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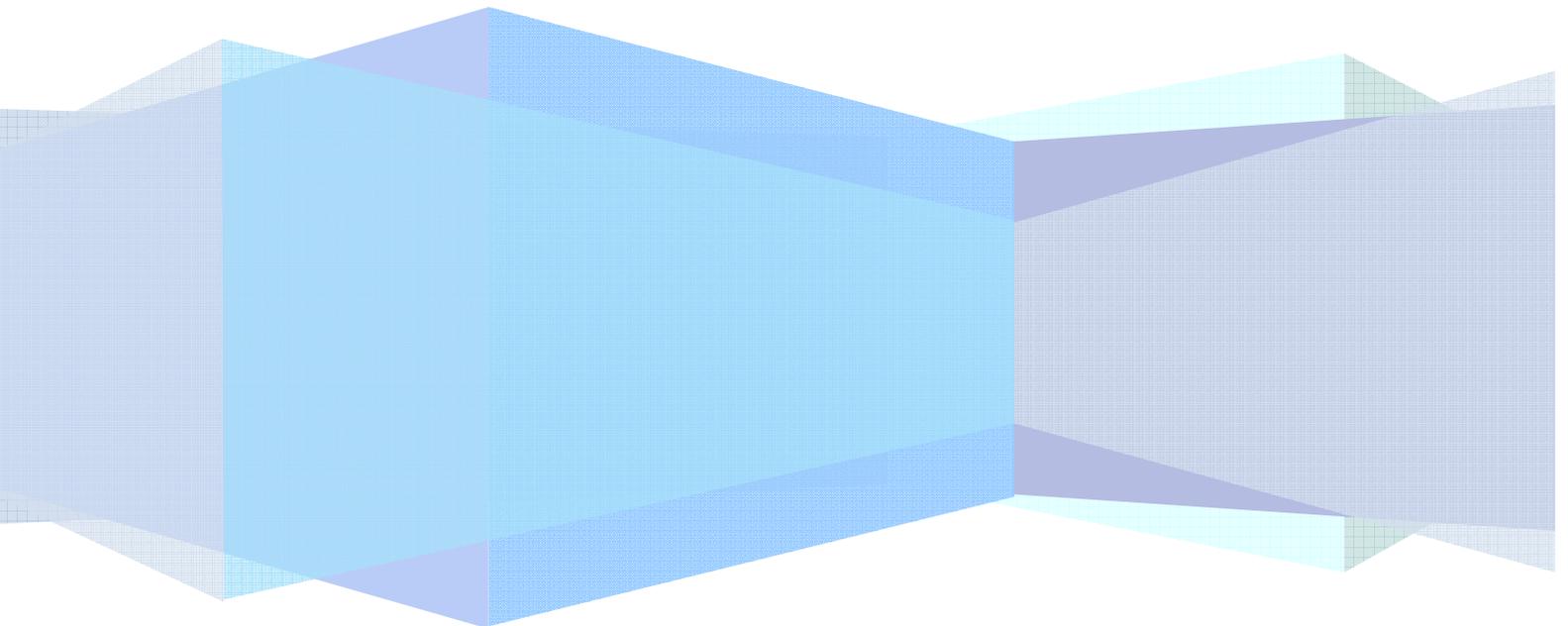
# MASTER'S THESIS

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Investigating successfulness in the CBR implementation for ConocoPhillips Norway

**Kristine Bergseth Samuelsen**



## Executive Summary

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The objective of this thesis is to investigate successfulness in implementation of a project tool called the Contingency Breakdown Report (CBR), which is a key document for project approvals at ConocoPhillips. The CBR is a document compiled in Excel and holds all the relevant cost, risk and schedule data for a project. In addition to investigating successfulness in the completion of the CBR, the processes leading up to the CBR inputs are also evaluated. Risk management and cost estimation are the essential processes, within the project, that provide the required CBR input. This study is based on two analysis methods, qualitative and quantitative analysis. The main analysis is a qualitative analysis and has been carried out by in-depth interviews and questionnaires. The quantitative analysis is a statistical analysis, of the data held in the CBR, supporting the qualitative analysis. The analysis results are presented individually.

This thesis provides a description of the CBR and the associated processes. Composing this description was a great help in understanding what the CBR is and why it is a tool that has been focused on greatly in ConocoPhillips. As well as providing a greater understanding this basis has also contributed to building an interesting and relevant interview guide and questionnaire. Understanding the CBR was important in figuring out where the most essential data, that could provide an answer to the problem statement; Has the implementation of the CBR been successful for ConocoPhillips Norway up to this point?, was and thereby the focus areas for the statistical analysis. This thesis is primarily based on the analysis results, which are gathered with the help of ConocoPhillips staff in Norway, and is complemented with relevant literature and articles. Information about the CBR, cost estimation and risk management is confidential ConocoPhillips material.

The study uncovered that, for the organization as a whole, success is achieved. However, successfulness has not been achieved considering user satisfaction and intentional use of the CBR versus the actually purpose it is serving. Implementing the CBR has meant successfulness for ConocoPhillips Norway since the CBR has become a more integrated, trusted and important tool to use in connection with the projects approvals than expected. The main reason why the users are unsatisfied and actual use and intentional use are not aligned, are the numerous and extensive changes that the CBR format has undertaken.

Early on, while performing this study, it became clear that there exist shared and strong opinions regarding the CBR. However all the CBR users in Norway Capital Projects agreed on the fact that the CBR needs to undergo strategic changes. Strategic changes with the aim of improvement and simplification are absolutely necessary for the project tool. Strategic changes or improvements that makes it easier to use, easier to understand, easier to complete, motivates the users and that adds value are: first a simplification of the CBR template followed by stability in the CBR template and a clarification of the CBR intention. Such strategic changes in the CBR are beneficial for ConocoPhillips in order to achieve successfulness. ConocoPhillips must also, regarding the CBR, focus on the most important issue, which is the contingency.

## Preface

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As a master student at the university of Stavanger it is required that you as a part of the masters degree in “Industrial Economics”, write a thesis of 30 credits. My master specialization is project management, whilst the engineering indentation is risk management. Writing a thesis in cooperation with the risk management group and cost estimation group in ConocoPhillips Norway was therefore a great opportunity to learn and get to know how project management, risk management and cost estimation are carried out in real life and also to get to know ConocoPhillips. Choosing what to write about was hard, but in cooperation with my contact person in ConocoPhillips the problem definition was determined dependent on a need to investigate a fairly new project tool, the CBR. To avoid imposed confidential requirements, specific numbers and values are left out from the included graphs in the statistical analysis.

Going through the analysis it became clear that the original problem statement was not easy to answer. The original problem statement investigated consistency in the processes leading up to the CBR input and also in the completion of the CBR. Due to the fact that it is hard to analyze and measure consistency in such large and comprehensive processes as the building of the CBR, the problem statement needed to be altered during the writing process. Nevertheless, in my attempt to investigate consistency in the processes it became clear that the aspect actually investigated was successfulness. The aspect of consistency is however, an integrated part of the final problem statement; has the implementation of the CBR been successful for ConocoPhillips Norway up to this point.

During these four months of writing I have gotten great support and guidance from my contact persons in ConocoPhillips and at the University of Stavanger. I will therefore thank my contact persons in ConocoPhillips, Ronald Dean Allred, Karl Ivar Weierød and Nathan Langton, for finding the time to provide me with relevant input, guide me in the right direction and spending valuable time contributing to improve my thesis. I would also like to thank everyone that took time out of his or her busy schedule to contribute with valuable input for my analysis. Finally, I would very much like to thank my advisor at the University of Stavanger, Kristin Helen Roll for always finding the time to help and guide me throughout the process of writing my master thesis.

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## Acronyms used

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Acronym	Description
CBR	Contingency breakdown report
CPMS	Capital Projects Management System
QRA	Quantitative Risk Analysis
AFF	Approval for feed
AFD	Approval for development
AFE	Approval for expenditure
FEL	Front-end-loading
FEL-0	Identify phase
FEL-1	Appraise phase
FEL-2	Optimize phase
FEL-3	Define phase
PM	Project Manager
PMT	Project Management Team
CES	Cost Estimate Summary
CEV	Cost Estimate Variance
CRE	Cost Risk Events
SRE	Schedule Risk Events
LRP	Long range plan
FIC	Facility Installed Cost
TIC	Total Installed Cost

## Introduction

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Today, projects play a big role in every oil company. There are currently several major projects, in the oil and gas industry, that are going through consideration, planning, and execution and close out. The work conducted in this industry is increasingly project based. When a company takes on a new project it also takes on large costs and risks. A company will therefore use commit sizeable resources in preparing for a project. Typical areas where resources would be assigned are procurement, planning, estimating and risk analysis.

ConocoPhillips has developed a company specific instrument to deal with risk analysis and cost estimation in projects. Prior to and during a project, ConocoPhillips use significant resources to estimate what a project will cost and the associated risks. This work is done in cooperation with the planning department in ConocoPhillips as well. All this information is put in to the Contingency Breakdown Report (CBR), which is the company specific instrument in ConocoPhillips for summarizing the basis for cost contingency for a project. The CBR is a standardized project approval document, where all the relevant information concerning cost estimation and risk analysis is included. It is a document that justifies the cost contingency value assigned to a project. There is one main user of the CBR, the risk specialist. When the risk specialist makes the CBR he receives the initial input data from the cost estimating and planning group. He then completes the CBR with the relevant risk data (probabilities and impact). The rest of the project management team use the CBR to see which risks are accounted for, escalation, foreign exchange and the summary results. It is clear that, other than the risk specialist, the CBR users mostly look into the CBR for needed data and use it for presentations and reference.

The CBR is a fairly new instrument for ConocoPhillips; it has only been applied since May 2008. And during this time it has been adjusted several times according to the need for different information. There have been 18 different CBR templates during the last 2 years, it is therefore clear that the tool is still in development. In a project there are several different stages or decision gates, and for each gate a new CBR is made. Because the CBR is such a young tool we have not had the chance to see the total effect after the introduction of it in connection with

project approvals. Projects, where CBRs, have been applied, are yet to be completed. For this reason there is uncertainty regarding if the CBRs are having a positive or negative impact. And since this is the case it will be important for ConocoPhillips at this point to see if it has been successful up to this point. The main issue to investigate is successfulness. Successfulness is defined as; Has the CBR lived up to its original intention. Thus the main problem statement is: **Has the implementation of the CBR been successful for ConocoPhillips Norway up to this point?**

To answer the problem statement the processes that lead up to the CBR inputs must be looked into as well as the CBR completion. These processes are mainly risk management, planning and cost estimation, and are very important processes in ConocoPhillips. In this thesis the focus is on risk management and cost estimation. Whether or not risk management and cost estimation is performed in a successful manner will be important to find out, because the CBR document is used from early phase throughout the execution of a project. All the calculations on cost and risk, which is applied during the project, are gathered here. If there has been an error in calculating the contingency or false estimation it can cause major negative consequences. Such negative consequences may affect the degree of achieved successfulness. False estimation or calculating errors can for example mess up the consistency degree in the processes leading up to the CBR and in building the CBR which is a way to ensure correct information and it is also essential for lead comparison and good decisions for ConocoPhillips. One apparent reason for the high focus on the CBR is that the CBR is a global document within ConocoPhillips and is compared against other investment opportunities within the company. Decisions of this type involving major values need to be based on equal and correct assumptions. It is therefore essential that the numbers are trustworthy and that the project teams can rely on the CBR to give them the correct information.

A starting point for the thesis is the fifteen Norwegian CBRs and the knowledge and experience the CBR users hold.

## Chapter 1: Presentation of ConocoPhillips

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This chapter provides an introduction of ConocoPhillips and in addition briefly clarifies aspects within the organization that are relevant for this thesis (Such as premise cost, contingency definition, percentiles used, CPMS guidelines, the different decision gates and the different estimation phases).

ConocoPhillips is an international, integrated energy company. It is the third largest energy company in the United States, based on market capitalization, and oil and gas reserves and production. Worldwide it is the sixth largest publicly owned energy company, based on oil and gas reserves, and the fifth largest refiner. The company's financial performance is clearly significantly affected by developments in the price of oil and gas, as well as changes in exchange rates, particularly as regards the US dollar (ConocoPhillips Norway Annual Summary report 2009, 2010).

The top management in ConocoPhillips is seated in Houston, and every sub-organization has to report to Houston. Houston Capital Projects has implemented guidelines that are to be followed by all capital project groups around the world. These guidelines are called CPMS and stands for Capital Project Management Standards. For risk management, cost estimation and CBR fabrication a specific CPMS document exists. CPMS was introduced in order to ensure consistency and transparency throughout the processes within the Capital Project organization and for the organization externally. The guidelines are necessary for achieving company-wide consistency and need therefore be applicable globally. There are different types of CPMS documents such as policies, management standards, technical standards, key procedures, procedures, tools & guidelines and templates (CPMS Overview, 2008).

ConocoPhillips in Norway is the largest foreign operator on the Norwegian continental shelf. The main office is located in Tananger right outside Stavanger. In the Tananger office 1900 people are employed (ConocoPhillips Norway website, 2010). Exploring for and production of oil and gas is the main activity for ConocoPhillips and core values as safety and protection of health, environment, material and financial assets are greatly focused on. The company is also pursuing a zero philosophy for injuries and critical incidents. In ConocoPhillips Norway the capital project

organization is to deliver projects that are safe, transparent, predictable and competitive (CPMS Overview, 2008). Figure nr.1 provides more detail on these objectives.



Figure nr.1: The ConocoPhillips way (CPMS Overview, 2008)

The main area for ConocoPhillips activities in Norway is the Greater Ekofisk Area where ConocoPhillips is the operator. Ekofisk is located in the North Sea, southwest of Stavanger. The Ekofisk Area consists of four ConocoPhillips operated fields. Two pipelines to terminals in Teeside, England and Emden, Germany transport the oil and gas. In addition to Ekofisk, ConocoPhillips have interests in the Eldfisk, Embla and Tor fields and assets in non-operated fields such as Heidrun, Statfjord, Visund, Oseberg, Troll, Grane, Alvheim and Huldra (ConocoPhillips Norway website, 2010).

The Capital Projects Group in Norway is a significant part of the organization and the CBR is an important tool used in connection with project approvals. In a ConocoPhillips operated project there are several things happening; onshore as well as offshore, independent of each other as well as dependent of each other, within the operators organization as well as in the contractors organization etc. During the lifetime of a project, from planning through execution and to close

out, there are many unknown events that can occur, there are several possibilities to make mistakes and the world is in constant change. Some specific examples are; design changes, technical errors, government regulations or requirements and inaccuracy. It is therefore not hard to see why a fund or reserve in addition to the expected cost is needed in case of an unforeseen event. This fund, reserve or buffer for the unexpected events is called contingency, and in ConocoPhillips the CBR document details how the contingency amount is established. Contingency has the purpose of increasing the chance of completing the project within budget. The expected cost is only the best estimate of what costs should be realized on average and is therefore not sufficient if any unexpected events should occur because then a contingency fund is required (Chapman, Ward, 1997). The three following definitions sum up what contingency is and also how ConocoPhillips see contingency.

*“Contingencies are buffers to reduce the probability of exceeding average values when asymmetric penalties are involved” (Chapman, Ward 2002, page 271)*

*“Contingency is a provision for those uncertainties in the estimate basis which are likely to occur but whose impact cannot be identified at the time the estimate is prepared” (Caddy 1993)*

*“The contingency value is the difference between the calculated average value, in the CBR labeled the approximate P50, and the premise value” (ConocoPhillips definition)*

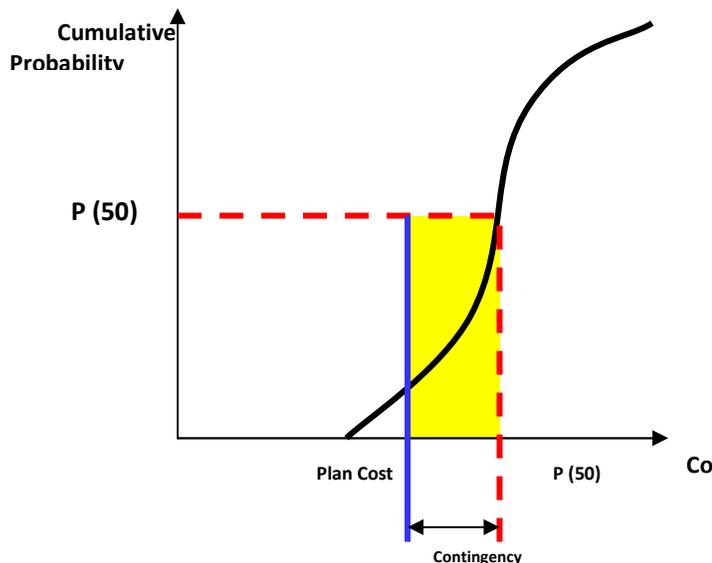


Figure nr.2: Contingency (CPMS Contingency Management Procedure, 2007)

Figure nr.2 show that contingency is defined in ConocoPhillips as the difference between the

P50 value cost and the premised cost. The premise cost is the best estimate if no risks occur. The premise also provides a reasonable expectation of project costs for a fixed scope of work, executed in a predictable fashion, in the current environment. In ConocoPhillips the projects funding is approved at a P50 level. A percentile in general is a measure of how much data is below or above the given value. A P50 percentile in ConocoPhillips is the calculated median value that the project will cost. ConocoPhillips has set the value that they want to achieve project cost within as the P50 value. We have a 50% chance of achieving project costs within and above this value, provide the risk impact given an optimistic outcome. The ranges around the P50 value are the P10 and P90 values; these ranges show how much cost is likely to vary around the P50 value. The P10 value tells us that there is a 10% chance of completing the project with costs that are under this value and a 90% chance of an overrun. The P90 value tells us that there is a 90% chance that project costs will be less than this value, but a 10% chance that costs will exceed this value. This is the pessimistic outcome (Contingency Management Procedure, 2007).

