustments. Increase of costs + schedules Loss of resources, capacities Loss of trustworthy in the abilities of the yard Loss of trust into decision makers/leaders		G07	department	No experience or no support in improving quality issues Loss of control of performances on production level (in terms of process, working hours, quality, safety, …) De-motivation/confusion of production labour results in resignation results in poor performance + quality	HIGH MODER./ HIGH MODER./ HIGH
B02.03	Owner/client (problem)	Much more keen and experienced than the yard Over-strict and critical after cracks appeared (after repair/refit performances by the yard)	Leading the yard performances (misguiding in terms of very/”too strict” requirements Yard follows the customer’s false defaults. Multiple control of yard performances (complicated approval	3.3.3.2		Client knew what he wants and how (much more experienced in field issues) Provided help to the yard in terms of field issues (“offshore”)	Misdirection + Misguidance of the yard on all disciplines. Obstruction of yard performances	HIGH HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
			structures) Multiple works needed.					
B03	Synchronic processes and prioritisation management							
B03.01	Planning + Scheduling	Poor planning policy / department Poor standards of planning techniques Lack of personnel capacities Poor performance + prioritisation measures	Pre-dominant reactive planning towards fixed milestones and events.	3.3.3.3	G01 G02 G03		Failure of keeping schedules (single item level) Failure of keeping schedules (project level) Creation of critical collisions of processes, milestone, …	HIGH MODER./ HIGH HIGH
B03.02	Planning + Safety	Difficulties / lack of support in horizontal planning of performances False performance + prior	Stopping of performances on specific areas for a specific time Stopping of single trades. → waiting time, extension schedules and increase of costs	3.3.3.3	G01 G02 G03	Critical hazards with bad injuries or victim have not been reported.	Safety critical collisions of different trades or contracted companies (e.g. horizontal performances of hot works and paint works) Hazards (fire, victims, injuries)	HIGH MODER./ HIGH
B03.03	Prioritisation towards external	Lack of experience / knowledge about	Repair or repair performances	3.3.3.3	G01		Neglect of critical performances.	MODER./ HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
	assets	complexity of performances (global) Preference towards external projects/clients No docking/dock capacity					Failure of main repair performance	MODER./ HIGH
E04	Integrity and prepardness							
E04.01	Quality measures	Lack of experience and lack of labour Introduction of complicated structures/measures by quality department Poor control Introduction of false performance measures	Deployment of huge amounts of external specialists Training/learning & incorporation time is necessary Dependent on guidance by client Introduction of many useful/ unnecessary/ complicated structures and performance measures	3.3.3.4	G07		Total reliance on external specialist Multiple works (until quality standards reached) Loss of time, costs, capacities Follow-up of false performance measures	MODER./ HIGH HIGH HIGH HIGH
E04.02	Documentation performances	Poor yard standards Lack of experience	Documentation tasks done by external quality department	3.3.3.4	G03		Bad documentation performance (final docs)	HIGH

Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of")	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
		and lack of labour High experiences of client	Documentation performances kept confidential / not traceable in within quality department Dependent on guidance by client				Loss of time, costs, capacities (especially towards project end)	HIGH
							Neglect of important, critical item documentation	HIGH
							Exclusion of production assets (no cooperation)	HIGH
E04.03	Traceability performances	Lack of experience Poor understanding of standards Production becomes plaything of quality department and/or client arbitrariness	Huge efforts put into traceability management Training/learning + adaption time needed Misguidance by QA/QC Reliance on client's advice + guidance	3.3.3.4	G02-G07		Poor traceability environment at the beginning attributes highly to total consistency	MODER./ HIGH
							Loss of time, costs, capacities	HIGH
							Multiple work	HIGH
							Hugh personnel and documentation performances needed	HIGH
							Misleading by client	MODER./ HIGH
E04.04	Safety performances	Lack of experience	Training/learning time needed to adapt to		G05		Continuous discussions with client	MODER./ HIGH

