

Ensuring Effective Quality Management of Road Projects in the Construction Branch

A Diploma Thesis based on a Part of the Norwegian E18 Highway Constructed by CJV-E18



CJV E 18 GRIMSTAD - KRISTIANSAND



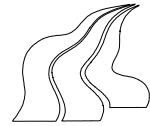
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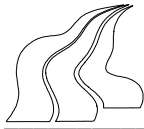
This report describes the challenges of creating an effective Quality Assurance (QA) system in the Construction Branch.

The project is based on the CJV-E18 company which are construction the expansion of the Norwegian E18 highway from Grimstad to Kristiansand.

The project analyses the contract, organisation and the QA Roads department in order to establish the conditions of the project.

Implementation of QA is analyzed put in relation to the cultural differences of the 33 nationalities that are working on the project. The project describes in general the nature of these cultural challenges in relation to the QA Roads department.

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Preface

This present report is a product of a Roads and Traffic Diploma project. The report is made at the Construction Joint Venture Company CJV-E18 in Norway in co-operation with the Danish construction company E. Pihl & Søn A.S, which will be referred as Pihl in the report. Pihl is together with the German construction company Bilfinger Berger constructing an approximately 40km highway from Kristiansand to Grimstad, with associated tunnels, bridges, culverts, ramps and side roads.

The construction of the highway is established as a Public Private Partnering (PPP) project. At PPP projects the contractor are responsible for designing, constructing, operating and maintaining the structure or infrastructural facility. For this specific contract the highway shall be operated and maintained for the next 25 years after construction. The PPP contractor is responsible for all costs in the above mentioned phases which increase the need for the contractor of a systematic Quality Assurance (QA) system to decrease the risk of unexpected cost during the operation and maintenance phase.

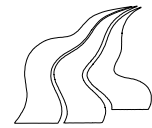
This report has focus on the issues involved with implementation of an effective QA system which shall fulfil all contractual and national requirements, related to the E18 project. All issues of implementation of QA is treated in this report is based in the view of the contractor.

To support this project the author has handpicked the relevant persons to contribute to the chapters of this report. The persons were chosen on behalf of their position, relation and involvement on the E18 project.

This project was carried out in the period of October the 28th to the 2nd of January, and has a workload of 15 ECTS points.

Lillesand, January 2nd 2009

Theis Vangsted



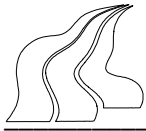
Reading Guide

The report uses the Chicago method to indicate the source references. This means that the source citations listed as author or provider of text, article or Web page. In addition, the year of release or publication is in the reference.

In the source list the remaining information about the sources will appear. If the sources are before a sentence, the sentence is based on the source. If the reference source is on the other hand after the sentence, it refers to the source of the previous section. If an entire section is based on one source, the source will act as a part of the introduction to the section.

In this report acronyms and abbreviations are widely used. The explanation of the word will appear the first time it is used and afterwards followed by the word inside brackets. A complete list on acronyms and Abbreviations can be found in the end of the report.

At each chapter a discussion is made upon the information provided on the chapter. The questions that the discussion chapters contain are treated in the discussion chapter at the end of the report.



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I wish to thank following for their contribution in making this project.

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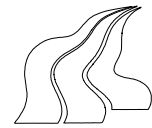
QA Manager *Torsten Asklund*, *E. Pihl & Søn A.S*, for providing general information about QA at *Pihl*.

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Peter Juel Jensen and all others who have been helpful in any way during the time of this project.



Abstract

This report treats the problems that a contractor is facing when implementing a Quality Assurance system on a project. The report is based on a specific Public Private Partnering project where a highway is constructed. The report describes the theoretical approach to the treated subjects and compares it with the situation at the contractor CJV-E18. To substantiate the specific situation key members of the involved companies have contributed to the report.

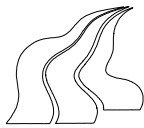
The report has analyzed the background for Quality Assurance in relation to the contract and organization. The study has shown that the PPP contract hands over nearly all risks are handed over to CJV-E18. Proper treatment of the risks offers potential for the contractor to increase profit, but the opposite when handled wrong. Planning is crucial when dealing with these risks. The PPP contract has minor influence in the organization of CJV-E18. When constructing an organization it is important to secure that all requirements in the contract is kept and the created positions fulfills the internal requirements in the company. It is important that all employees knows their position and what is expected of them to create a functional organization.

Based on this analyze the Quality Assurance (QA) department for Roads has been described. The QA Roads department needs to inshore that all contractual- and national law requirements are kept. For documentation standardized sheets based on the ISO 9001 standard are used. Procedures for executing work in relation to requirements are authored by the department. It is important that all involved employee's respects and take the Quality Assurance system seriously in order to run optimal.