The project group is assigned a stretch target to deliver the project at its premised cost plus variances, but the commitment is made at P50 level to increase chance of completing the project within budget. To the degree, which the contingency fund is used, depends on the target set by the company. Targets must reflect the opportunity aspect of risk, and what we are aiming for (Chapman, Ward 1997). Chapman and Ward (1997) claim that if optimistic targets are not aimed for, expected costs would not be achieved on average, and contingency funds will be used more often than anticipated. ConocoPhillips target is the P50 level and this gives the project a 50% chance of completing within budget. One could discuss whether or not the target should be set more ambitiously; say at a P40 level in order to achieve completion cost at a lower level. The P50 level is established for the total company portfolio based on all world-wide projects and it is expected within ConocoPhillips to achieve the P50 level for a large project portfolio. However the contingency consumption also depends on what happens during the project lifetime. As previously stated the contingency is a reserve that is needed in case of an unforeseen event and the consumption will therefore vary a lot from stage gate to stage gate and from project to project.

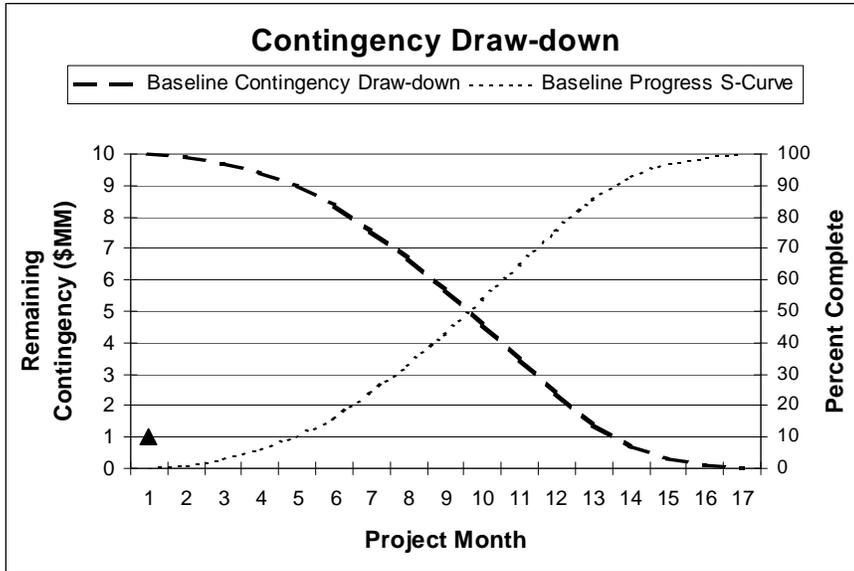


Figure nr.3: Contingency draw-down (CPMS Contingency Management Procedure, 2007)

The curve shown in figure nr.3 reflects the remaining risk since the contingency is established based on risks. The graph shows that the remaining contingency is decreasing whilst percentage of completion of the project is increasing as we proceed on the project time line. For the project management teams (PMT) this is a helpful graph in connection with the project, the graph shown in figure nr.3 makes it easier to control, manage and be aware of the contingency. The contingency value can be as much as 20 percent of the project cost, in large projects this cost element amount can be quite significant, and it is therefore natural that it plays a big role in every project and that it is controlled during the project. Monitoring and controlling the contingency during the project lifetime is important; this is done in a contingency draw-down curve as shown in figure nr.3.

Before a project is started several decisions need to be taken and in ConocoPhillips there are decision gates for this. The gates are AFF, AFD and AFE; this is also the order in which they follow. In addition to decision gates they are also called approval gates, funding gates, sanction gates and stage gates. AFF means approval for feed and provide information that supports understanding of the economic basis of the project (AFF Gate Guide, 2007). AFD means approval for development and initiates project development. AFE means approval for expenditure and the AFE is the funding mechanism that initiates project execution. The AFE can also be understood as a contract between management and lower organization that defines scope and

performance deliverables (cost, performance and schedule) for the project (CPMS Overview, 2008). For the cost estimation group the project is divided in to phases called FEL, which means front- end- loading. These gates are related to the decision gate for the project, this is shown later on in figure nr.6. FEL-0 is the identifying phase, FEL-1 is the appraise and selection phase, FEL-2 is the optimizing phase whilst FEL-3 is the defining phase.

## Chapter 2: Introduction of the CBR

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This chapter provides a more thorough review of the CBR; this document is meant to facilitate key discussions between the users, the project teams, project services and corporate management. Whilst explaining the CBR it is natural to provide a description of the processes leading up to the CBR input. The cost, planning and risk group provides the input in the CBR. Risk analysis and cost estimation procedures are described in order to understand the processes that are most focused on in this thesis and that lead up to the CBR input and thereby the completion of the CBR. This thesis is investigating successfulness in connection with the implementation of the CBR for ConocoPhillips Norway. Cost estimation and risk management, which includes risk analysis, therefore constitute an important part of the analyzing process

### 2.1 Purpose

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The main purpose with the CBR is to substantiate the projects contingency requirements and to facilitate discussions on the types of risks and mitigation efforts undertaken. The CBR is designed to present the risk profile of the project to the senior management in a fully transparent review format and is also used to measure the success of a project compared to the risk assessment. When deciding to sanction a project the CBR provides for a consistent document to compare the project to other investment opportunities within ConocoPhillips. The CBR is prepared by the risk specialist when a project approaches a decision gate or execution review point (CBR Definitions and guidance v8, 2009).

## 2.2 CBR users

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The CBR is used by many different parts of the ConocoPhillips organization, and is for that reason alone an important document. I have categorized the different users as primary and secondary. Primary users are; the risk specialist who is the principal user of the CBR and members of the risk and cost estimation group. The risk group provides the risk input to the CBR, whilst the cost estimating group provides the cost input and in addition need the CBR to gather information on the contingency value and the P50 schedule for escalation. The primary users are, to a high extent, involved in the processes around the CBR such as the risk assessment, the cost estimation and the making of the CBR. There are several secondary users. The project team uses the CBR to see which risks should be prioritized in the mitigation process and to find the contingency required. Corporate planning needs the CBR to find spends by year, by currency and the expected contingency. For the corporate management the CBR is a project summary document and is used to monitor, compare and control the projects. Investment appraisal wants information on the unescalated cash flows, range of capital outcomes, and range of milestone dates. The secondary users use the CBR mainly for reporting purposes and presentations, but also to collect needed information and as a reference tool since all the important information is gathered in the CBR. It is clear that the primary users have the most valuable input on the processes around the CBR, they also work with the CBR to a higher extent than the secondary users do (CBR Definitions and guidance v8, 2009).

## 2.3 Structure

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In this chapter this thesis will clarify how the CBR is built and how the different inputs are processed. There are several sections to the CBR and these are explained further in this chapter of this thesis. The different sections to the CBR are as follows: Header, cost estimate summary (CES), cost estimate variance assessment (CEV), risk event, escalation, foreign exchange (FX) and summary.

### 2.3.1 Header section

Contingency Breakdown Report						ConocoPhillips Project Development & Procurement	
<input type="checkbox"/> Pre-AFF	<input type="checkbox"/> Authority for FEED	<input type="checkbox"/> Authority for Development	<input type="checkbox"/> Authority for Expenditure	<input type="checkbox"/> Supplement/Other			
<Project Name>						SAP ID: <SAP ID#>	
<b>Project Description</b> <Project scope and status description> <Supplement: State the actual spend up to a specified date. Also, fill-in the YOVD column in the cost estimate summary section and the YOVD row in the Summary section, otherwise clear as necessary.>							
Operator <Company Name>		Currency Units	MMUSD	Cost \$ Year	2009 January	Cost Interest	100%
Date of Risk Assessment:	2-Feb-09	Project Manager:	<Project Manager Name>				
Date of Last Revision:	3-Apr-09	Risk Specialist:	<Risk Specialist Name>				
Revision Number:	Revision 1 DRAFT	Cost Estimator:	<Cost Estimator Name>				
Project Document Control#:	To be added by project	Team Members:	<QRA Attendees Names>				

Figure nr.4: Header section template, (CBR Guide, 2009)

The header section (See figure nr.4) contains basic information such as the project name, decision gate, and description of the project, SAP ID, operator, cost year, estimate currency unit, team members and date of risk assessment. The header provides descriptive information on the project and the associated funding gate and has the purpose of letting the reader know who is responsible for the project and the input data, what the project is and when this is taking place.

### 2.3.2 Cost estimate summary (CES)

COST ESTIMATE SUMMARY			COST ESTIMATE VARIANCE ASSESSMENT							
	MMUSD YOVD	MMUSD Premise	MMUSD Lo (-P10)	Hi (+P30)	Avg (+P50)	Contingency MMUSD	%EIC	Range Pot Lo (-P10)	Hi (+P30)	Comments
<b>DESIGN ALLOWANCE &amp; FEL3 CAPITAL</b>										
Design Allowance	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
FEL3 Capital	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
<b>SUB-TOTAL DESIGN ALLOWANCE &amp; FEL3 CAPITAL</b>	<b>2.0</b>	<b>2.0</b>			2.2	0.2	0.9%			
<b>SUBSURFACE</b>										
3D Seismic	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Subsurface FTEs	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
<b>SUB-TOTAL SUBSURFACE</b>	<b>2.0</b>	<b>2.0</b>			2.2	0.2	0.9%			
<b>FACILITIES</b>										
Equipment	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Materials and Bulks	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Labor	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Pipelines (incl. outside of field boundaries)	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	Note: see Labor Variance section
Site Prep	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	\$200mm export ppt, \$80 replace in-field flowlines
SubContracts	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Camp	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
<b>SUB-TOTAL FACILITIES</b>	<b>7.0</b>	<b>7.0</b>			7.7	0.7	3.1%			
<b>CONTRACTORS</b>										
Home Office & Engineering	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Construction Management	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
<b>SUB-TOTAL CONTRACTOR</b>	<b>2.0</b>	<b>2.0</b>			2.2	0.2	0.9%			
<b>SD &amp; HSE</b>										
Sustainable Development	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
HSE Capex	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
<b>SUB-TOTAL SD &amp; HSE</b>	<b>2.0</b>	<b>2.0</b>			2.2	0.2	0.9%			
<b>OWNER'S COSTS</b>										
Owner's Cost - Upstream	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
Owner's Cost - Insurance	1.0	1.0	0.9	1.3	1.1	0.1	0.4%	-10%	30%	
<b>SUB-TOTAL OWNER'S COSTS</b>	<b>2.0</b>	<b>2.0</b>			2.2	0.2	0.9%			
<b>TOTAL PREMISE ESTIMATE</b>	<b>17.0</b>	<b>17.0</b>			<b>18.7</b>	<b>1.7</b>	<b>7.6%</b>			

Figure nr.5: Cost estimate summary section template, (CBR Guide, 2009)

The cost estimate group provides input for this section of the CBR. In the cost estimate summary (CES) section of the CBR the relevant cost estimate data is included, and hence also the premise estimate as seen in the right part of figure nr.5. Premised costs do not include contingency or escalation, but can include design allowances.

The estimation is mainly based on object weight, from the early stages and through the execution phase. One example of this is when cost for a specific element built in steel is estimated, the weight in steel is basis for the cost calculation. In addition to weight, cost calculation is also based on man-hours depending on the element estimated (CPMS Cost Estimating Standard, 2007). For sub sea elements the estimation is not based on weight, rather on a specific dimension of the element, for example: length. Due to the focus on weight it is clear that weight is one of the main sources for variation and error.

At every stage gate there are different aspects on what the cost estimate is based on, there are also some requirements that need to be fulfilled and guidelines to follow. The estimation process varies, but the cost estimating team must always follow the corporate guidelines (CPMS). Cost estimating methodologies, tools<sup>1</sup> and documentation are standardized throughout the company in order to ensure that all estimates for operated and non-operated projects that are going through approval gates (AFF, AFD and AFE) are reviewed in a consistent manner and at the same level of detail. These standards will also ensure consistency in the cost estimating process. For each stage gate the estimates shall be developed in accordance with a list of aspects and factors that need to be included in the deterministic estimate. There are, for example, some requirements regarding how much engineering work that needs to be completed, to help define the project and ease the estimation. The detailed overview given in figure nr.6 of these standards; accuracy, engineering and contingency requirements are provided to steer the estimate in the specific phases. During the lifetime of a project, from planning phase to execution phase ConocoPhillips provide several cost estimates, one for each CBR at each stage gate (CPMS Cost Estimating Standard, 2007). From figure nr.6 we can see the connection between different FEL levels and the different stage gates.

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<sup>1</sup> For information on cost estimation tools see Appendix nr.3

## CE Classification / Approval gates

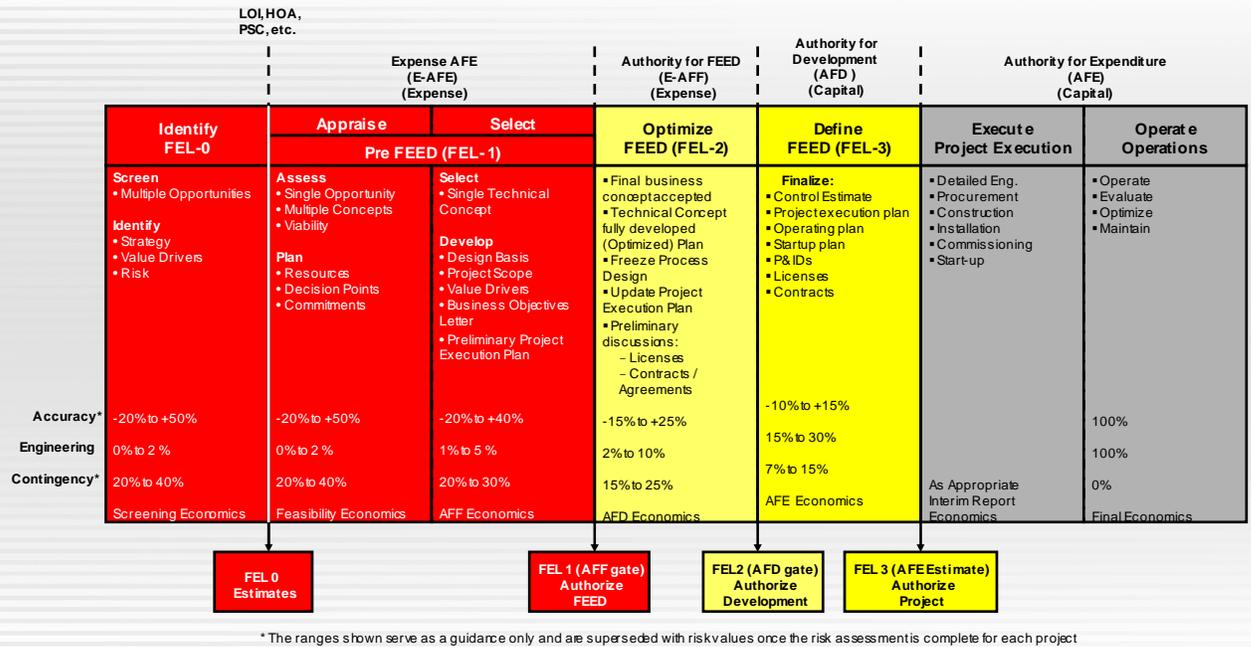


Figure nr.6: Requirements for estimation, (CPMS Cost Estimating Standard, 2007)

Early on the project estimates are based on very broad objectives and limited information, at AFF the estimate is prepared after a single development concept has been selected, at AFD the estimate is prepared after the single development concept is optimized. The AFE estimate is prepared to support full project funding. Except for the early decision gate, there are requirements on typically how much engineering work that should performed. There are also requirements on how accurate the cost estimate should be at the different stages. Estimate prepared at AFE shall become the Original Approved Phase Funding, and is used as a reference for the remainder of the project. The objective with these requirements or standards given in figure nr.6 is:

- Consistency  
The requirements are a way to ensure greater consistency in methodology and use of recognized best practices to improve predictability of estimates.
- Implement estimating practices  
Having these requirements as a basis and a check list will encourage estimating practices that fully reflect the likely total installed costs (TIC) of capital projects from early definition phase through execution.
- Provide common understanding  
Using the standards given in figure nr.6 a common understanding of the quality and accuracy of cost estimates expected at each approval gate is achieved (CPMS Overview, 2008).

When computing the cost estimate there are several issues that needs to be taken in to consideration. Previous projects of similar nature are a natural starting point; prior experience can be utilized to establish norms and assumptions. Quantities of different materials and the price of these materials will depend on the project and market situation and is of course conclusive in the computing. The quality of scope is also essential and in addition issues such as: Foreign exchange, number of bidders, base date, procedures and deliverables, benchmarking, contract strategy, new technology, productivity and wages should be considered.

When estimating cost the two main strategies used In ConocoPhillips are “Top-down” and “Bottom-up”. The main strategy at the early stages is to use “Top-down” estimation. This strategy is applied from FEL-0 (Identify phase) to FEL-1 (Appraise phase) (See figure nr.6). This means that the estimation starts with the superior product, and the estimate for the lower level components is calculated as a percentage of the main estimate. For example we start with the platform and then estimate the cost of building elements as a percentage of the superior cost. At later stages, FEL-2 (Optimize) and FEL-3 (Define), a “Bottom-up” estimation strategy is adopted. This method uses the components at the lowest level and makes an estimate for each component. Then these component estimates are put together to form a high level estimate (CPMS Cost Estimation Standards). The input in the CES section is the main contribution from

cost estimators in the CBR<sup>2</sup>. The input have the same format for every gate and every project, but as described above the input is based differently for the various gates and different types of projects (CPMS Cost Estimating Standard, 2007). The CES section only includes the detail level sufficient to accommodate the different risk ranges shown in the cost estimate variance (CEV) section. The CEV section is introduced in the following chapter.

### 2.3.3 Cost estimate variance (CEV)

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Along with the cost estimate we have the CEV assessment. In figure nr.5 the CEV is the right part of the figure. It details the estimating uncertainty for the premised cost. The CEV-section should include pricing variance and variance that could result from cost estimating methods and data sources. This section also provides us with information about the range percent. The low and high range percent value provides the source values for the calculations that determine the low (P10), high (P50) and average cost (P50) values. The low and high percent values represent the accuracy of the cost estimate. This range should become smaller during the project's lifetime, due to the rise of detail level later on in the project. Cost values should be expected to vary within the range specified, for the exact scope specified, assuming no problems with the execution method, and in the current environment. The contribution, of the specific cost elements as a percentage of total installed costs (TIC), is also included here.