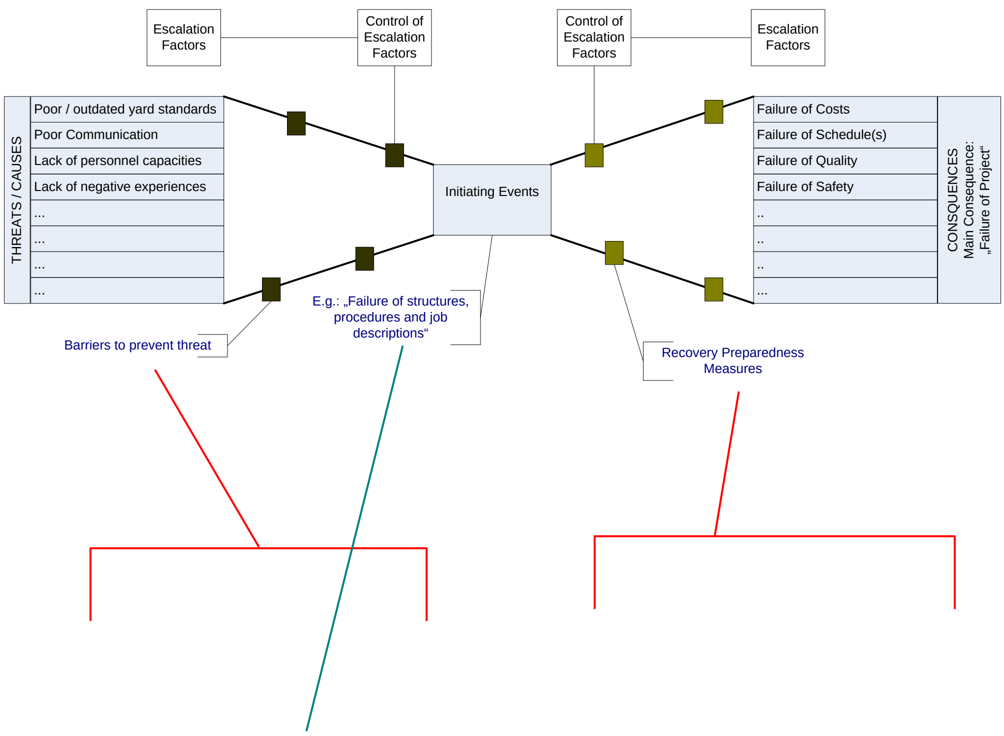
Table A-III- 3: Risk Assessment (Petrojal Banff)

Nº	Initiating Event („Failure of“)	Causes / Threats (Main)	Consequences	Thesis Refer. (Ch.)	Table A-III-1 Refer.	Remarks	Risk (Threat)	Risk (Value)
			client’s (offshore) safety standards				safety representatives	
							Stopping of construction sites (until safety re-established) → loss of costs, time, capacities	HIGH
							Hazards (accidents with minor to moderate injuries)	MODER./ HIGH
							Hazards (death / killing)	LOW

Appendix IV

Appendix IV - BARRIER ALLOCATION

<u>Description for application of table:</u>



„Initiating Event“

	Barriers			Recovery Preparedness Measures	
Chapter Refer.	**Index**	**Description**	**Chapter Refer.**	**Index**	**Description**
3.2.1	ORGANISATION (G01)				
3.2.1.1	**Structures, procedures, job descriptions (G01.01)**				
4.2.6.1	F.1	Revised 'Process of Repair'	4.2.6.3	F.3	Standards for Communication
4.2.6.2	F.2	Revised 'Job & position descriptions'	4.2.6.4	F.4	Non-conformity guidelines
	as part of this, Introduction of:				
4.2.1	A	Standard Project Team'			
4.2.2	B	Integrated Project Engineering Department'			
4.2.3	C	New Field Team'			
4.2.3	D	Quality Department			
4.2.5	E	DCIPD			
4.2.7	G	Integrated Planning + Prioritisation Management			