When implementing Quality Assurance it is important to look on the specific relations in the project. What needs to be done? What is required by the contract? What is required by the national laws? What do we have? In large projects many foreign nations are often required to work together. All nations have different ways of working and views on leadership. The effect of this is present in the Quality Assurance Department. These problems are to be dealt with in basis on the cultural view of the nation. Implementing of own view is to doomed to fail.

The Client AOV expects that CJV-E18 deliver quality documentation that fulfils all contractual requirements. In order to provide CJV-E18 with funds, AOV needs to make a monthly status of the construction. The funds are measured on progress in relation to time schedule. It is important to provide AOV with regular documentation to inshore an optimal monthly payment.

This report resolves in general- and specific recommendations for implementing of QA.



Resumé

Denne rapport behandler de problemstillinger en entreprenør står over for når der et kvalitetssikringssystem skal implementeres på projekt. Rapporten tager udgangspunkt i et konkret Offentlig Privat Partnering (OPP) projekt hvor en motorvej opføres. Rapporten beskriver den teoretiske tilgang til de behandlede emner og sammenligner dem med situationen hos entreprenøren CJV-E18. Til at underbygge den specifikke situation har nøglepersoner for de involverede virksomheder bidraget til rapporten.

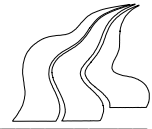
Rapporten har analyseret baggrunden for kvalitetssikring i henhold til de kontraktuelle og organisatoriske forhold. Analysen har vist at stort set alle risici er overladt til entreprenøren. Korrekt behandling af disse risici giver entreprenøren mulighed for at øge det potentielle overskud men kan samtidig også give den modsatte effekt ved forkert behandling. Planlægning er således vigtig i denne sammenhæng. OPP kontrakten har til dels indflydelse på organisation i CJV-E18. Ved oprettelse af en organisation er det vigtigt at sikre at alle krav i kontrakten er overholdt og at de oprettede positioner i virksomheden udfylder de interne behov i virksomheden. Det er vigtigt at alle medarbejdere ved hvad de skal foretage sig og hvad der forventes af dem hvis organisationen skal fungere.

Baseret på analysen er kvalitetsafdelingen for veje blevet belyst. Kvalitetsafdelingen skal sørge for at dække alle krav beskrevet i OPP kontrakten og i den nationale lovgivning. Til at dokumentere dette anvendes der standardiseret ark der er baseret på ISO 9001 standarden. Afdelingen forfatter procedure til hvorledes alle typer af arbejder skal udføres i henhold til kravene. Det er vigtigt at alle involverede parter respektere og tager kvalitetssystemet seriøst hvis det skal fungere optimalt.

Ved implementering af kvalitetssikring er det vigtigt at belyse de konkrete forhold i projektet. Hvad skal der udføres? Hvad siger kontrakten? Hvad siger den nationale lovgivning? Hvad har vi at gøre med? Ved større projekter arbejder der ofte mange forskellige nationaliteter sammen. Alle nationer har forskellige arbejdsgange og ledelses syn. Disse forhold har indflydelse i kvalitetsafdelingen. Håndteringen af disse problemstillinger bør tages med udgangspunkt i nationaliteternes kulturelle syn. Implementering af eget syn vil med al sandsynlighed mislykkes.

Klienten AOV forventer at CJV-E18 leverer kvalitetsdokumentation der opfylder alle kontraktuelle krav. For at kunne tilføre CJV-E18 kapital skal AOV månedligt gøre status over fremdriften. Kapitalen bliver udmålt efter fremdrift i forhold til tidsplanen. Det er derfor vigtigt at tilføre AOV med løbende dokumentation for optimal månedlig udbetaling.

Rapporten udmunder i generelle og specifikke anbefalinger for implementering af QA.



Permissions

I confirm the data provided by E. Pihl & Søn A.S and CJV-E18, the author has permission to use in this project. The author is allowed to publish and provide the data to third party interested for further evaluation of this project and further research of the described subjects of the report.

Lillesand, January 2nd 2009

Jan Korsgaard

Deputy Project Director at CJV-E18

E. Pihl & Søn A.S

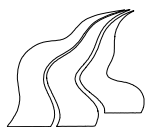
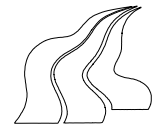
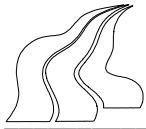


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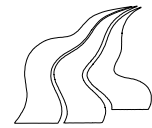
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1 Introduction

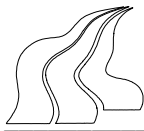
When the first specialized craftsmen started manufacturing tools and materials for others to purchase and use, the principle of quality was simple: "let the buyer beware". The first known records of Quality Assurance (QA) in Civil Engineering were the Great Pyramid of Giza. The four sides of the base should be perpendicular to within 3.5 arc seconds.