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<sup>2</sup> After the cost estimate is finished, the costs are loaded into a cost loading matrix (an Excel spreadsheet) before the numbers are imported into the CBR. This is done to simplify the process of importing the numbers before a fully resourced schedule is prepared in execution.

### 2.3.4 Risk Event Section

The risk event section is split into two parts, cost risk events (CRE) and schedule risk events (SRE).

COST RISK EVENTS					
<Risk Description>			0.9	4.0%	<Risk description. Include additional risk information, explain premise assumption >
As Premised: <Define premise assumptions>	0.0	30%			<Provide additional commentary on alternative outcomes and explanation of >
<Description of alternative outcome>	1.0	50%			<impact level calculation and probability.>
<Description of alternative outcome>	2.0	20%			
<Risk Description>			1.5	6.7%	<Risk description. Include additional risk information, explain premise assumption >
As Premised: <Define premise assumptions>	1.0	50%			<Provide additional commentary on alternative outcomes and explanation of >
<Description of alternative outcome>	2.0	50%			<impact level calculation and probability.>
All Other Cost Risk Events	0.0	100%	0.0	0.0%	<List names of the risks in the lower 20% of risks for this section.>
<b>COST RISK EVENTS SUBTOTAL</b>			<b>2.4</b>	<b>10.7%</b>	

Figure nr.7: Cost risk event section template, (CBR Guide, 2009)

Risk events are discrete elements that have a probability of occurrence and an associated impact on cost and/or schedule. In ConocoPhillips risks are defined as an event or condition that may or may not occur that will have a positive or negative effect to a task or project. For a risk to be valid it must be possible to describe a cause, state the estimated likelihood of occurrence and state the impact upon the project, and this will be plotted into the Risk event section of the CBR. To simplify reading of the risk data the CBR quantifies risk events as if they have discrete outcomes. For some risks this is a proper characterization, but it is a simplification of risks that have a continuous distribution of outcomes. The probability gives the likelihood of the outcome.

Risk events are categorized as cost risk if the principle mechanism of impact is on cost (CPMS CBR Guide, 2009). Cost risk can be described in cost terms, but may also have secondary schedule implications. Figure nr.7 shows that this section of the CBR provides us with a description of the risks nature as well as showing most likely impact. This section is split in labor uncertainty and cost risk events. Labor uncertainty is included in the latest CBRs to highlight the impact of key estimating variables associated with labor. The quantification of labor uncertainty is similar to the quantification method used for risks. In early stage projects, where there is little information about labor rates, the labor section is excluded.

Schedule risk events can be described as having a definitive impact on the schedule that results in secondary cost implications. Schedule risk events are identical to cost risk events except for that it has an impact in schedule terms. In the CBR the schedule risk events are presented in the exact same way as the presentation of the cost risk events in figure nr.7. In both the CRE and

SRE section there are normally comments provided to each risk event, so that the reason for why it is taken into account is obvious. This can be seen in figure nr.7 on the right side of the figure.

The risk group provides the input for the risk event section by performing a risk analysis. A major part of risk management<sup>3</sup>, which is one of the important processes leading up to the CBR input, is analyzing the risks. The primary aim of the risk analysis is to support capital projects in capturing, articulating and analyzing their cost and schedule risk. This is done by identifying the risks, developing integrated risk models by using a software tool called Primavera Risk Analysis<sup>4</sup> (PertMaster), recommending and justifying the appropriate contingency requirement, making sure corporate requirements are followed and constructing the CBR. The process is iterative and all aspects of the process will be built upon during the current phase of the project. The risk management process is thus not a closed system, for instance the risk analysis results should be used to inform the project, which in turn may change both the priorities of risk effort and risk management plan for the subsequent phase.

The risks are categorized in the CBR to ensure that risks are being captured in key project areas. The different categories are shown in figure nr.8 on the following page.

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<sup>3</sup> The complete description of risk management is provided in Appendix nr.4

<sup>4</sup> See Appendix nr.5 for information on Risk management tools in ConocoPhillips.

## Categories of Risk

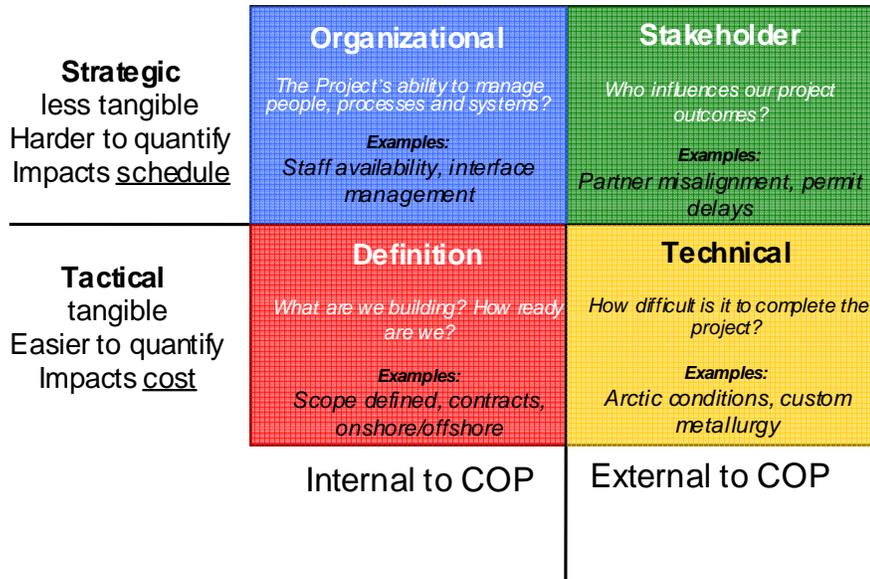


Figure nr.8: Risk categories – a description (Risk workshop slides, 2008)

The different categories for risk are organizational, stakeholder, definition and technical. Figure nr.8 shows that definition and technical risks are easy to quantify and have impact on cost, whilst organizational and stakeholder risks are harder to quantify and primarily impacts schedule. Definition risk is risks that cover insufficient definition of work or materials. Technical risks cover the complexity of the project; the risk of weather is also included here. Stakeholder risks are the risks that occur due to external events such as new government regulations or partner requirements. Organizational risks are external risks such as the market situation and the financial situation in a partner company (Risk Management Presentation, 2009).

From figure nr.8 it is clear that in the cost risk event section there should be more definition and technical risk, whilst in the schedule risk event section the presence of organizational and stakeholder risks should be highest.

### 2.3.5 Schedule Variance

SCHEDULE RISK SUMMARY				Contingency		Comments
SCHEDULE RISK VARIANCE				MMUSD	%EIC	
	Lo (P10)	Hi (P90)	Avg (P50)			
None	0.0	0.0	0.0	0.0	0.0%	<Description of included risks.>
None	0.0	0.0	0.0	0.0	0.0%	<Description of weather risks and impacts to project.>
<b>SCHEDULE RISK VARIANCE SUBTOTAL</b>				<b>0.0</b>	<b>0.0%</b>	

Figure nr.9: Schedule Variance section template (CBR Guide, 2009)

Schedule variance (SV) arises from duration estimation uncertainty in the deterministic schedule. Figure nr.9 shows how the SV section in the CBR is, how much contingency the SV section contributes with and comments. In ConocoPhillips uncertainty is the normal variance on task duration or a cost line that represents that some tasks may take less or more time than planned for no specific reason. Variation on task duration or a cost line that has a specific reason is recorded as risks. The uncertainty is normally represented by a three-point estimate showing the minimum, most likely and maximum durations or cost (Risk Management Presentation, 2009). In figure nr.9 the three point estimate is the P10, P50 and P90. This variance section will only be included if a schedule-risking tool, such as PertMaster<sup>5</sup> is used.

<sup>5</sup> PertMaster (Primavera risking tool) is one of the tools used in risk analyzing, for more information on risk analyzing tools see Appendix nr.4.

### 2.3.6 Escalation and Foreign exchange

<b>ESCALATION</b>		GPS LRP DEC 09		GPS LRP MAY 09		<b>Comments</b>
<b>Year</b>	<b>Percent of TIC</b>	<b>Weighted Per Ann.</b>	<b>Escalation MMUSD</b>	<b>Weighted Per Ann.</b>	<b>Escalation MMUSD</b>	
2009	0%	0.0%	0	0.0%	0	<Unescalated Costs by Class are scheduled according to the P50 schedule.> <Costs are escalated on the basis of the P50 schedule.> <In the escalated range of final TIC costs, prorate the escalation consistent with the contingency range, if the escalation is not calculated by another more accurate means for the range.> <Unused escalation scenarios and foreign exchange currencies listings should be clear from the CBR form.>
2010	0%	0.0%	0	0.0%	0	
2011	0%	0.0%	0	0.0%	0	
2012	0%	0.0%	0	0.0%	0	
2013	0%	0.0%	0	0.0%	0	
2014	0%	0.0%	0	0.0%	0	
2015	0%	0.0%	0	0.0%	0	
<b>Total</b>	<b>0%</b>		<b>0</b>		<b>0</b>	

Figure nr.10: Escalation section template (CBR Guide, 2009)

Figure nr.10 represents the way that escalation is presented in the CBR. Escalation is the practice of converting today's NOK into the actual NOK required to complete the project over the expected timeframe. Escalation indicates the proportion by which costs are expected to rise or fall from year to year for the same category of goods and services. Escalation is applied in accordance with corporate guidelines; these guidelines will be mentioned in the comment section of figure nr.10. The comment section highlights exceptions as well. The purpose of releasing corporate approved cost estimation rates is to ensure a consistent approach to industry inflation, reflect cost trends systematically and accurately in a project, and link cost to company approved oil prices (CBR Definitions and guidance v8, 2009). The LRP (long-range plan) cost escalation rates are provided for 22 separate categories to provide a higher level of granularity for more transparency into the aspects of cost that are expected to change. These 22 categories come in under the following wide themes: Equipment and bulks, chemicals and catalysts, labor and drilling (CPMS Cost Estimating Standard, 2007).

The CBR provides the foreign exchange section to highlight the potential impact of foreign exchange assumptions on the project cost. Transactions in foreign currency are recorded at monthly exchange rates determined by the market rate at the beginning of each month. The selected scenario is always the current corporate LRP rates applicable in the year of the CBR.

### 2.3.7 Summary section

The final section of the CBR is the summary section; this is where all the key data is collected.

The summary section includes contingency summary, cost summary and range summary as seen in figure nr.11.

<b>SUMMARY</b>														
	Gross		Gross	Net	% of		Uneso FIC	Eso. FIC	Spread	Spread%	Drilling/Other	TIC	AFE Gate	1st Prodn
<b>Contingency</b>	MMUSD	<b>Costs</b>	MMUSD	MMUSD	FIC	<b>Range</b>	MMUSD	MMUSD	MMUSD	of P50	MMUSD	MMUSD	Date	Date
Variance Contribution	17	Premise	17.0	17.0	75.6%	P10	16.0	16.0	3.3	-17.1%	16.0	16.0	1-Jan-09	1-Jan-09
Cost Risk Summary	2.4	Contingency	5.5	5.5	24.4%	<b>P50</b>	<b>19.3</b>	<b>19.3</b>	--	--	19.3	<b>19.3</b>	<b>1-Mar-09</b>	<b>1-Mar-09</b>
Schedule Risk Summary	14	Escalation	0.0	0.0	0.0%	P90	22.5	22.5	3.2	16.6%	22.5	22.5	1-Jun-09	1-Jun-09
Modeling Adjustment	0.0	VOID	0.0	0.0										
<b>Total Contingency</b>	<b>5.5</b>	<b>FIC</b>	<b>22.5</b>	<b>22.5</b>										
		Drilling	0.0	0.0										
		TIC	22.5	22.5										

<b>P50 Total Facilities Installed Net MM USD</b>	<b>22.5</b>
<b>P50 Total Installed Cost Net MM USD</b>	<b>19.3</b>

Figure nr.11: Summary section template (CBR Guide, 2009)

#### 1. Contingency Summary

Contingency is the main focus of the CBR, contingency is the difference between the P50 value and the premise value as stated in chapter 1. The summary section of the CBR focuses therefore on contingency. Before the explanation of the contingency summary is provided in this section it is beneficial to sum up how contingency is determined in ConocoPhillips.

Allocating money to meet costs that exceed the P50, the contingency fund, defines a “level of commitment”. The contingency is a change to meet the commitment. To determine this “level of commitment” there are several things that needs to be carried out; an assessment of the perceived threats and the extent to which these can be covered by a contingency fund, an assessment of the implications of both over- and under achievement in accordance to the commitment (Chapman, Ward 1997). In other words the calculation of contingency should be done in a systematic approach, and take into evaluation the project risks and associated consequences they may have on project costs.

In ConocoPhillips contingency is determined depending on size and scale of the project, financial exposure to the company and the decision stage gate of the project. It should also be a result of the cost estimate and risk analysis; usually a range-based approach is applied in ConocoPhillips. A range based approach uses the cost elements as a starting point. The risks associated with

these cost elements are evaluated and are used to establish a cost range. One range-based approach may include the following steps: Prepare base estimate, develop cost breakdown structure, select risk profiles, identify major cost drivers, assess the impact of cost drivers, calculate range values, identify correlation between cost elements, run simulation<sup>6</sup> (Monte Carlo<sup>7</sup>), analyze results. A range-based approach provides a solid back up for the contingency in the way that it documents the process of determining the contingency and the data collection (Caddy, 1993). And is the main strategy used in oil and gas projects

The contingency determination is based according to the stage gates as mentioned above. This information is provided in CPMS guidelines, which are corporate guidelines that provide the different disciplines within ConocoPhillips with standards and requirements to follow. Contingency shall be determined based on a high level quantitative risk analysis (QRA<sup>8</sup>) that takes technical definition, analogs and potential foreseen risks into consideration. For AFD and AFE the contingency determination is split depending on the size of the project. For small project, projects that have a net value<sup>9</sup> of less than 75MM<sup>10</sup> dollars, contingency shall be determined on the basis of the estimate, technical definition maturity<sup>11</sup> and the appropriate guidelines. While for large projects, net value higher than 75MM dollars, the QRA shall provide a cost cumulative probability distribution as an output. Based on this distribution contingency appropriate to achieve a P50 figure shall be set (CBR Guide, 2009).

In the contingency summary, the contribution to contingency from each source of risk is shown and added up, together these contributions amount to the total contingency for the project. The total contingency also takes the modeling adjustment into account. The different contributors to total contingency are labeled as approximate P50 values, however these values are closer to average cost impacts than P50. In ConocoPhillips the corporation funds projects at a P50 level and since the total contingency value is closer to average cost than the P50 cost this needs to be

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<sup>6</sup> See Appendix nr.4 for explanation of Monte Carlo simulation.

<sup>7</sup> Monte Carlo simulation is used in ConocoPhillips due to the fact that there are no sufficiently good simulation alternatives when the models contain a high amount of variables that are interlinked.

<sup>8</sup> See Appendix nr.4 for figure and explanation of QRA

<sup>9</sup> The net value means the cost for ConocoPhillips

<sup>10</sup> MM stands for million.

<sup>11</sup> This means how much knowledge ConocoPhillips have about the technical issues.

adjusted, this is the modeling adjustment. The risk specialist converts the mean values to a “true” P50 value based on a Monte Carlo simulation<sup>12</sup>.

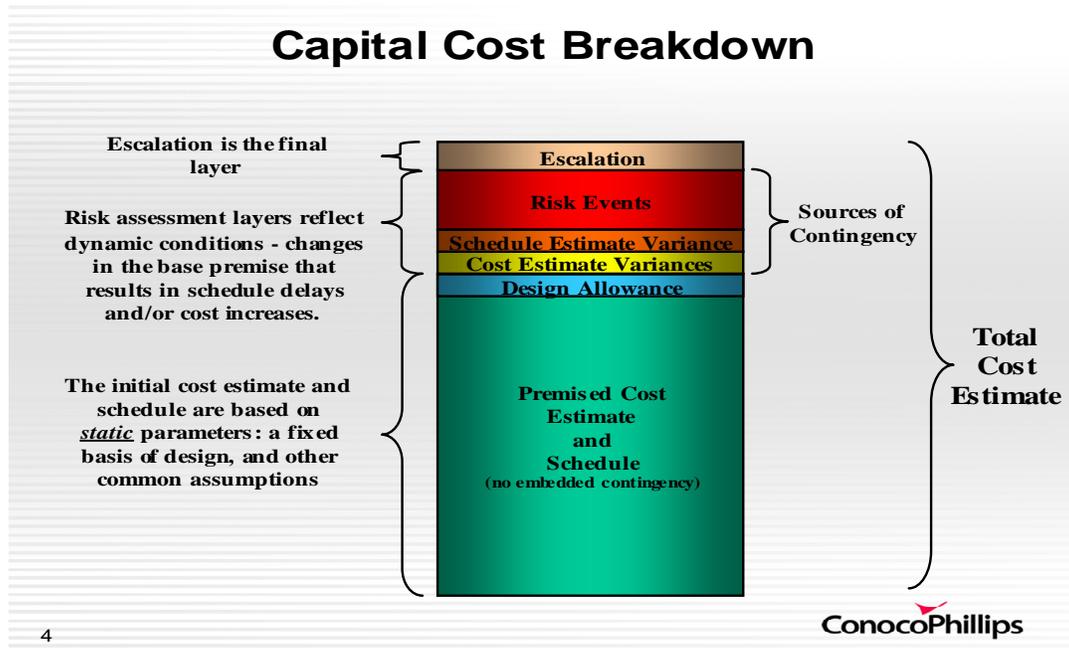


Figure nr.12: Sources of contingency (Risk Workshop slides, 2008)

Figure nr.12 shows the sources of contingency in addition to the capital cost breakdown structure. The sources of contingency are, as shown in figure nr.12, risk events (CRE and SRE) and variance (Cost and Schedule).

## 2. Cost Summary

The cost summary, see figure nr.11, shows the premise cost, which is also found in the Cost Estimate section at the top of the CBR, the contingency value and the amount of escalation. Together the premise, contingency and escalation value amount to the total installed cost (TIC). TIC is the total cost of the project with the costs of drilling included.