Barriers			Mitigating Measure (Barrier)		
Chapter Refer.	**Index**	**Description**	**Chapter Refer.**	**Index**	**Description**
3.2.1	**ORGANISATION (G01)**				
3.2.1.1	**Structures, procedures, job descriptions (G01.01)**				
4.2.6.1	F.1	Revised 'Process of Repair'	4.2.6.3	F.3	Standards for Communication
4.2.6.2	F.2	Revised 'Job & position descriptions'	4.2.6.4	F.4	Non-conformity guidelines
	as part of this, Introduction of:				
4.2.1	A	Standard Project Team'			
4.2.2	B	Integrated Project Engineering Department'			
4.2.3	C	New Field Team'			
4.2.3	D	Quality Department			
4.2.5	E	DCIPD			
4.2.7	G	Integrated Planning + Prioritisation Management			
3.2.1.2	**Action, communication, planning (G01.02)**				
4.2.6.3	F.3	Standards for Communication	4.2.6.3	F.3-1	Continuous feedback audits (during or in between projects)
4.2.3	C	New Field Team' (project level): in terms of planning + coordination tasks	4.2.6.3	F.3-2	Final feedback + revision audit (after project)
4.2.3	D	Quality Department	4.2.7	G	Integrated Planning + Prioritisation Management'
	in terms of implementing and maintaining the quality of action, communication and planning			*to support and maintain communication + planning tasks on all levels and between all disciplines*	
4.2.5.2	E.2	Planning Team			
	in terms of supporting planning tasks				
4.2.5.3	E.3	IT-team			
	in terms of creating a platform for information exchange + integrated planning				
4.2.5.4	E.4	Competence Team			
	in terms of dynamising interdisciplinary information exchange and supoort				
4.2.7	G	Integrated Planning + Prioritisation Management'			
	to support and maintain communication + planning tasks on all levels and between all disciplines				
3.2.1.3	**Behaviour and habits (G01.03)**				
3.2.1.4	F	Revised Yard Standards	4.2.6.3	F.3-1	Continuous feedback audits (during or in between projects)
	allocation, observation, revision of current habitual processes assessment upon consequences (positive and negative)		4.2.6.3	F.3-2	Final feedback + revision audit (after project)

	Barriers			Mitigating Measure (Barrier)	
Chapter Refer.	**Index**	**Description**	**Chapter Refer.**	**Index**	**Description**
	if negative: assessment of causes + implementation of counter measures (update of yard standards) *if positive: clear definition and formulation (update of yard standards)*				
				to investigate on the effects of certatin habitual processes *analysis and assessment on positive and negative consequences* *update of Yard Standards [F]* *preparedness for future case/situation/projects*	
3.2.1.4	**"Neglect" of specialists advice (G01.04)**				
4.2.6.1	F.1	F.1 Revised 'Process of Repair'	F.3-1	F.3-1	Continuous feedback audits (during or in between projects)
4.2.6.2	F.2	F.2 Revised 'Job & position descriptions'	F.3-2	F.3-2	Final feedback + revision audit (after project)
	enhanced implementation of specialists (field eng. [C] project eng. [B], quality [D], planning + competence [DCIP] in the contract revision + quotation period of the project phase			*to investigate on the effects of the implementation of specialists* *adjustment based on positive and negative outcomes* *update of Yard Standards [F]* *preparedness for next case / situation / projects*	
4.2.7.1	G.1-1	Integrated Planning (in the project phase)	4.2.7.1	G.1-2	Integrated Planning (in the field phase)
4.2.7.2	G.2-2	Prioritisation Management (in the project phase)	4.2.7.2	G.2-2	Prioritisation Management (in the field phase)
3.2.1.5	**Feedback and communication (G01.05)**				
4.2.6.3	F.3	Standards for Communication ("latest update")	4.2.7	G	Integrated Planning + Prioritisation Management'
				to support and maintain communication + planning tasks on all levels and between all disciplines	
			4.2.6.4	F.4	Non-conformity guidelins
				to guide directing of issues to other levels/disciplines if communication failed	
3.2.1.6	**Item work list (G01.06)**				
4.2.6.1	F.1	F.1 Revised 'Process of Repair'	4.2.6.1	F.1	F.1 Revised 'Process of Repair'
4.2.6.2	F.2	F.2 Revised 'Job & position descriptions'	4.2.6.2	F.2	F.2 Revised 'Job & position descriptions'
	enhanced implementation of specialists (field [C] engineering [B], quality [D], planning + competence [DCIP] in the contract revision + quotation period of the project phase			*enhanced implementation of specialists (field [C] engineering [B], quality [D], planning + competence [DCIP] in the revision + quotation of "Change/variation orders" (field phase)*	
4.2.7.1	G.1-1	Integrated Planning (in the project phase)	F.3-1	F.3-1	Continuous feedback audits (during or in between projects)