<sup>12</sup> See Appendix nr.4 for an explanation of the Monte Carlo simulation.

### 3. Range Summary

---

The Range Summary shows the range of possible Facilities Installed costs<sup>13</sup> (FIC) and Total Installed cost (TIC) outcomes for the project given the risks identified. Figure nr.11 show how the range summary is presented in the CBR. The ranges are shown as percentile values; P10, P50 and P90, and show how far from the P50 value the high and low outcomes are likely to vary. The range values are generated with a Monte Carlo simulation model of costs, schedule and risks; the risk specialist does this.

### 2.4 Summary

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The introduction of the CBR has shown that the CBR document entails a lot of information regarding the project. In addition to very essential information the CBR contain descriptive and practical information relevant to the specific project that the CBR is built for. With this presentation of the CBR and the cost estimating and risk management processes the aim was to give a basic understanding of what the thesis is investigating successfulness in and why successfulness will be important for ConocoPhillips.

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<sup>13</sup> FIC is the sum of premise, escalation and contingency without the cost of drilling included.

## Chapter 3: Data collection and use of method

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With this chapter the objective is to give the reader a brief introduction to the methods that are available, the methods that are applied in this thesis, why the different methods are chosen and also how the data is collected. In addition to what methods are chosen, a brief explanation of how to analyze the data gathered by the chosen methods will be given.

My aim is to apply and use the chosen methods as a tool, or as a procedure to solve my problem, gather relevant information and analyze the data correctly.

### 3.1 Method – definition

---

A method is basically a tool to achieve an answer to the problem statement.

There are two main types of methods; quantitative analysis and qualitative analysis. To answer different questions different methods are used; quantitative methods refer to *how much of a kind* and qualitative methods to *what kind* (Kvale, Brinkman 2009). A quantitative analysis is a numerical analysis, where the procedure often is predetermined prior to the analysis. The relation between variables is studied and the approach is numerical, while the qualitative analysis is more about understanding the studied phenomenon (Troost 1997). A qualitative analysis is a much more flexible research method than the quantitative analysis since the procedure cannot be definitely predetermined and the analysis can be adjusted as we go along according to the researchers' wishes.

A quantitative analysis and a qualitative analysis can be used separately or be combined.

### 3.2 Choice of method based on data

---

It is essential that the method of choice is able to assist this thesis in solving the problem. The problem statement is the starting point for the research, so the problem statement should therefore be taken into serious consideration before the choice of method is made. When we look into the problem statement which is; has the implementation of the CBR been successful for ConocoPhillips Norway up to this point, we must consider how we shall collect relevant information/data and what kind of data is needed to solve this problem. There are two types of data: quantitative and qualitative. Measurable data is data that is countable, easy to categorize and that gives a numerous result; called quantitative data. Data that accounts for the qualitative skills within the interview object is called qualitative data (Larsen 2007).

According to Larsen (2007) the characteristics of the study objects should be accounted for when choosing a method. In this study the CBR is the main object of study. The CBR is a compound project tool, consisting of a lot of data that is provided by the cost estimation group and the risk management group. Characteristics of the CBR, the study object for this thesis, are of both a qualitative and quantitative form. Numbers, that are included in the CBR, are of a quantitative form whilst the processes leading up to these numbers contain data of a qualitative form. The numerical data given in the CBR presuppose a quantitative analysis. Data on the qualitative form is in this thesis, the thoughts, opinions and attitudes the CBR users hold. Since the experiences and knowledge within the CBR users are helpful in answering the problem statement of this thesis, a qualitative analysis is the right choice of method in addition to a supportive quantitative analysis.

As mentioned previously a qualitative and a quantitative analysis can be used separately or they can be combined. A good reason for combining the two methods is according to Larsen (2007) that by using them together the strengths of one method can balance out the weaknesses of the other method. In answering my problem definition it is essential that both the qualitative and quantitative aspect regarding successfulness is investigated, this is not only important but also necessary to be able to answer the chosen problem statement. Applying these methods together will balance out the weaknesses of the methods, increase the reliability of the analysis, make the results comparable, and hopefully provide an answer to my problem; has the implementation of the CBR been successful for ConocoPhillips Norway up to this point?

### 3.3 Methods used to collect the relevant data

---

To investigate successfulness in the implementation of the CBR for ConocoPhillips Norway, the processes providing the CBR input must also be looked into.

In searching for an answer to the main problem for this thesis, the experience and knowledge the employees possess is the key. Since the primary CBR users execute the processes providing the CBR input the relevant data will be gathered through interviews with the primary CBR users. To gather information from the secondary users a questionnaire is sent out, these answers will assist in considering if the implementation of the CBR has been successful. The secondary users will without a doubt provide a very valuable “outsiders” point of view. Analyzing the problem from both the inside and outside is advantageous.

Performing a quantitative analysis on the numbers in the CBR, to see if the numbers show the expected trends, will be helpful in finding out if the CBR implementation has been successful. The quantitative analysis is carried out as a statistical analysis.

#### 3.3.1 Qualitative interview

---

One of the main advantages with this type of research is that the interviewer and interviewee meet face to face, and as an interviewer I should attempt to make it as equal as possible to an every day conversation (Larsen 2007). During a face-to-face interview it will be easy to ask follow up questions, maybe discover aspects of the problem that should be investigated more and avoid confusion.

Prior to the interviews I prepared an interview guide (See Appendix nr.1), this to help me remember to cover all the relevant themes. To guide the interview I had a few questions and in addition some key words that was relevant to the questions. The interview questions were sent out to the interview object one day prior to the interview. The interview scene was a closed office where the interviewees could speak freely. The interviews were recorded and written down immediately afterwards, so that relevant thoughts, associations and opinions were captured. Analyzing the data though, takes place first when all the data is gathered.

Selecting the different persons to interview came as a natural consequence of the CBR. The CBR affect many people in ConocoPhillips, but only a few of these work closely with it and know the potential upsides and downsides regarding the corresponding processes. Clearly it was only profitable to perform an in-depth interview with the persons working closest with the CBR. And due to the fact that the risk specialist builds the CBR, two in-depth interviews were undertaken with him.

### 3.3.2 Questionnaire

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A standardized questionnaire (See Appendix nr.2) was used to gather information. The questionnaire was sent out to the secondary users by mail. The questions were open so that if the project managers had any valuable thoughts around the questions they could easily provide these. Even though an open question requires greater motivation to answer than a closed question, according to Larsen (2007), closed questions with predetermined reply alternatives could lead to important input being left out. I therefore chose to ask open questions, but the project managers also had the opportunity to just choose predetermined alternatives without any extra explanation. I choose to leave them with this opportunity because of their busy time schedule and thereby encourage greater participation.

To get a relevant selection of interview objects, my contact person in ConocoPhillips made a selection of project managers that would provide valuable feedback.

### 3.3.3 Statistical analysis

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The CBR is filled with numerical information. With a statistical analysis performed on the main sections, using well-known statistical techniques as average, variation and standard deviation the goal is to investigate if the numbers match with the set expectations. The set expectations are formulated as hypotheses and are computed in cooperation with the risk specialist. To be able to see if the numbers in the CBR match the trends the data is manipulated, sorted and systematized in graphs.

### 3.4 How to analyze the data

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There are many ways of analyzing data and the results are of course very dependent on the researcher. Even though choosing the right research method for gathering information is essential, it is more important that the gathered data is understood and analyzed in the correct manner. If the analysis is poorly performed it makes no difference how well the researcher have managed to collect relevant and valuable data. In this section a rough description of the analysis process follows.

#### 3.4.1 Method of analyzing

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Regardless of choice of method, a general perception is that if we simplify, categorize, systemize and summarize the data this will ease the analysis process. As stated by Kvale and Brinkmann (2009) to analyze means to separate something into parts and elements, which was exactly what I attempted to do first. While systemizing, the irrelevant data should be excluded. After the irrelevant data is left out it is natural to start the analysis and search for typical patterns, tendencies, trends and reasons why. The quantitative analysis is easier to carry out than the qualitative analysis due to the fact that we have numerical data, which is provided in the CBR. But the same procedure of categorizing, systemizing and summarizing is followed for both methods. And since there are no strict rules or procedures, the rest of the analyzing process for this thesis are dependent on the type of data.

Due to the fact that two types of qualitative analyses with the same objective have been performed it is natural to evaluate these results together. And these results will be evaluated and analyzed on the basis of three different aspects that affect the CBR users perceptions; experience, motivation and mood<sup>14</sup>.

Throughout the analyzing process I will keep the goal for the thesis clear in mind so that the results will provide a relevant answer to the problem statement.

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<sup>14</sup> The reason for why this is the case is explained in chapter 4.1 and how this is done is explained in chapter 5.1.1

### 3.4.2 Reliability and validity

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Even though there are no strict rules, two main criteria is basis for analyzing the results (Trost 1997). The results are analyzed based on reliability and validity. According to Kvale and Brinkmann (2009) reliability is the consistency and trustworthiness of a research account. Measures to ensure reliability in the analysis process has been discussions with and guidance from both the risk specialist and risk team leader at ConocoPhillips Norway to ensure that the right questions are asked. Using both a qualitative and a quantitative method is also a step in securing reliability. And I have strived to get sufficient knowledge about the actual theme so that the correct and interesting follow-up questions are being asked in the interviews.

During an analysis process valid information is a key. By choosing a flexible method as the in-depth interview, where the questions can be altered and corrected as the interview goes a long, valid data is ensured. And we must trust that the data given in the CBRs is valid.

## Chapter 4: Theoretical basis

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In chapter 4 the theoretical basis for the analysis is presented.

The theoretical basis is supposed to assist in the process of analyzing for successfulness in the implementation of the CBR. Successfulness is hard to define exactly. Distinct persons and organizations may define successfulness completely opposite. Related to the CBR successfulness has been achieved if the intention with the CBR is attained and if the wanted and expected results occur. The original intention with the CBR was to initiate discussions around contingency and how the different risks affect the contingency amount.

Studying successfulness can become comprehensive since the processes leading up to the CBR must be looked into as well. Chosen focus aspects to delimit the analysis area in this thesis is therefore; intentional use of the CBR versus actual use of the CBR, CBR user satisfaction, complexity and stability in the CBR format, does the format encourage consistency, favorability of the CPMS guidelines and are the expected trends fulfilled.

In investigating successfulness it is important to perform a qualitative analysis to gather information from the CBR users and a quantitative analysis in order to see if ConocoPhillips Norway attains what is expected and wanted from the implementation of the CBR. A basis for the qualitative analysis must be the CBR users' personal perceptions of successfulness in connection with the implementation of the CBR, but it is also important to see if the users are satisfied. Psychological aspects are hence a natural basis for evaluating successfulness in the processes and will be described in more detail in chapter 4.1. A basis for evaluating successfulness in the CBR numbers has been computed in cooperation with the risk specialist in ConocoPhillips and is presented in chapter 4.2.

#### 4.1 Basis for the qualitative analysis

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The qualitative analysis had an aim of investigating successfulness in the processes around the CBR, which are building the CBR, estimating cost and managing risk to provide the required input. In chapter 2 the CBR was presented. In the presentation of the CBR both cost estimation in ConocoPhillips and risk analysis in ConocoPhillips was briefly presented. Chapter 2 shows clearly that the processes of building and providing input to the CBR are very comprehensive. Building the CBR, estimating cost and managing risk are demanding processes, and for that reason there are people within ConocoPhillips whose only responsibilities are performing these processes accordingly. Investigating successfulness in comprehensive and demanding processes where the people, who execute the work, play the most important roles can become very extensive and must be delimited as mentioned earlier on.

The employees are the key to finding out whether or not successfulness up to this point has been achieved since there are no end results yet to evaluate. The employees that are directly tied to building the CBR, estimating cost input and providing the risk input all have a perception of whether or not the processes have been performed with success and if the end result of the processes, the CBR has been a success. A perception is highly dependent upon the person who owns the perception. Risk management, cost estimation and CBR building are complex processes and a perception of achieved successfulness is based primarily on intellectual interpretation. This is the case since these processes are social processes, according to the definition in Kaufman and Kaufman (1996), which needs to be worked on by the person owning the perception. In other word it is not easy to see if successfulness is achieved, in order to decide on this the person has to evaluate and accommodate his or her perception. Considering successfulness within the set focus area the CBR users' subjective perception needs to be taken into account.

Perception is a process that encloses our view of the physical and social environment with basis in the impression from our senses here and now (Kaufman, Kaufman 1996). People receive input through their senses. Kaufman and Kaufman (1996) claims that we are not passive receivers when it comes to sensing the reality, we use our knowledge and concepts as basis in order to form a meaningful picture of the objects and events that surround us. For example; the risk

specialist will form an opinion about successfulness in the process of building the CBR based on his knowledge and experience.

According to Kaufman and Kaufman (1996) our perception will be affected by biological, experience, need and motivational factors and also emotional conditions. The perception subjects in this thesis are the CBR users and the perception objects are the CBRs and the connected processes. As claimed by Kaufman and Kaufman (1996) experience is a conclusive factor in regards to perception, when a CBR user looks into the activity he or she is performing a decisive set of interpretation factors dependent on the user are utilized in evaluating the perception object. The knowledge and experience is to a high degree the same among the CBR users. Education level, ability to learn and utilize the knowledge will of course differ, but in connection with the CBR all the users have been familiar with the document almost since introduction. Motivation relevant to the CBR affects our perception as well, and it is important to be aware of this so that completely false perceptions are avoided. In regards to the CBR one should be careful while considering an opinion owned by a person who has a negative attitude towards the document. His or her opinion might be just as valuable as the opinion of a person with a positive attitude toward the CBR, but the state of attitude has to be accounted for whilst analyzing. An emotional condition, which is a factor that affects our perception according to Kaufman and Kaufman (1996), is affection. Mood can have a big impact on our perception. Since it is impossible for this thesis to investigate the CBR users' mood whilst performing their work with the CBR, the mood must be considered in connection with the data gathering.

Proving successfulness in comprehensive processes, as CBR building, cost estimation and risk management, cannot be objectively proved since the processes are so dependent upon the people who execute them and for that reason the peoples' senses and logic needs to be trusted in order to investigate successfulness of the CBR implementation. Trying to find a conclusion my subjective perception must also be balanced out with the CBR users' perception to avoid unsatisfactory conclusions. Analyzing the results from the questionnaires and the in-depth interviews is based on the CBR users' subjective perceptions of successfulness.

## 4.2 Basis for the quantitative analysis

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The numerical content given in the 15 CBRs was the basis for the quantitative analysis. The quantitative analysis was performed as a statistical analysis where the numbers are gathered and manipulated in order to graphically present what is stated in the hypothesis, which are set up in cooperation with the risk specialist. The hypothesis is set up in cooperation with the risk specialist since he holds a great amount of knowledge of the CBR and what ConocoPhillips Norway expects that the number show.

If the hypotheses are proven to be true this will show that the CBR implementation has meant successfulness for ConocoPhillips Norway. The quantitative analysis test successfulness by investigating if ConocoPhillips achieve what they want, for example in terms of decreasing contingency value throughout the project, narrower ranges (P10 and P90) throughout the project, less risk impact and variance throughout the project. As previously stated while considering successfulness many aspects must be looked into, the quantitative analysis has the aim of investigating if successfulness is shown in the numerical part of the CBR.

The quantitative analysis is thus based upon common statistical techniques and a graphical presentation of the manipulated numbers given in the CBR. And the graphical presentation is afterwards looked into and compared to the hypothesis.

## Chapter 5: Analysis

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This chapter sum up the analysis results found by using both a qualitative and a quantitative method. For this reason chapter 5 is split in two main sections before the limitations of the analysis are discussed and the summary results are presented at the end. The first section will sum up the major and most important analysis, which is the qualitative analysis. Secondly the quantitative results will be presented.

### 5.1 Qualitative analysis results

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The results are based on the subjective perceptions collected from the CBR users as explained in chapter 4. 1, an interpretation of the factors affecting the perceptions is provided prior to the presentation of the subjective perception results. In the first part, where the perception factors are presented, the factors will be presented specifically for the primary and the secondary CBR users. The results from the questionnaire are also included here as previously stated in the chapter about how the data is analyzed.

The interview subjects have all been familiar with the CBR almost since it was introduced, so the knowledge among the interview objects was exceptional on this subject. And this provides a very good starting point for the analysis.

#### 5.1.1 Perception factors

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As discussed in the theoretical basis chapter, there are several factors affecting a person's perception of a process, a certain activity or a co-worker. Even though personality has a significant impact on a person's subjective perception to make a map of all the CBR users' personalities and how this affects perception is impossible and not necessary either when considering successfulness. The factors that are focused on that affect the CBR users perceptions are experience, motivation and affect (Kaufman and Kaufmann 1996).

The CBR was introduced in May of 2008 and all the primary users have been acquainted with the CBR since introduction. Experience, when it comes to the CBR, is therefore common among the CBR users focused on in this thesis. However the experience level within the business is various among the CBR users, this has affected how the statements have been emphasized. The

primary users have different responsibilities affiliated with the CBR, so the level of knowledge and working experience with the different sections will of course vary. Since this is the case, statements, from for example the cost group or the risk group, have been evaluated as an outsiders view. The secondary users that contributed with input to my thesis are all project managers (PM). The feedback from the project managers has been emphasized because they have valuable experience and also because they only use the finished product, the CBR, and their opinions are direct and honest without colouring. Coloured opinions towards the CBR will arise when users work closely with the CBR and are highly depend on it.

Motivation is understood as the decisive factor that steers and maintains the CBR user's demeanour when it comes to the CBR. However when analysing the results and investigating successfulness, motivation is understood as the coloured opinions that the interviewees have towards the CBR. To be able to be aware of the coloured opinions as a researcher, it was important that I had knowledge of the interview objects prior to the interviews. The interviews revealed for example that the risk group, who is highly involved in the CBR, had very positive opinions whilst the cost group and the project managers were more wavering. Perception of the CBR and of successfulness will be dependent on this type of motivation and motivation of this sort has therefore carefully been taken into account when considering the statements from the various CBR users.

Affection in terms of mood can affect the CBR users' perception or the stated opinions on the day of the interview. During the in-depth interviews it is somewhat clear to see what kind of mood the primary users were in, thoughts around this was written down after the interviews and has been helpful in evaluating the perceptions. During the interviews it was noticeable that the primary users took time out of their busy schedule, but they were in a good mood independently. The questionnaire was answered by mail so the secondary user's state of mind is unknown and not considered while evaluating their responses.

The three different factors of perception; experience, motivation and mood, are important aspects to be aware of when studying and evaluating subjective perceptions. The factors have been decisive in the weighting of the gathered perceptions, functioned as basis for evaluating and analyzing the collected data and are incorporated in the following results.

### 5.1.2 Measures of successfulness

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As previously stated in the theoretical basis chapter successfulness is in this thesis measured against four different aspects; intention, format, CPMS guidelines and user satisfaction. Accordingly the analysis results are presented and discussed in agreement with the five measure of successfulness.

#### *Intention*

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Since successfulness is defined as the coherence between intentional use of the CBR and actual use of the CBR, the original CBR intention must be presented in detail. The intent with the CBR was to have discussions around contingency, how the different risks affect the contingency amount and also to ensure consistency in contingency assessments<sup>15</sup>. And the CBR should make it easy to compare projects, one should be able to track and look back on.

The intention with the CBR was originally clear from the corporate side, but since the document has greatly evolved the intention is not necessarily the same today as it was for over 2 years ago. During the lifetime of the CBR it has greatly evolved, it has been altered 18 times and gone through major changes three times. The intention has however been held constant and has not been altered in accordance with the changes. It must be mentioned that the changes have come as a natural consequence of Houston requirements and has not been planned. The original intention is not necessarily the most suitable for the CBR document after the extensive changes. The areas of use have also become wider than what was expected, since the document has been integrated and focused on very highly in projects. The motivations of the users are dependent on a clear intention, a high value in every aspect of the CBR and coherence between the intention and the actual purpose it is serving. For the implementation of the CBR to be considered as successful the original intention must fit the purpose the CBR is serving.

A common perception among the CBR users is that a clear intention is essential for the users in terms of motivation. The reason for a common wish for a clear intention or a more suitable intention is as stated motivation, but also to be able to avoid confusion. Confusion among the users originates when the CBR is used outside its purpose without a good reason or explanation for why this is the case. All the users agreed on the fact that the CBR has exceeded the original

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<sup>15</sup> The aspect of consistency is discussed in the following “measure of successfulness”-section about format

intention, because the areas of use have become wider than what was expected and that the CBR has become integrated and focused on very highly in projects. The data collected from the CBR users revealed that the use of the CBR is extensive and outside its original intention. Outside its original intention the CBR is used; for presentation, as reference, as a communicating and reporting tool.

All the changes in the CBR format; new sections added, original sections altered, new ways of categorizing risks and handling risk have made the first and the latest CBR hard to compare. The intention of starting the right discussion around contingency is achieved with the CBR implementation and has not been affected by the changes in format. One of the main purposes for implementing the CBR was to compare, track and be able to perform “look back”- audits. The CBR users all agree that the changes have made the comparison difficult. There exist shared opinions among the users of whether or not success is achieved. The primary users within the risk group say that success is absolutely achieved because the CBR has exceeded the intention and became a more important document than ever expected. Other users however claim that the lack of coherence between intentional use and actual use gives no reason for believing that success is attained even though the CBR has turned out to be a very useful project tool.

The CBR implementation had an original purpose and intention. Implementing a new project tool is hard and it is not easy to please all the users. The CBR has however exceeded its original intention and has become a more important project tool than ever expected. Even if the original intention does not fit the exact purpose it is serving that is no reason for claiming that successfulness is not achieved in my opinion. The reason for this is that the CBR has become such an important project tool and is utilized by a lot of users and serves several purposes in addition to making sure that the right discussions are taking place.

I mean that a renewal of the CBR intention and a clarification of the areas of use could nevertheless be very beneficial for ConocoPhillips in order to avoid confusion around areas of use, let the users understand the purposes it is serving and increase the users’ motivations.

## *Format*

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Successfulness when it comes to the CBR format is that the CBR is applicable, understandable and adds consistency. The CBR is compiled in Excel and there is a strict format to follow when building the CBR. Using a strict format makes the CBR the same for every project, this to ease the comparison between projects and ensure consistency. There is little room for flexibility and creativity; this is without a doubt one of the greatest contributors to ensure consistency with regards to the CBR and the connected processes. A clear motivation for constructing the CBR was consistency. An important aspect is the fact that the CBR is compiled in Excel, Excel is easy to use and very many have knowledge of it, but at the same time the threshold for making mistakes is very low.

There has been several and extensive changes in the CBR template as mentioned earlier. These changes have of course been decisive for the stability in the format but they have also had an impact on format complexity and consistency. From the first template until the one that is utilized now the complexity has increased, it is truly hard for a person who is unfamiliar with the CBR to adopt it without a thorough explanation and a good statistical knowledge. In addition to the increase in complexity, new sections have been added and original sections have been altered. Not all sections are perceived as valuable to all users and some are primarily for the purpose of reporting to Houston. The changes and increased complexity has taken the focus away from what is important, the contingency. To achieve success the CBR must be simplified, undergo a stable period, add consistency and every section of the CBR should add value to the project.

The constant changing in the format has not been beneficial according to the CBR users. The result of the changes has made the format more complex and requires additional effort from the CBR users in terms of new requirements and procedures to learn. All the CBR users comment that the CBR format has become too complex and that it has to be simplified in order for the CBR to be a success. A very complex format makes the CBR hard to read, understand and also less efficient to use. A cost estimator felt that to be able to understand the CBR one had to be a specialist in statistics or be part of the risk group, because they work very closely with the CBR. A common agreement among the CBR users is that the CBR is too complex, hard to understand, not easy to use if unfamiliar with the format and requires a lot of effort to handle

correctly. Due to this common perception successfulness, in terms of an applicable and understandable format, is not achieved according to the users.

Compiling the CBR is performed by a small group of people; three persons are involved in this process. The people building the CBR and providing the risk input are experienced and have good knowledge of the CBR, this does provide consistency. Errors can however occur and affect how consistent the processes are executed, such errors can easily mess up an otherwise consistent process, and errors are therefore important to catch according to the risk group. Typical errors are results of input, technical input from contractors, complexity of models, and extensiveness of required data and lack of communication. A flaw can become catastrophic if it is left undiscovered; looking over the processes performed and finding ways to detect errors is essential and contributes to ensure consistency. Errors are captured by reviews, internal reviews, question and answering session regarding the CBR, error trapping in the CBR template, quality check of the team members' work by other team members. In the situation today there are very few errors that escape the measures undertaken to discover the errors.

The CBR format requires specific input from the cost and risk group and this has to be in the same form for every project for that reason the software used to compute the input has been standardized. This means more consistency in the software used, and for that reason higher degree of consistency in the processes leading up to the CBR.

The CBR is very complex and the processes providing the CBR input are very comprehensive, and as the CBR has become more complex and more detail is required from the processes behind the data, this leads to a greater workload for the risk and cost group. More work leads to less time to focus on specific and important tasks that need to be performed, and the time aspect is clearly important when it comes to being consistent according to the primary CBR users. The more time one has to perform a task the more thorough it is performed. When changes in input data are required for whatever reason, the complexity of the format is guilty in making this an extensive process. The CBR users agree on that the format does aid consistency but at the same time the complexity of the format takes focus away from the consistency aspect. With no regards to whether or not the changes in the CBR have been necessary, the changes have not been exclusively beneficial for the consistency aspect. Success in terms of consistency is

achieved according to the CBR users and reviews, quality checks and questioning each other's work are essential in achieving this.

The most benefits will, according to the primary CBR users, be achieved if the areas of value are focused on instead of spending time focusing on less important sections such as; Escalation and foreign exchange. These sections are important for the company as a whole but there is a common perception that these sections do not add value to the project and is just another requirement from Houston.

Changing the CBR, has in my opinion, not been entirely beneficial for the format. It has not been beneficial mostly because of the fact that constant changing has lead to frustration and also required intensive effort on the users' behalf. A project tool will naturally meet some resistance at implementation, but for the users to develop a relationship with the project tool it needs to be held constant for a period of time. A stable format would let the users gain familiarity with the tool and also understand what parts should be improved and what parts should be left untouched. During the study I felt that it would be beneficial for the users to achieve such an understanding because it would let them see what needs to be simplified and why it should be simplified.

In my opinion a format that requires extensive statistical knowledge to use is not beneficial or to be considered as successful when it is supposed to be used in many different parts of the organization where the experience, knowledge and educational background among the users are various. After understanding the format and the needs and wishes of the different CBR users it became clear to me that a much simpler format could serve the same purpose. A simplification of the format would not alter the most important aspect of building the CBR, which are the processes providing the CBR input. A simplification would for that reason be beneficial in terms of making the format more understandable, encourage users to utilize the CBR and make it more applicable. The study revealed that the risk and cost group has handled changes in the CBR very professionally and the new requirements have been adapted very rapidly. Stability in the template would however in my opinion be the decisive factor in achieving success in the future.

Successfulness when it comes to the CPMS guidelines will be achieved if the guidelines are followed and if they are favourable for building the CBR and the processes leading up to the CBR input. Standardization is also a key to ensure successfulness if it is beneficial for the processes. To follow the CPMS guidelines is a goal for ConocoPhillips in order to ensure transparency and consistency within the company. Defining a minimum of expectations and requirements, and establishing common terminology and definitions a common approach to projects is achieved across the company portfolio. Such a common approach lets the project members communicate more effectively, transfer lessons learned more readily, integrate into project management teams more seamlessly and develop project systems more quickly. In addition to fixing a common approach all capital projects are periodically reviewed and audited against CPMS requirements to ensure compliance (CPMS Overview).

The guidelines do not give an exact procedure on how to perform risk management, cost estimation or how to build a CBR but they are supposed to be a standard to follow for the whole organization. The CPMS for the CBR does not give the procedure of how to build a CBR, but gives an overview on how it should be carried out. When the CPMS was introduced the cost estimating group searched them for deviation on how things are done in the Norway organization and got acceptance for their wishes to perform things in the way that it already is performed. In other words the CPMS guidelines do not affect the estimation process in the Norway organization in detail; this is also due to the fact that CPMS have copied a lot of what has been done in the Norway organization. ConocoPhillips Norway has a CPMS Norway for the risk management standard; this is a bit more detailed than the general CPMS and describes *how* to perform risk management and *what* to do in order to achieve efficient risk management instead of *when* the non-described activities in risk management are to be performed which is stated in the general CPMS for risk management.

CPMS guidelines give an overview, and some of the documents give different pieces of information of what you should do, but they do not provide much specific guidance according to the primary CBR users. The level of detail makes it easy to follow the guidelines but they do not contribute with much guidance, since there is a lot of room for variation within the guidelines. The detail level comes as a consequence of the fact that the CPMS must be globally applicable.

The guidelines are common for the entire ConocoPhillips organization and it would be very demanding to make detailed guidelines that fit every part of the organization according to the cost estimators. A common agreement among the primary CBR users is that local variations are the most important reason for why this is a challenge, and these variations will make some of the requirements in the CPMS counterproductive for some parts of the organization. According to the primary CBR users it is clear that very specific CPMS guidelines would not only be demanding to design but also to follow. General guidelines as the CPMS are absolutely useful in standardizing processes in a large company as ConocoPhillips and in ConocoPhillips Norway the guidelines for building the CBR, cost estimation and risk management is followed, all the CBR users agree on this. However, general guidelines are also the best way to implement standards and procedures according to the primary users; this is due to the important need of flexibility.

As mentioned in the previous section the CBR template has changed several times, in terms of new sections added and new demands required. The CPMS is supposed to help standardize the specific processes, the CPMS for the processes relevant to this thesis is however so high level that the changes in the template has not required any changes in the guidelines. It is a lot to demand new CPMS guidelines for every change in the CBR format, but maybe a review every year or a review of the guidelines when major changes are implemented in the CBR template should in my opinion be undertaken to see if there are deviation between the recommended approach given in the guidelines and the required approach given in the CBR format.

Considering the need for flexibility, the high detail level of the CPMS guidelines is an advantage. In my opinion there need to be a balance between standards and guidelines to follow and the need to be flexible for the specific project, so it is not certain that high detail CPMS would be preferable even though they might ensure consistency and transparency throughout the organization to a higher degree. The need for consistency and transparency must be balanced against the need to be efficient and do things in the right way. For instance in the cost estimating process the estimators need to be flexible according to the information they have access to at different times. And for the risk management it is especially hard to standardize the CPMS guidelines since the set of risks vary and are very seldom the same for every project.

The CPMS guidelines are being followed according to the CBR users and this is also shown by the recent corporate reviews and audits. Considering the detail level of the CPMS, which is very low, this is favourable for the processes performed in ConocoPhillips Norway. Standards and procedures somewhat guide the way, but variation after specific needs and wishes are accepted.

#### *General user satisfaction*

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According to Kaufman and Kaufman (1996) job satisfaction is the degree the employees experience their work as positive or negative. Relevant to this thesis, job satisfaction is the degree CBR users experience their work with the CBR as positive or negative. User satisfaction is in addition to be dependent upon the presented measures of successfulness; intention, format and CPMS guidelines also highly dependent on their subjective perceptions towards the CBR in general.

During the interviews it became clear to me that the users' satisfaction is dependent upon a clear intention, because the intention creates the expectations the CBR users have towards the CBR and also affect their motivation as mentioned in a previous section about intention. Locke's theory of value discrepancy states that an unsatisfied employee is caused by a difference between the wishes an employee has towards the job and the actual experiences the employee makes in the job (Kaufman, Kaufman 1996). Related to this thesis this can be understood as the expectation a CBR users has toward the CBR and the actual experiences the employee have with the CBR. For a CBR user who is unfamiliar with the CBR prior to implementation, the expectations toward the CBR will be based on the intention they are provided with from the corporate side. For this reason the original CBR intention will be conclusive in considering user satisfaction in addition to motivation. Format and given CPMS guidelines will also affect users' satisfaction in terms of the users being able to work easily with the CBR, handle it efficiently and having guidelines that they feel are favourable for the work they are supposed to perform. Successfulness will be achieved if the CBR users are pleased with the CBR as a project tool.

As presented previously there are many different CBR users and they are working with and are dependent on the CBR to various degrees and this will affect their perception of the CBR to a high extent. The risk group work very closely with the CBR and are very dependent on the project tool. A common perception among the risk group is that the CBR is without a doubt an

important document and that it has had a positive effect on the projects after implementation. The risk group are in general satisfied with the CBR. The cost estimators do not work with building the CBR, but they provide input and utilize it for presentations and reference. The cost estimators comment that the CBR was important, but that it has not had an entirely positive impact on the process of estimating cost. A consensus among the cost estimators is that the CBR has not affected them in a positive way, in some occasions the CBR has demanded a lot of extra work and the satisfaction is low. According to the project managers the CBR is without a doubt a very important document, but they did not agree on the fact that the implementation of the CBR has been positive for the Norway part of the ConocoPhillips organization.

To sum up user satisfaction in relation to the previously covered measures of successfulness; the primary CBR users shared a common perception; that the intention must be clarified. The study did uncover that the users wish for extensive changes in the format and long for stability, in regards to the CPMS guidelines the CBR users agreed that they were the right level of detail to be beneficial for the processes. The CBR users are satisfied with the CPMS guidelines for the CBR and the connected processes. However the CBR users were not entirely satisfied with the CBR intention and the CBR format.

In my opinion, it is clear that the people who are most involved with the CBR have almost exclusively positive opinions towards the CBR. They understand it, know why it is used and see the benefits very clearly as well as they are well aware of what needs to be changed in order to achieve more benefit. The cost estimators, who do not use the CBR as a working tool directly but provide input and sometimes use it for presentations, feel that it has become just an additional requirement for them. Just like the cost estimators the project managers see the positive effect of the CBR, but this is mostly due to the processes that it initiates, not the document itself. A conclusion to draw from this is that the people who understand every aspect of the CBR and work very closely with it see it as a very positive document, whilst the people who do not work directly with it see it as important, but not as a positive implementation although. The CBR has not entirely achieved successfulness when it comes to user satisfaction.

### 5.1.3 Summary

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My analysis shows that the CBR intention of the CBR has changed and the users wish for an updated clarification of the intention with the CBR, so that the purpose the CBR is supposed to serve is clear to all the users. Considering successfulness when it comes to format, the CBR has failed according to the users. A simplification and a stable period are preferable and would in addition to be beneficial for the applicability of the CBR also satisfy the users. A stable period is clearly favourable because constant variation in the CBR template has led to frustration and discontent among users. Discontent and frustration is not beneficial. The CPMS guidelines are beneficial for the processes of risk management, cost estimation and CBR building according to the CBR users, and the guidelines therefore contribute to the aspect of successfulness. The analysis results show that successfulness is achieved with regards to some aspects and not with regards to other aspects. The results of the analysis clearly show that in order to achieve successfulness in every aspect considered, except for the CPMS guidelines, changes are needed.

It is very hard to please every user with a project tool such as the CBR and since the qualitative analysis results are based on subjective perceptions this also became visible and affected the results. Members of the risk group are the most satisfied users. They do however hold the most valuable input on what changes should be implemented and why these changes would benefit the project tool. The cost estimators and the secondary users are a bit more wavering; they are not completely satisfied with the project tool and wish for the CBR to undergo changes.

Successfulness is not entirely achieved based on the results found in the qualitative analysis, and to achieve success change is in order.

## 5.2 Quantitative analysis results

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A reasonable starting point is the hypotheses set up in cooperation with the risk specialist. To check whether or not these hypotheses are true and searching for the reasons why is a way to see if successfulness is achieved. After discussing the successfulness with the risk specialist the result was; if the following six hypotheses turn out to be true successfulness is achieved. By combining statistical techniques with a graphical presentation the goal is to see if the numbers support the hypotheses.