Chapter Refer.	**Barriers** Index	Description	Chapter Refer.	**Mitigating Measure (Barrier)** Index	Description
4.2.7.2	G.2-2	Prioritisation Management (in the project phase)	F.3-2	F.3-2	Final feedback + revision audit (after project)
				to investigate on the effects of the implementation of specialists (in project phase) *analysis and assessment on positive and negative consequences* *update of Yard Standards [F]* *preparedness for future case/situation/projects*	
			4.2.7.1	G.1-2	Integrated Planning (in the field phase)
			4.2.7.2	G.2-2	Prioritisation Management (in the field phase)
3.2.1.7	**Keeping the schedule - "time constraint" (G01.07)**				
4.2.6.1	F.1	F.1 Revised 'Process of Repair'	4.2.6.1	F.1	F.1 Revised 'Process of Repair'
4.2.6.2	F.2	F.2 Revised 'Job & position descriptions'	4.2.6.2	F.2	F.2 Revised 'Job & position descriptions'
	enhanced implementation of specialists (field [C] engineering [B], quality [D], planning + competence [DCIP] in the contract revision + quotation period of the project phase			*limitation or re-distribution of key function responsibilities on the yard (e.g. field engineer who is carrying general responsibility for coordination of production performances, engineering, quality matters, safety matters, schedules and many others)*	
4.2.7.1	G.1-1	Integrated Planning (in the project phase)	4.2.6.3	F.3	Standards for Communication ("latest update")
4.2.7.2	G.2-2	Prioritisation Management (in the project phase)		*+ Feeback audits during, in between and after projects for updates of "Yard Standards"*	
			4.2.7.1	G.1-2	Integrated Planning (in the field phase)
			4.2.7.2	G.2-2	Prioritisation Management (in the field phase)

3.2.2 ENGINEERING + PLANNING (G02)

	Engineering (G02.01)				
4.2.1	A (all)	Standard Project Team	F.3-1	F.3-1	Continuous feedback audits (during or in between projects)
4.2.2	B (all)	Integrated Project Engineering Department	F.3-2	F.3-2	Final feedback + revision audit (after project)
4.2.3	C	New Field Engineering Team as to 4.2.3		*to investigate on the engineering performance* *analysis and assessment of positive and negative consequences* *update of Yard Standards [F]* *preparedness for future case/situation/projects*	
	to support engineering from the field perspective				