Following hypotheses are expected:

1. Contingency is decreasing through the lifetime of a project.
2. The average P10, P50 and P90 are decreasing throughout the project life.
3. Considering the different sections such as schedule risk contingency, cost risk contingency, schedule variance, cost variance, the variation around these values should become narrower from stage gate to stage gate.
4. The different risks are categorized as definition, organization, technical and stakeholder. In AFF definition and stakeholder risks should have the highest presence, whilst in AFE organization and technical risk will be dominating.
5. A trend where the costs move from variance to risk events.
6. Cost risks have decreased whilst schedule risks have increased.

### 5.2.1 Investigating the hypotheses

---

In an attempt to avoid that size, complexity or maturity of the projects affect the results to highly, the various numbers have all been divided by total installed cost (TIC) or facilities installed cost (FIC) and presented as percentage. Utilizing the average value is to avoid false results due to the unequal amount of CBRs in the different stage gates.

## 1. Contingency is decreasing through the lifetime of a project.

As we want to investigate the CBR portfolio as a whole, the average contingency is presented for the different stage gates. The three main stage gates a project passes through are AFF, AFD and AFE as explained earlier. The statement in hypotheses nr.1 should come naturally from the fact that as we precede in the life of a project more information is available and there is less uncertainty. Less uncertainty means less that add to the contingency value, since contingency is the buffer for the consequences of the unknown events that may occur.

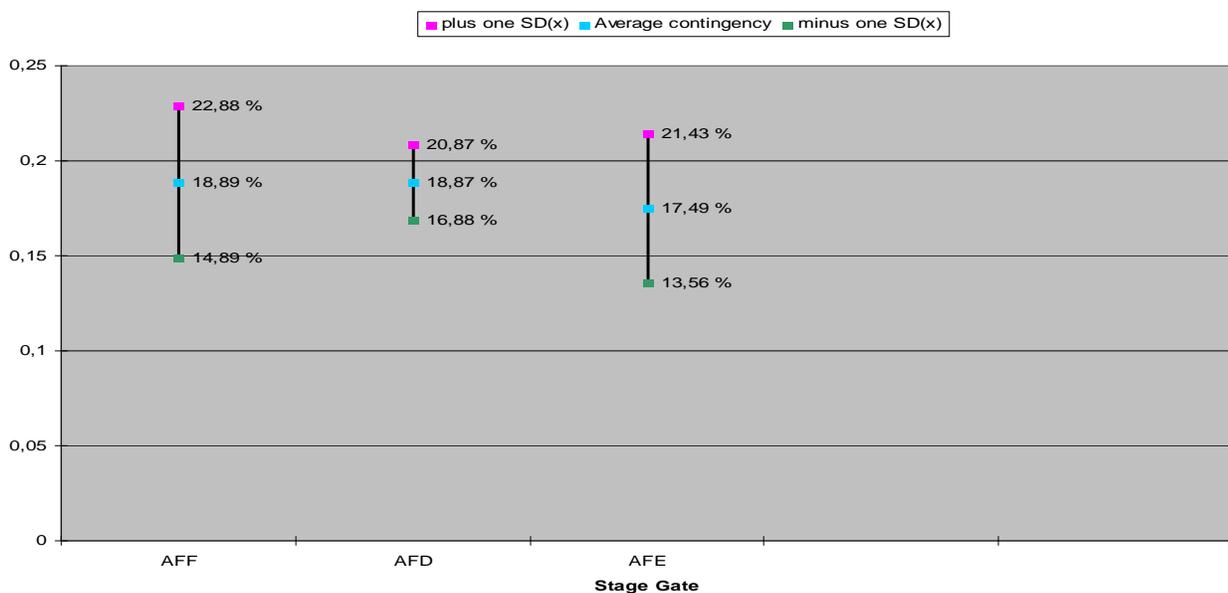


Figure nr.13: Contingency average as a percentage of FIC

### Result:

From the figure we can see that the average contingency value as a percentage of facilities installed cost (FIC) for the different stage gates are decreasing. For AFF we see that the contingency average is 18.89 %, AFD 18.87% and AFE 17.49%. Notice also that for AFE we see that the range around the average contingency increases. At this stage gate only CBRs for three projects are available and the size of one of the projects is in great disproportion to the size of the remaining two, and this causes the standard deviation to increase in comparison to AFD to AFE. However, the graph shows us that the contingency is decreasing as stated in the hypothesis and the hypothesis is true.

2. The average P10, P50 and P90 is decreasing throughout the project life.

The reason for why the P10, P50 and P90 values should decrease is the same as for the contingency value, due to the fact that we get more information the further we go in a project life, less uncertainty exists and therefore less cost.

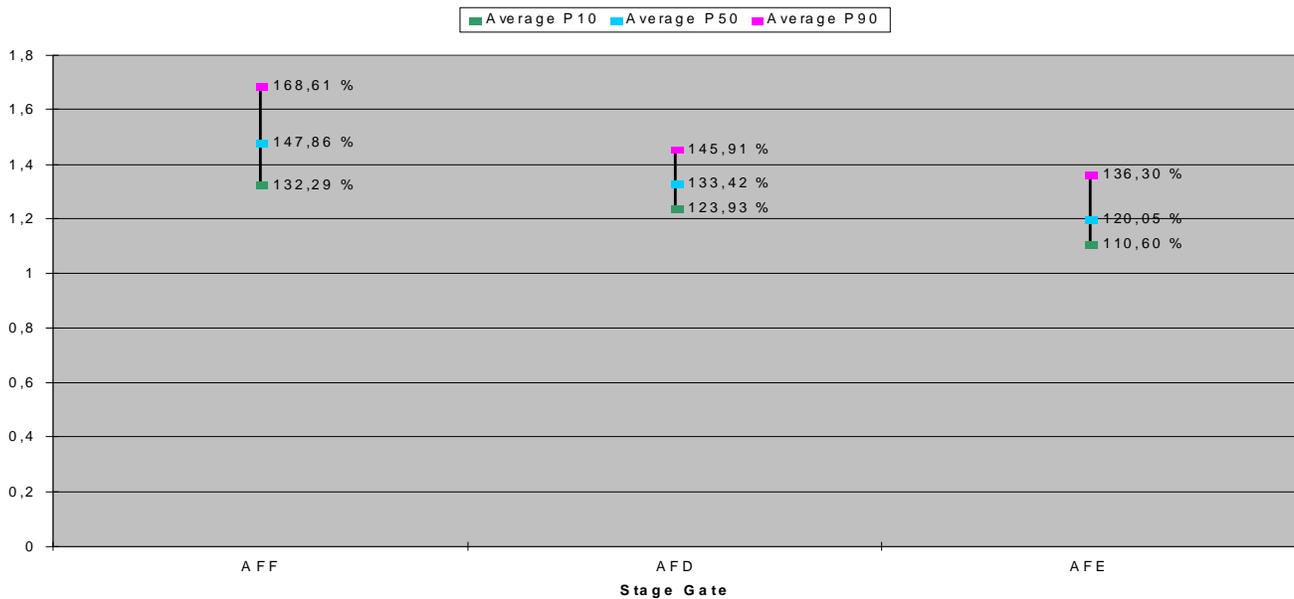


Figure nr.14: Average P10, P50, P90 presented as uplift from premise

**Result:**

Here we should look into the P10 and P90 values, which are the ranges around the calculated average value. These ranges should become narrower as well as the P10 and P90 value should decrease. More information about the project leads to greater certainty in the data and the P10, P50 and P90 should be more reliable. Narrower ranges mean a higher chance of completing the project within the wanted P50. As we can understand from the graph this is achieved.

3. Considering the different sections such as cost variance, schedule variance, cost risk contingency, schedule risk contingency, the variation around these values should become narrower from stage gate to stage gate.

As the project goes through the different gates the accuracy range becomes narrower, this hypothesis is built on the same assumptions as the two prior ones. More information leads to less uncertainty and higher reliability.

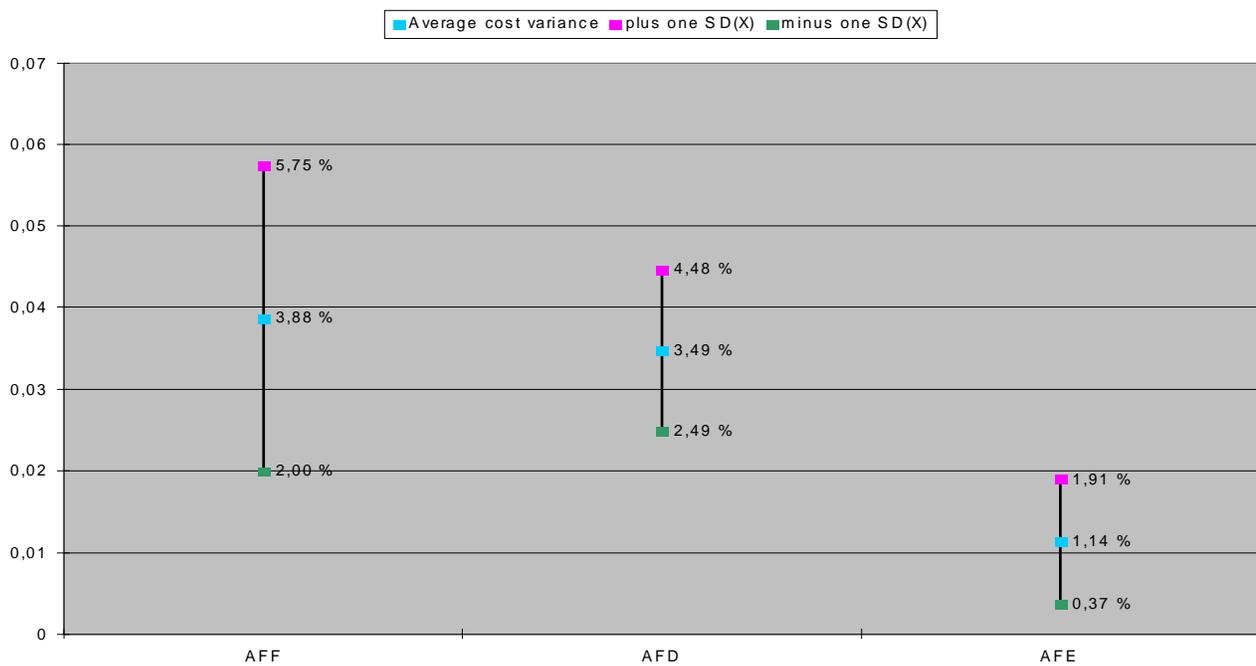


Figure nr.15: Cost variance

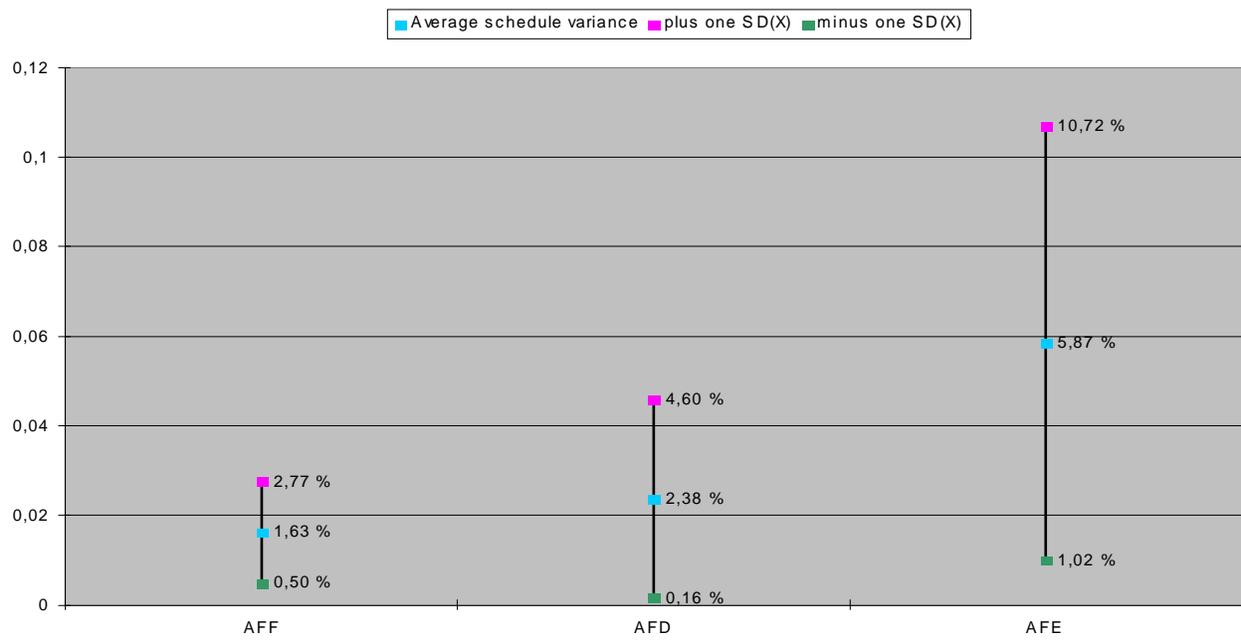


Figure nr.16: Schedule variance

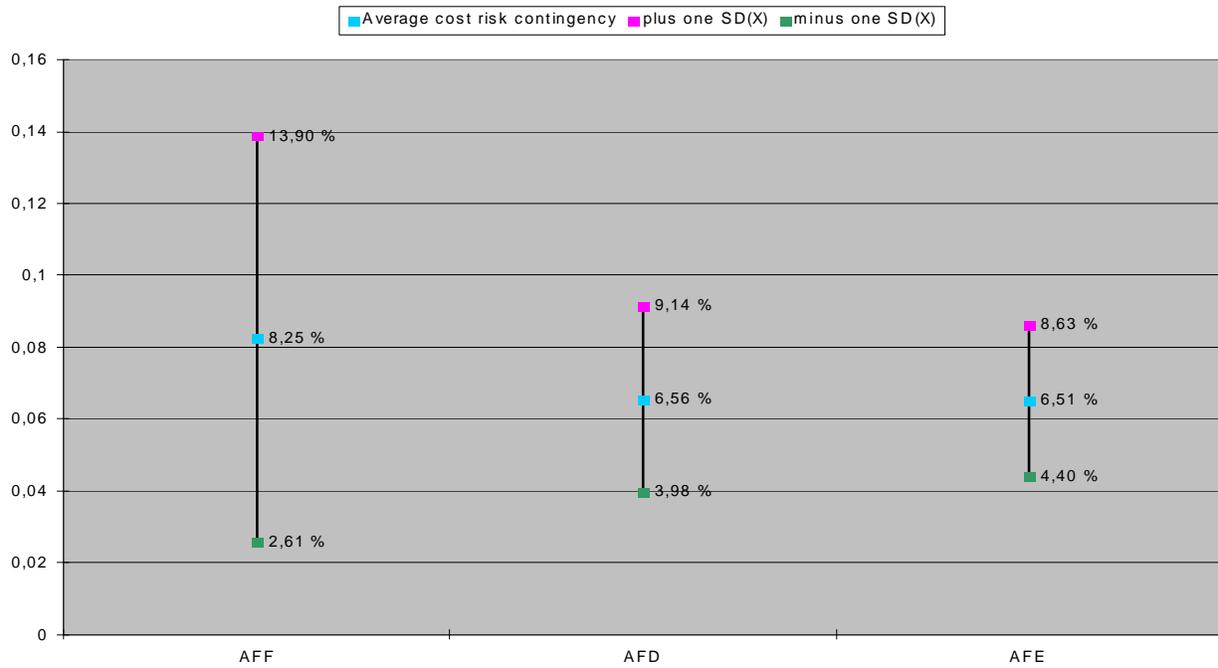


Figure nr.17: Cost Risk contingency

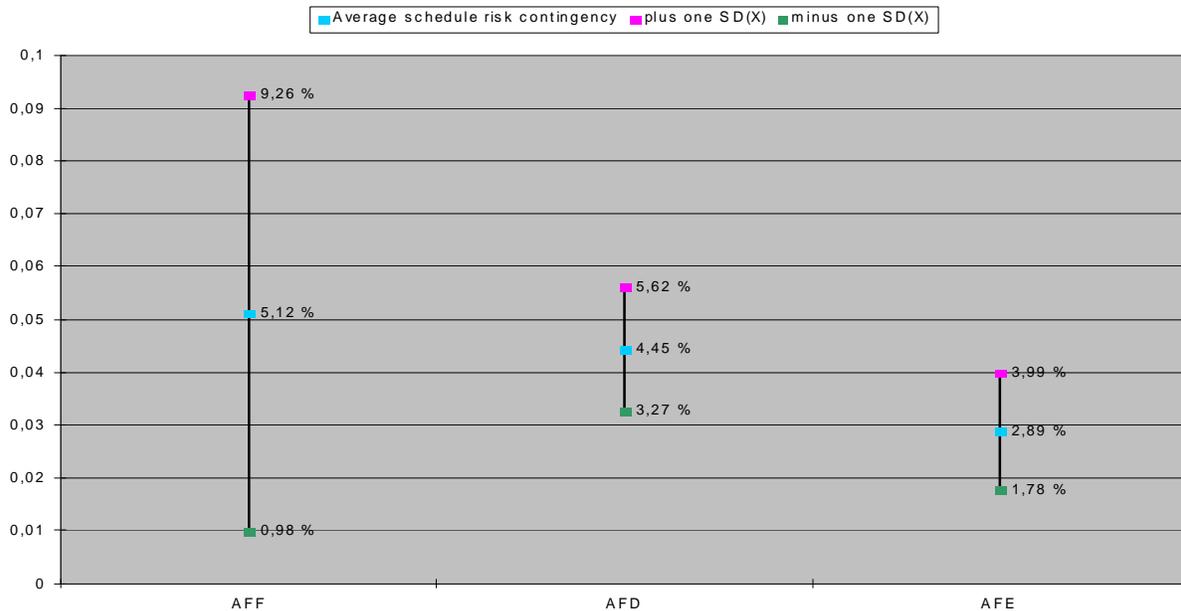


Figure nr.18: Schedule Risk contingency

#### Result:

From the graphs we can see that the various sections, except for Schedule variance support the hypothesis. The schedule variance section does not support the hypothesis. The expected trend is that the average Schedule variance value would decrease and that the ranges would become narrower. The main reason for deviation from the hypothesis is the issue of weather risks that impacts Schedule variance. Since 2008 the risk group has become better in handling and understanding weather risks. At AFE the risking has been performed with more accurate information than in AFD and AFF, and weather risk has for that reason had more of an impact in this section. Another thing to look into is the type of project at AFE, since the highest rise in average schedule variance is located here. Three projects have gone through AFF, two of these projects are sub sea projects and the third project involves deploying a network of seismic cables buried 1-2 meters into seabed. These projects are not typical projects, and this has most likely affected the expected trend as we can see in figure nr.16. Since the graphical presentations support the hypothesis with an exception of the Schedule variance graph, which has a valid and logical reason for why it deviates from the wanted and expected situation, the conclusion is that hypothesis nr.3 is fulfilled.

4. The different risks are categorized as definition, organizational, technical and stakeholder. In AFF definition and stakeholder risks should have the highest presence, whilst in AFE organization and technical risk will be dominating.

Definition and stakeholder risks are supposed to be high at AFF and decrease throughout the projects life. At the beginning there should be a higher degree of definition risks due to the low detail level in scope, as we proceed we achieve more information and the definition risks will decrease. Stakeholder risks are high early on in a project; this is because as we progress and issues regarding the project are clarified stakeholder risks are resolved. Organizational risks will have a constant presence, but is supposed to start out low and increase as the project approach the end. This is due to the fact that at the execution phase the projects are more dependent on other organizations and markets than in early phases. Technical risks is also supposed to increase, the reason for this is that when the development and execution phases is reached the project is “real” and not just on paper. And then the project will come across technical challenges; weather is included in this category.

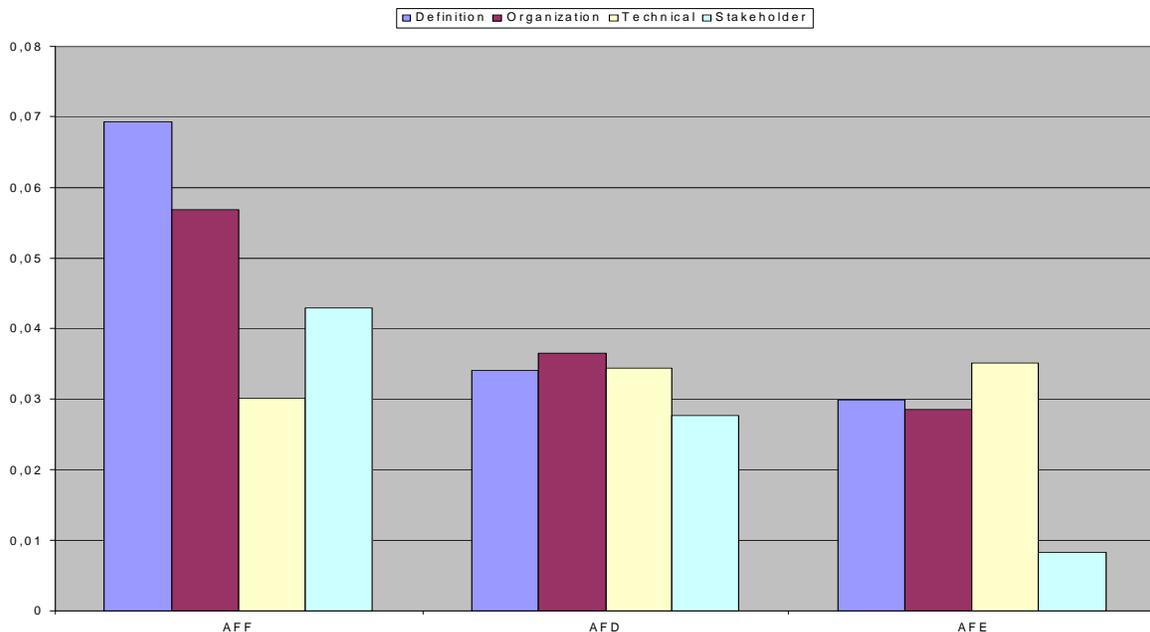


Figure nr.19: Risk Spread per stage gate

**Result:**

From figure nr.17 we can conclude with that the categories definition, stakeholder and technical lives up the statement in the hypothesis. But this is not the case for the organizational risks, instead of increasing in amount they are decreasing. The reason for why organizational risks are decreasing is due to the fact that ConocoPhillips have dealt with the dependence upon other organizations and markets in a favorable manner and has therefore avoided a high dependence. Successfulness exists within all risk categories except for organizational. However, since the deviation found in organizational risks is of benefit for the organization; hypothesis nr.4 is fulfilled.

## 5. A trend where the costs move from variance to risk events.

As the risk team has developed and learned how to manage and deal with risk in a better manner a trend where the variance value decreases through the gates should appear. This is because the risk team has become able to list more risks as risk events instead of including this impact in the variance section.

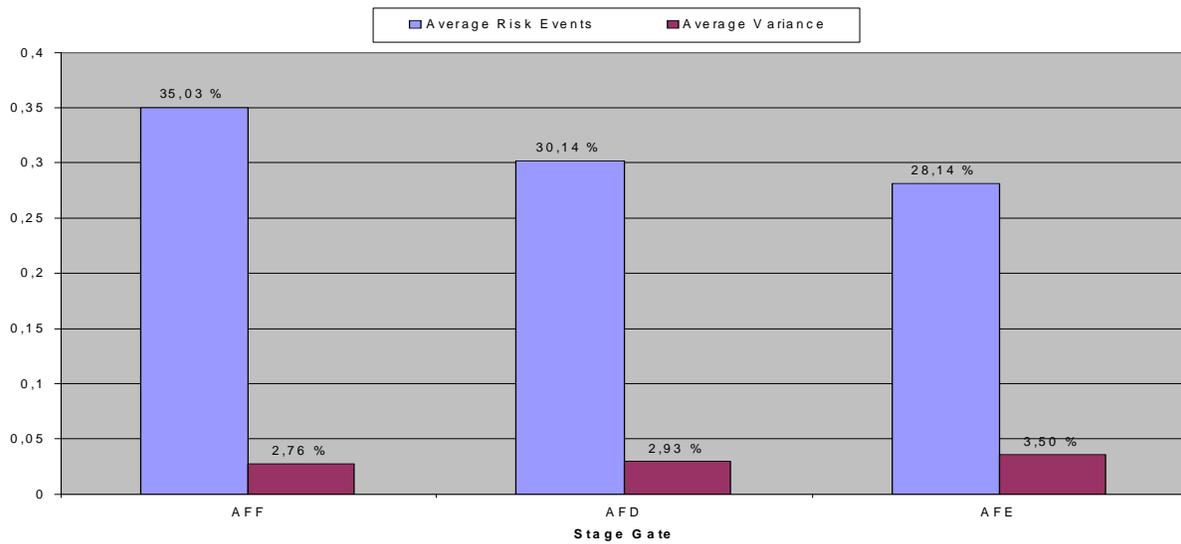


Figure nr.20: Risk events versus Variance Risk

### Result:

The graphical presentation provides us with an understanding of that the average risk events do decrease while the average variance does increase and the graph gives us a conclusive answer.

Hypothesis nr.5 is true.

6. Cost risks have decreased whilst schedule risks have increased.

Cost risk events typically add to cost while schedule risk typically add time to schedule. Schedule risks contribute mainly to the time schedule, but secondly add cost. The reason for why schedule risks should increase is that the risk team has become more confident in how to manage schedule risks. However the main trend that should appear here is that cost risk is the main contributor to contingency, due to the fact that labour uncertainty is included in the cost risk and therefore requires more contingency.

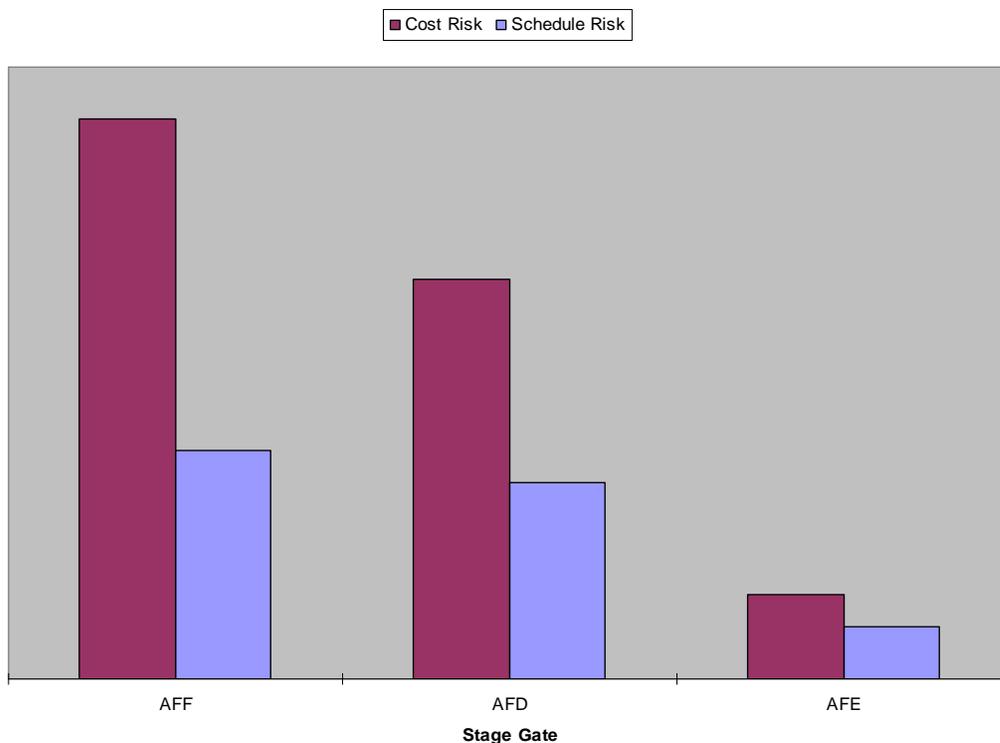


Figure nr.21: Cost risk versus schedule risk

**Result:**

Directly from the graphical presentation it is clear that the cost risks have decreased in size going from AFF to AFD to AFE. The schedule risks have not increased in impact, but have increased in proportion to the cost risks. However, going through the different gates in a project more information is known and the overall risk impact becomes less. So even though schedule risk does not increase in total its increase in proportion to cost risk does support the hypothesis.

### 5.2.2 Summary

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Causes such as different project sizes, low number of CBRs to compare, hard to compare the CBRs due to extensive changes since introduction, project complexity, project nature, new technology, more knowledge and different assumptions made prior to calculation, is the reason why the quantitative analysis has been the supporting analysis method instead of the main method. The major cause is that due to several different versions of the CBR it is somewhat complicated to compare the CBRs with each other without looking into the assumptions that are the basis for the calculations. The graphical presentations show, for the most part, that the hypotheses are true. Where this is not the case there are valid and logical reasons for why the graphical presentations do not support the hypotheses. The quantitative analysis results conclude that the numbers do support the hypotheses, and we can say that successfulness is achieved due to the fact that the wanted and expected situations have occurred.

### 5.3 Summary results

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In studying successfulness, the qualitative aspects such as the CBR users' perceptions are considered to be most important in this thesis, due to the fact that successfulness is more a perception of how the situation is than a specific situation. For this reason the results from the qualitative analysis are decisive.

The interpretation of the qualitative results gives no basis for claiming achieved successfulness, whilst the quantitative results show that successfulness is achieved. The main reason for why the results do not match is the fact that even if successfulness is achieved in how things are performed the CBR users' perception may not be aligned with this. In other words, the CBR users perform their tasks correctly, but there is no obvious reason that this means that the CBR users are satisfied and feel that successfulness is achieved. The CBR users can perform their work towards the CBR perfectly, but still not be satisfied with the project tool and still feel that successfulness is not achieved. In a large organization, as ConocoPhillips, the corporate side must have the decisive authority, but taking the workers input into consideration is clearly beneficial with regards to the CBR in the CBR users' opinion and also in my opinion. Achieved successfulness in terms of the wanted and expected situations to occur, which is shown in the results from the quantitative analysis is a great result for ConocoPhillips Norway and the entire ConocoPhillips for that matter. But in this case it is still very important to listen to the CBR users and understand how the project tool should be improved.

Considering the important aspect of users input; successfulness is not entirely achieved.

## Limitations of the analysis

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In accomplishing this analysis there are limitations that needs to be considered. The method of choice is an apparent limitation. The nature of the problem statement required the use of both a qualitative and a quantitative method. By using these methods together weaknesses with one of the methods are eliminated by the other methods strengths, but there will always be weaknesses that cannot be entirely eliminated by using the two methods together.

A weakness with the qualitative method in this thesis, which is not eliminated by the quantitative method, is the low number of interview objects and replies from the questionnaire. The in-depth interview was performed with five primary CBR users and the questionnaire was answered by six project managers. Another limitation with the qualitative analysis is the fact that it is based on the CBR users' perceptions. A CBR user is not a robot, he or she is flexible and will perceive thing differently from time to time and in regards to different activities.

The number one limitation regarding the CBR and the quantitative analysis is the amount of CBRs to study. While conducting an analysis it is always important to have a representative selection of objects to study. In this study we had 15 Norwegian CBRs to investigate; this will affect the quality of the statistical analysis. Trying to avoid that this limitation had too big of an impact on the statistical analysis, the percentage and average value has been utilized whenever it was natural. In addition standard deviation is provided in order to avoid manipulation of the average values. In order to be able to compare the projects, every value investigated has been presented as a percentage of either the premise value or the total installed cost-value, before using average on the percentages. Presenting the numbers as percentage of a common size in the different projects is an attempt to eliminate the fact that projects are of different size. There is no reason to conceal the fact that the analysis results would be of better quality if there had been a higher amount of CBRs to investigate, but on the other hand the 15 CBRs was the only available material to study.

Another limitation is how long the CBR has been used; this limitation is closely related to the amount of CBRs. All new project tools will have ups and downs in the beginning before an organization will choose to stop using it or to improve it. Here the CBR is fairly young and has already gone through many changes, and has not yet had the chance to reach a period of

stability. A stable period would give the users an opportunity to give feedback on positive and negative sides, and thereby implement a planned improvement. The fact that the CBR has evolved entails that the statistical analysis becomes more challenging when a new section is added, or an existing section is altered. While studying successfulness it would also have been an advantage to see the end results compared to what the end results were expected to be. This can be seen in connection with the fact that the CBR is so young. No projects have been completed yet and we can for that reason not see if there is coherence between estimated cost, assigned contingency and real cost and contingency used. However, combining the two analysis methods with the most weight put on the qualitative analysis was an attempt to avoid completely false results.

The CBR is a company specific tool within ConocoPhillips dealing with contingency. The results in this study is therefore mainly based on internal ConocoPhillips material and additional information from the Norwegian part of the organization dealing with North Sea Capital Projects, which limits the result to suit this specific part of the ConocoPhillips organization. The results of this analysis cannot be generalized to be valid for the entire ConocoPhillips organization.

## Discussion

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This discussion part sum up the pros and cons with regards to the CBR and also discuss how the company should go forward in order to achieve successfulness.

### *Pros and Cons*

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All the critical and relevant risk and cost data revolving around a project are gathered in one single document, employees working on a project should be aware that the most essential data can be found in the CBR. It is therefore easy to find the needed information in the way that it is all collected in one document, which is very beneficial. At the same time this document is very complex and it might be difficult for people, who are unfamiliar with it to find the specific information they are searching for. Its complexity is a result of the template format, which requires a lot of data, with a different degree of relevancy. The complexity is also a factor that contributes to making the processes associated with the CBR very time consuming, easy to make errors and hard to understand where the numbers come from. The CBR is supposed to make it easy to compare international ConocoPhillips projects with each other; this has been somewhat difficult up to now since several different templates have been utilized. One of the main goals with introducing the CBR was comparison between projects; it would therefore be advantageous for ConocoPhillips to use the same template for a period of time. One stable template may also contribute to reducing time spent working on the CBR and minimize the work on the input data. One of the main errors sources is the fact that the CBR is compiled in Excel. Excel is very flexible and user friendly which is positive, but at the same time there are very few ways to ensure that the numbers are correct other than by checking it number by number or formula by formula.

### *Going forward*

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The study uncovered that the risk group are most satisfied with the CBR, a reason for this is that the risk group are most familiar with the CBR and integrate the CBR in their work routines. The cost estimators and the secondary CBR users, on the other hand, were not as satisfied with the CBR to the same extent as the risk group. But with a few changes in format adjusting complexity; making it simpler and afterwards enabling stability the cost estimators and the secondary users would all have more benefit from the CBR since the tool would be much simpler and easier to handle. A common agreement among the users of the CBR is that the template needs to be stable and that it should be simplified. The users clearly see this as the most important measures to be undertaken and that this would lead to a higher degree of successfulness in terms of more satisfied users. Since the CBR has evolved the original purpose and intention with the CBR has been lost during its lifetime. To avoid confusion and frustration a detailed clarification of purpose and intention would be beneficial for motivating and giving the users a positive attitude towards the CBR. The CBR has become a very important and frequently used tool and it is therefore necessary that the users be pleased with the tool.

Since the aim for this thesis is to investigate successfulness, the suggested way forward is in agreement with this aim. Measures that should be undertaken in order to ensure successfulness is stability in the CBR template, simplify the template, consistent training of the project management teams and risk specialist, higher knowledge and experience transfer, make and present result reports from the CBR and document big variations in the CBR template.

## Conclusion

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This thesis presents ConocoPhillips' project tool the Contingency Breakdown Report (CBR). The CBR document is compiled in Excel and holds all the relevant cost, risk and schedule data for a project. The objective of this thesis has been to determine if success, regarding the implementation of the CBR, is achieved.

The findings from this thesis suggest that success in implementing the CBR has not been fully achieved. The implementation of the CBR has meant successfulness for ConocoPhillips Norway, because the tool has become more important than expected and is well integrated and trusted in projects. However, the CBR users are not fully satisfied and wish for the CBR to undergo strategic changes in order to improve.