	Barriers			**Mitigating Measure (Barrier)**	
Chapter Refer.	**Index**	**Description**	**Chapter Refer.**	**Index**	**Description**
4.2.4	D	Quality Department			
	to support engineering from the quality assessment + control perspective				
4.2.5	E	DCIP	4.2.6.4	F.4	Non-conformity guidelines
4.2.5.1	(E.1)	*to handle engineering documentation*			
4.2.5.2	(E.2)	*to support integrated planning performances*			
4.2.5.3	(E.3)	*to provide IT support*			
4.2.5.4	(E.4)	*to support on knowledge/information procurement and support*			
4.2.5.5	(E.5)	*to implement engineering performances into traceability management system*			
4.2.6	F	Yard Standards			
4.2.7	G	Integrated planning + prioritisation management			
	to establish planning + prioritisation between engineering and the rest				
	Planning (G02.02)				
4.2.6.1	F.1	F.1 Revised 'Process of Repair'	F.3-1	F.3-1	Continuous feedback audits (during or in between projects)
4.2.6.2	F.2	F.2 Revised 'Job & position descriptions'	F.3-2	F.3-2	Final feedback + revision audit (after project)
	enhanced implementation of specialists (field [C] engineering [B], quality [D], planning + competence [DCIP] in the contract revision + quotation period of the project phase			*to investigate on the planning performances* *analysis and assessment of positive and negative consequences* *update of Yard Standards [F]* *preparedness for future case/situation/projects*	
4.2.7	G	Integrated planning + prioritisation management			
	to establish integrated planning + prioritisation between all deprtments				
4.2.3	C	New Field Engineering Team as to 4.2.3			
	to support planning + prioritisation from the field perspective				
4.2.4	D	Quality Department			
	to support planning + prioritisation from the quality assessment + control perspective				
4.2.5	E	DCIP			
	to provide the operational basis for planning + prioritisation				

Chapter Refer.	Barriers Index	Description	Chapter Refer.	Mitigating Measure (Barrier) Index	Description
3.2.3	**DOCUMENATION MANAGEMENT (G03)**				
	Organisation (G03.01)				
4.2.6	F	Revised Yard Standards	4.2.6.4	F.4	Non-conformity guidelines
	Consistency (G03.02)				
4.2.6	F	Revised Yard Standards	F.3-1	F.3-1	Continuous feedback audits (during or in between projects)
4.2.4	D	Quality Department	F.3-2	F.3-2	Final feedback + revision audit (after project)
	to support consistency acc. To applicable quality standards (regulations, client, yard, etc.)				
	Traceability + IT (G03.03)				
4.2.4	D	Quality Department			
	contract quotation support/revision from quality perspective documentation, planning/scheduling of all quality measures coordination + approval of quality inspections and NDT performances				
4.2.5.1	E.1	Documentation			
	operational foundation of traceability of documentation performances				
4.2.5.3	E.3	IT team			
	operational foundation of IT support and maintenance for any traceability performance				
4.2.5.5	E.5	Traceability support management system			
	realisation + maintenance of integrated planning integration + maintenance of IT based traceabilty systems				
3.2.4	**IT MANAGEMENT SYSTEM (G04)**				
4.2.6	F	Revised Yard Standards			
4.2.5.3	E.3	IT team			
4.2.5.5	E.5	Traceability support management system			
	realisation + maintenance of integrated planning integration + maintenance of IT based traceabilty systems				
4.2.7	G	Integrated planning + prioritisation management			
	to establish integrated planning + prioritisation between all departments				

	Barriers			Mitigating Measure (Barrier)	
Chapter Refer.	**Index**	**Description**	**Chapter Refer.**	**Index**	**Description**
3.2.5	**SAFETY MANAGEMENT (G05)**				
4.2.6	F	Revised Yard Standards	4.2.6.4	F.4	Non-conformity guidelines
4.2.7	G	Integrated planning + prioritisation management			
	to establish integrated planning + prioritisation between all departments				
3.2.6	**PRODUCTION (G06)**				
	Field Engineer (G06.01)				
4.2.6	F	Revised Yard Standards	4.2.6.4	F.4	Non-conformity guidelines
4.2.3	C	New Field Engineering Team as to 4.2.3	4.2.4	D	Quality Department
4.2.4	D	Quality Department		*counter-reaction if field engineering fails or is about to*	
	to support in general quality measures				
	to support on surveillance, inspections and approval of technical executions				
4.2.5	E	DCIP			
	to provide the operational basis for planning + prioritisation				
4.2.7	G	Integrated planning + prioritisation management			
	to establish integrated planning + prioritisation between all departments				
4.2.2	B.2	Specialists by discpline			
	enhanced cooperation between engineering/design and field engineering performance/needs				
	Trades + subcontractors (G06.02)				
4.2.6	F	Revised Yard Standards	4.2.6.4	F.4	Non-conformity guidelines
4.2.3	C	New Field Engineering Team	4.2.4	D	Quality Department
	due to division of tasks sub field engineers can concentrate on the cooperation with and coordination of trades + subcontractors			*counter-reaction if traded/subcontractors failed or are about to*	
4.2.4	D	Quality Department			
	to support in general quality measures				
	to support on surveillance, inspections and approval of technical				

Barriers			Mitigating Measure (Barrier)		
Chapter Refer.	**Index**	**Description**	**Chapter Refer.**	**Index**	**Description**
	executions				
4.2.7	G	Integrated planning + prioritisation management			
	to establish integrated planning + prioritisation between all departments				

3.2.7 QUALITY ASSESSMENT * CONTROL (G07)

4.2.4	D	Quality Department	F.3-1	F.3-1	Continuous feedback audits (during or in between projects)
4.2.7	G	Integrated planning + prioritisation management	F.3-2	F.3-2	Final feedback + revision audit (after project)
	to establish integrated planning + prioritisation between all departments				
4.2.5	E	DCIP			
	to provide the operational basis for planning + prioritisation on quality measures				

Appendix V - AHP EXAMPLE

Appendix V

Main Criteria

		Importance	
1	CLASS ST.	16,98%	
2	INTEGRITY	42,92%	
3	DELIVERY	40,09%	

Subcriteria 1 (CLASS ST.)

				COSTS (per Item)		
				BASIC	ADD.	TOTAL
1	LLOYDS	54,11%	9,19%	500,00 €	0,00 €	500,00 €
2	DNV GL	26,85%	4,56%	450,00 €	100,00 €	550,00 €
3	BV	13,63%	2,31%	400,00 €	200,00 €	600,00 €
4	ABS	5,41%	0,92%	250,00 €	400,00 €	650,00 €

Subcriteria 2 (INTEGRITY)

1	Grade 1	49,52%	21,26%
2	Grade 2	26,77%	11,49%
3	Grade 3	15,76%	6,77%
4	Grade 4	7,95%	3,41%

No of Items required:

No of Items required:
50

Subcriteria 3 (DELIVERY)

1	Delivery 1	77,61%	31,12%
2	Delivery 2	14,72%	5,90%
3	Delivery 3	7,67%	3,07%

Alternatives:

Alternative 01	CLASS	IMPORT:	COST
Subcriteria 1 (CLASS ST.)	LLOYDS	9,19%	500,00 €
Subcriteria 2 (INTEGRITY)	Grade 1	21,26%	
Subcriteria 3 (DELIVERY)	Delivery 2	5,90%	

Alternative 02			
Subcriteria 1 (CLASS ST.)	LLOYDS	9,19%	500,00 €
Subcriteria 2 (INTEGRITY)	Grade 3	6,77%	
Subcriteria 3 (DELIVERY)	Delivery 3	3,07%	

Alternative 03			
Subcriteria 1 (CLASS ST.)	DNV GL	4,56%	550,00 €
Subcriteria 2 (INTEGRITY)	Grade 3	6,77%	
Subcriteria 3 (DELIVERY)	Delivery 1	31,12%	

Alternative 04			
Subcriteria 1 (CLASS ST.)	BV	2,31%	600,00 €
Subcriteria 2 (INTEGRITY)	Grade 1	21,26%	
Subcriteria 3 (DELIVERY)	Delivery 1	31,12%	

			CRITERIA 01										CRITERIA 02			
9	8	7	6	5	4	3	2	1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/8

← more important   more important →

No of Criteria: 3

CHOOSE:

CLASS ST.	↔	**INTEGRITY**	1/3
CLASS ST.	↔	**DELIVERY**	1/2
INTEGRITY	↔	**DELIVERY**	1

No of SubCriteria 01: 4

LLOYDS	↔	**DNV GL**	2
LLOYDS	↔	**BV**	4
LLOYDS	↔	**ABS**	7
DNV GL	↔	**BV**	2
DNV GL	↔	**ABS**	3
BV	↔	**ABS**	2

No of SubCriteria 02: 4

Grade 1	↔	**Grade 2**	2
Grade 1	↔	**Grade 3**	3
Grade 1	↔	**Grade 4**	4
Grade 2	↔	**Grade 3**	2
Grade 2	↔	**Grade 4**	3
Grade 3	↔	**Grade 4**	2