During the interviews and the process of analyzing the collected data, it became clear to me that the CBR document has become an integrated part of ConocoPhillips projects in Norway and it is very much depended upon. Achieving complete successfulness in the implementation of such an important project tool is therefore advantageous and in my opinion not necessarily hard for ConocoPhillips Norway. However, the study also showed that the CBR is not the important focus for the CBR users at this point, but rather the risk management process, the cost estimation process, the discussions that the CBR enables and the contingency amount. Contingency should therefore be the focus point when implementing strategic changes in order to improve the CBR.

This thesis argues for implementing strategic changes such as; first simplifying the format and then keeping the format stable and a clarification or a renewal of the intention. With an implementation of such strategic changes, the CBR would easily achieve complete successfulness. Because there is a huge potential with the CBR, and with some strategic changes, there is no doubt that this project tool would become even more important and beneficial for both project teams and corporate groups.

CBR is short for contingency breakdown report and the focus should be on exactly this in the future. The contingency should be the focus point for the Contingency Breakdown Report.

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## Primary CBR users

### A. Personal level

1. What is your position?
2. How long have you had knowledge of the CBR as a project tool?

### B. CBR

#### Goal:

To achieve an understanding of the processes that lead up to the CBR and how the CBR is used in a project.

3. How do you define contingency?
  - Premise
  - P50
4. How do you use the CBR? Could you describe how a CBR is used in a project?
  - Presentation
  - Key information
  - Risk analysis
  - Cost estimation
5. How do you contribute to the CBR? What are your areas of responsibility?
  - Input
  - Output
6. What were your expectations to the CBR?
7. Was there a need for the CBR?
  - Standardizing
  - Reporting
  - Summarizing
  - Informational value
8. Do you feel that you have a need for the CBR?
  - Areas of use
  - Time aspect
9. Do you see any positive effects of the implementation of the CBR?
  - Changes
  - Causes

10. What is negative about the CBR?
- Effect on procedures
  - Effect on motivation

### **C. CPMS guidelines**

**Goal:**

**To achieve an understanding of the guidelines and standards for the processes that leads up to the CBR and for the CBR itself.**

11. To what degree do you feel that the CPMS guidelines are followed?
- How to measure
  - Detail level
  - How to follow
12. How do you follow the CPMS guidelines?
- Specific procedure
  - Quality of work
13. How do you feel about the CPMS guidelines for the CBR? Are they useful?
- Local differences
  - Variation in project and gate
14. Would you, if yes which changes would you recommend in the CPMS guidelines to ensure consistency?
- Basis for changes
  - Detail level
  - Local variation

### **D. Consistency**

**Goal:**

**To achieve an understanding of why consistency is wanted, how the situation is today, what ensures consistency in the processes, what can be improved and how.**

15. Have you been consistent?
- Procedures
  - Quality check
16. What helps you perform your work in a consistent way?
- Review
  - CPMS guidelines
  - Colleagues

17. To what extent do you feel that there is consistency in the usage of the CBR?
- Purpose of use
  - Different users
  - Goal
18. Do you think the process for risk quantification and CBR completion is well understood?
- Consistency in the process
  - Knowledge of procedures
19. What do you do to ensure consistency?
- Main goal
20. How do you think we can ensure consistency?
- Discussion
  - Consensus on procedures
  - CPMS guidelines
  - Local exceptions
21. What may cause errors?
- Influences
  - Impact
  - Amount of data
  - Time aspect
22. Do you have any suggestions to what can be done in another manner to ensure consistency?
- Input sources
  - Discussion
  - Houston
  - Size and complexity
23. Are there any typical error-sources?
- Variation
  - Complexity
  - Amount of data

## **E. Summary**

24. Do you feel that the CBR has lived up to the expectations of the company?

**Secondary CBR users**

1. Do you think the process for risk quantification and CBR completion is well understood?

		Answers
	Yes, by all team members.	X
	Yes, but only by the PM and risk specialist.	XX
	No, and this should improve.	XX
	No, but ok with work being done.	XX

2. Do you think the processes above have been consistently applied onto Norway BU projects?

		Answers
A	Yes.	XXXXXX
B	Sometimes.	
C	Rarely.	
D	No.	

3. Do you think that the risk analysis has been performed in a consistent manner?

		Answers
A	Yes	XXXXX
B	To some degree.	
C	No	
D	Other input, please describe:	X

4. Do you think that the cost estimate procedure has been performed in a consistent manner?

		Answers
A	Yes	XXXXX
B	To some degree.	X
C	No	
D	Other input, please describe:	

5. Do you think the CPMS guidelines are being followed to the required extent in the Norway BU projects?'

		Answers
A	Yes.	XXXXXX
B	Sometimes.	
C	No.	
D	Other input, please describe:	

6. How do you feel that we can ensure consistency in the CBR?  
Choose several alternatives if needed.

		Answers
A	Stability in the CBR- template.	XXXXX
B	Training the project management team and risk specialist.	XXX
C	More detail in the CPMS guidelines.	
D	Greater usage of knowledge databases.	
E	More time to focus on the CBR inputs and the CBR.	XXX
F	If other input, please describe:	

7. Is the CBR an important document for you in a project?

		Answers
A	Yes.	XX
B	To some degree.	XXXX
C	No.	

8. Have you noticed any changes in the CBR?

		Answers
A	Yes, major changes.	XXX
B	Yes, small changes, easier to complete.	XX
C	No.	X
D	Other input, please describe:	

10. What effect do you feel that the implementation of the CBR has had?

		Answers
A	Positive, helps the project.	XXX
B	Neutral	XX
C	Negative, too complex, takes to long.	X
D	Other input, please describe:	

12. If you have any thoughts on with what the CBR has contributed, please share you input here:

11. If you have any suggestions to what should be done in another manner regarding the CBR, please share your input here:

On early phase estimates, typical FEL-0 estimates, Questor software can be used. In this software the key data and type data can be placed. Type data can be what kind of platform, the number of wells and so on. With the use of the type data and key data the software makes a broad estimate. Questor is barely used in the Norwegian projects though. In the late phase estimates, typically FEL-2 estimates, where the detail level is very high there are a lack of good tools to apply in addition to Excel.

The main tool for estimating is Excel, and it is used in every phase of the project. Excel has a variety of functions and is a very easy and applicable tool for estimating. One of the advantages with Excel is that it can easily be designed to fit the estimating needs. On the other side working in Excel can be time consuming and errors can easily be made.

## Appendix nr.4

Risk management is all about the identification and how to manage the factors or events that might cause deviation from the plan. Deviation is in this case the risk events included in the CBR. The purpose of risk management in ConocoPhillips is to apply risk and opportunity management processes to improve project performance and increase the likelihood of achieving project objectives. Risk management is a continuous process. Continuous risk management increases the likelihood of achieving overall shareholder objectives. It is also a way to help the team members' focus, behave and work together. Identifying, assessing, planning and implementing helps the team members make decisions that will improve the execution phase of the project and obtain a higher predictability of project cost, schedule and resources. All of which is beneficial for the project and the organization (Risk Management Presentation, 2009).

As each project is unique the specific activities, techniques and toolsets utilized may differ. Different approaches may also be required between phases and depend upon the level of risk identified and the degree to which it is considered manageable. Even though there are large variations between the phases and projects, there are a few main steps in how it should be executed as shown in figure nr.A4-1.

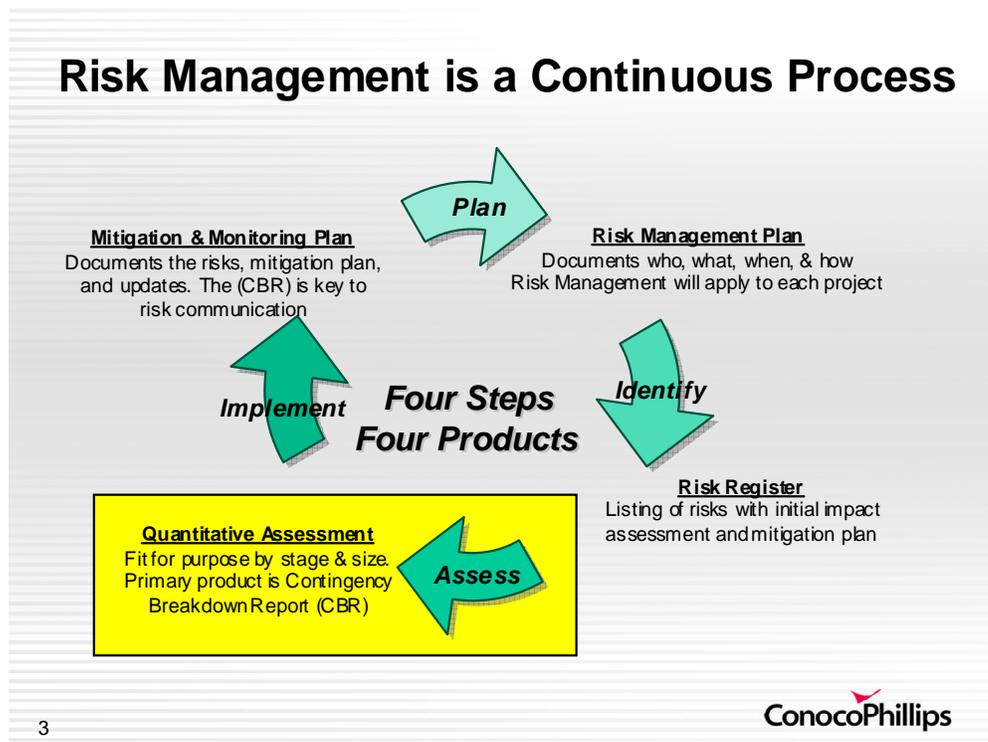


Figure nr.A4-1: Risk Management – a continuous process (Risk Management presentation, 2009)

Step 1(Plan) in the risk management process is planning. In the planning phase the basis for the risk management efforts are set. Here the how, who and when is decided and gives an output in the form of a risk management plan. After planning, the risks are identified, documented and prioritized in step 2(Identify). A variety of techniques are applied here such as workshops, interviews and lessons learned assumption analysis among others. The preferred method is brainstorming workshops. A risk register, as the procedure shown in figure nr.8 will be established in this step. Such a register is a listing of all the risks from all risk areas with initial impact assessment and mitigation plans. One of the benefits with establishing a risk register is that it documents the history of a risk over time and ConocoPhillips is able to exploit this in a positive way for subsequent projects. Identifying the risks and listing them in the risk register provides a strategic understanding of key risks and possible opportunities, which is beneficial.

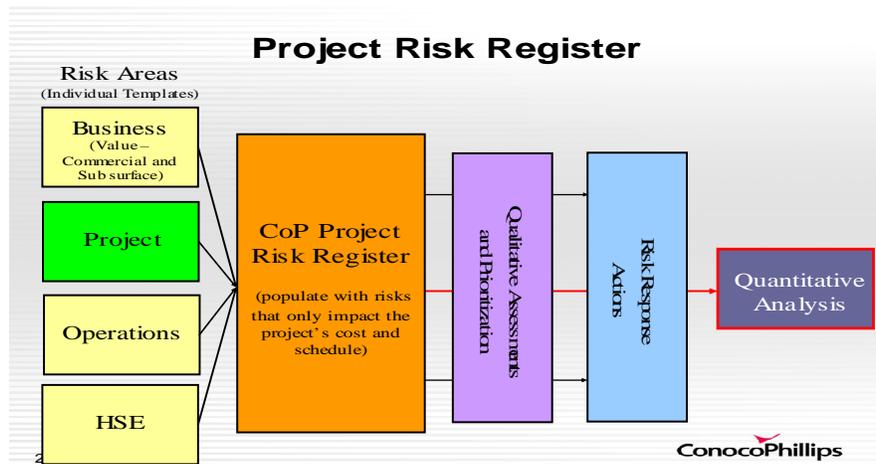


Figure nr.A4-2: Risk Register, (Risk Management presentation, 2009)

A natural step 3(Assess) is then to assess the risks. This assessment is quantitative and the CBR is the primary product established in this step. To exploit the CBR tool to the fullest it is fit for purpose by stage and size of project. Step 4(Implement) is implementation. Mitigation and monitoring plans are found; these plans document the risks, mitigation plans and the prospective updates. The mitigation process has the aim of avoiding and minimizing the risk, and it is carried out by examining the risks that impact the project and determines actions to implement in order to reduce the possible consequences. Several types of mitigation strategies are used and the key activity in the different strategies are; avoid risk, reduce risk, mitigate fallback, share risk, realization, accept and monitor risk, each of them targeting the different

components of a risk. If no mitigation actions can be implemented, contingency plans are established. Contingency plans involve identification of plans and strategies in advance that shall be adopted should a potential risk happen (CPMS Risk Management Standard, 2008).

The key risk management tools consist of the Risk register, for the tracking of risk and mitigation, and a quantitative risk analysis (QRA). The risk register is continuously updated and maintained, and is established during step 2(Identify).

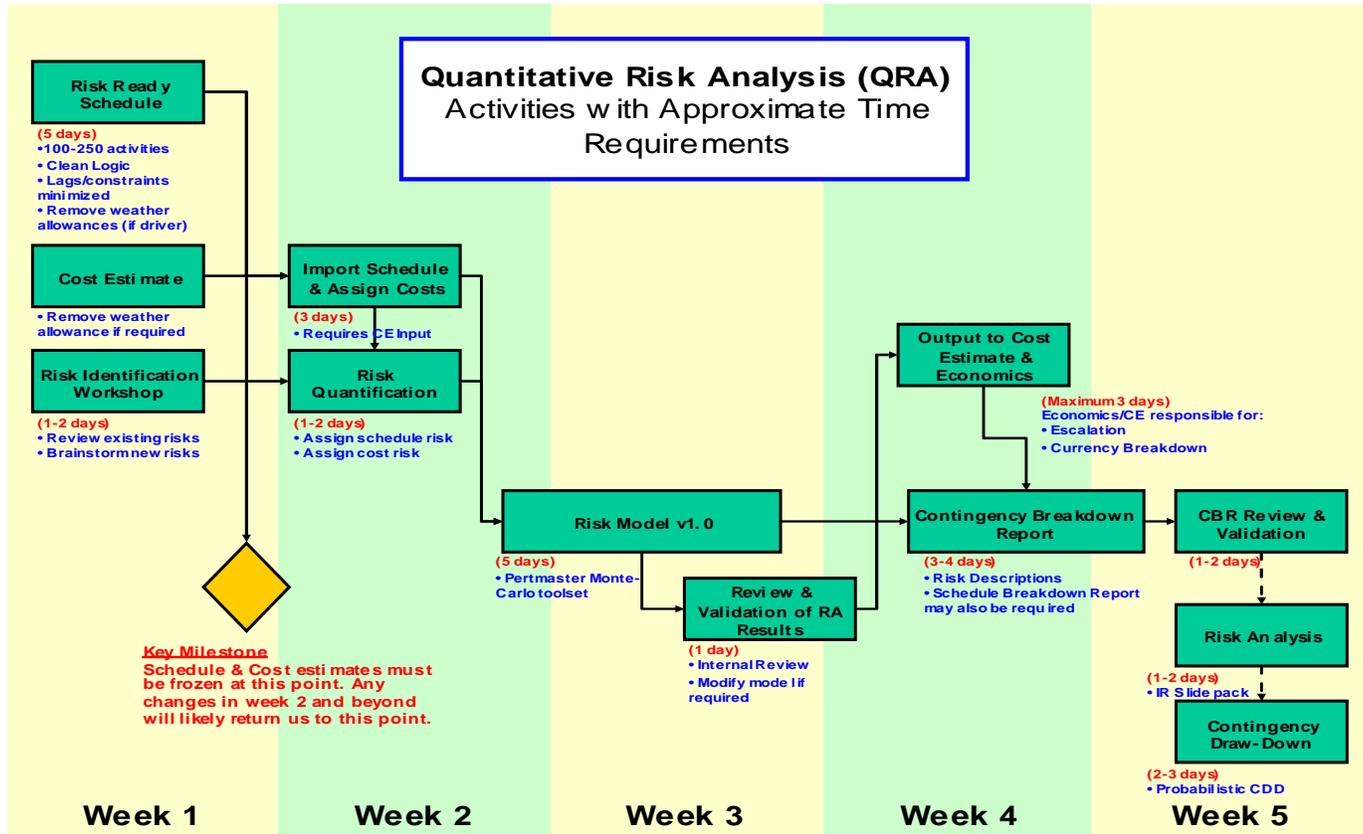


Figure nr. A5-1: QRA, (Risk workshop slides, 2008)

In the QRA, as seen in Figure nr.A5-1 under Risk Model v1.0, the use of Monte Carlo risk simulation software to statistically analyze the effect on the project of the risks and opportunities identified in the risk register is a main action. Monte Carlo simulation is used for risk analyzing in ConocoPhillips because there are many variables that are interlinked and a Monte Carlo simulation is best suited. The Monte Carlo simulation is usually applied when the model is complex, nonlinear, or has several uncertainty parameters. The simulation runs the model for over 10000 evaluations. This is an iterative method that evaluates a deterministic model with sets of random numbers as inputs (Wittwer, J.W, 2004). Primavera Risk Analysis

simulation, formerly called PertMaster, is used in QRA. It is the Monte Carlo risk simulation software used in ConocoPhillips that will calculate the duration and cost of the project based upon the risk inputs in a critical path analysis. This software allows for an integrated schedule and cost model to understand the variance and risks around each schedule task and cost component as well as interdependencies between tasks and risks. Monte Carlo analysis involves the simulation of many iterations of the model to create statistical outputs such as the s-curve, from where the P50 can be read, and is used to determine the project contingency level

Conducting an effective QRA involves the coordination of project data from a number of functional areas and so it is essential that a clear QRA timeline is in place. The QRA time line is shown in figure nr.A4. The QRA timeline gives a detailed description of the performed activities and the approximate time requirements (CPMS Risk Management Standard, 2008).

A spreadsheet application, Crystal Ball, is used for quick (easy) risking. This application is suitable for predictive modelling, forecasting, simulation and optimization (Oracle software, 2010). Crystal Ball is not used to the same extent as PertMaster, which is the main risking tool used in the Norway office. The CBR is built in Excel and both PertMaster and Crystal Ball utilizes this, Excel is the main risk register tool.