No of SubCriteria 03: 3

Delivery 1	↔	**Delivery 2**	6
Delivery 1		**Delivery 3**	9
Delivery 2	↔	**Delivery 3**	5

Appendix V

SUMMARY	BENEFIT	COSTS (p. Item)	COSTS (total)	RELATIVE COSTS (total)
Alternative 01	36,35%	500,00 €	25.000,00 €	23,26%
Alternative 02	19,03%	500,00 €	25.000,00 €	23,26%
Alternative 03	42,44%	550,00 €	27.500,00 €	25,58%
Alternative 04	54,69%	600,00 €	30.000,00 €	27,91%

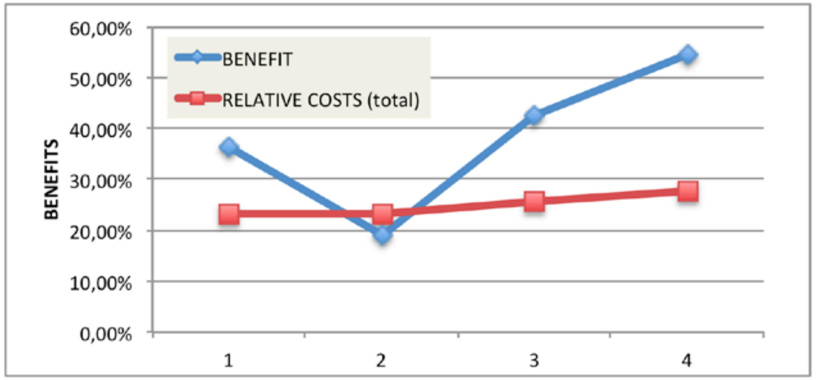


Chart 01

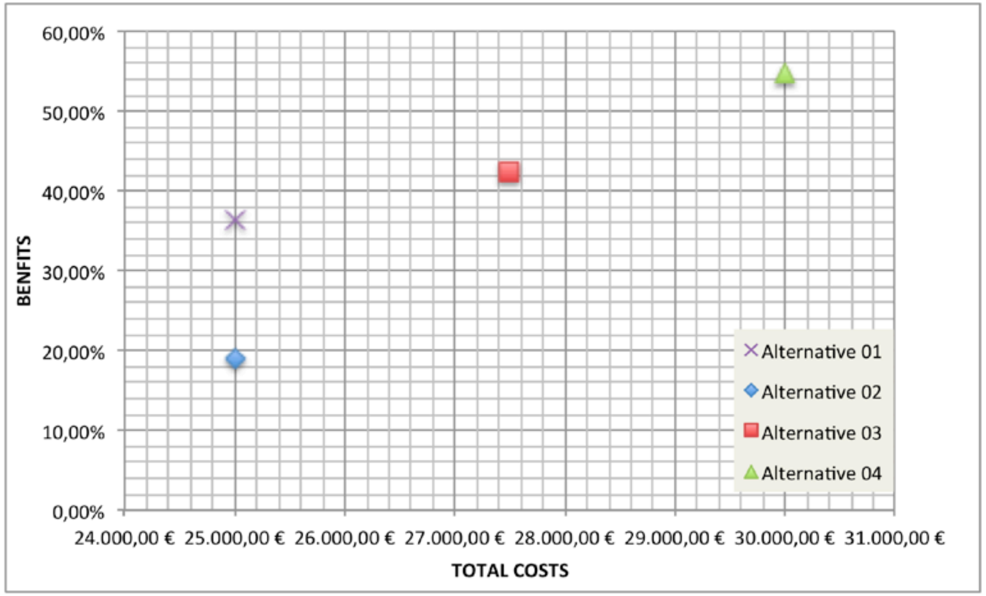


Chart 02