The systematic QA emerged in the Industrial Revolution when large groups of people performing a similar type of work. The quality of the products was now comparable. More sophisticated products increased the possibilities for mistakes and reliability engineering became important. Special methods to ensure reliability were introduced in the 1950s. In the 1960s total quality control was beginning to emerge. It was soon realized that, to produce high-quality products at competitive prices, a quality system operating throughout all stages of production was required. In the 1970s product safety became an issue. As highly complex and expensive plant with great potential risk element were being constructed such as nuclear power stations, the regulatory authorities and others began insisting on procedures that not only ensured satisfactory quality but also provided evidence of safe and controlled operation. QA was seen as the answer to this problem.

The purpose of this project is to analyze the factors that apply during implementation of a Quality Assurance (QA) system for roads in a foreign country. The project has based on the QA Roads system at Construction Joint Venture E18 (CJV-E18) by describing the system in relation to the agreed Public Private Partnering (PPP) contract with the Client Agder OPS Vegselskab (AOV).

The factors that this report investigates are the influences of external and internal requirements towards a QA Roads department. Upon the analyze and the defined structure of the department the report investigate the challenges the QA Roads department are facing in relation to cultural believes of purpose and involvement of QA. The view of QA by the client is investigated towards requirements and aims to the contractor.

Limitations of this report are that it gives a general picture of the theory behind the analyzed aspects described in the next chapter. Requirements for further analyzes are discussed in the Recapitulation chapters. The theory is compared with the situation at CJV-E18. Internal view on the situation was supported by handpicked relevant persons on behalf of their position, relation and involvement on the E18 project. The persons were asked individual question in relation to the subjects treated in this report. In order to make a complete overview and get all opinions an extended and systemized information gathering is required for further evaluation.



2 Report Structure

The report is constructed in accordance to the structure described in Figure 1.

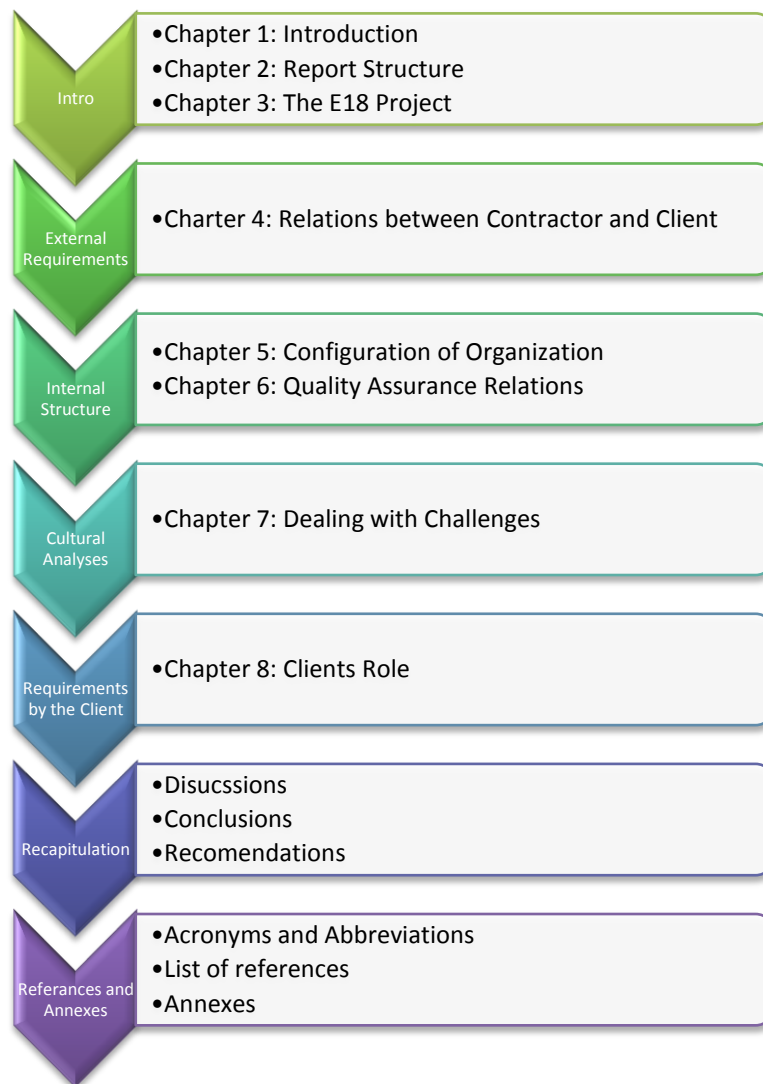
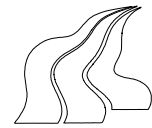


Figure 1: Report structure

The first three chapters describe the scope of work that the report cover and introduce the reader to the situation in the E18 project. In this Public Private Partnering (PPP) project three major actors are involved, the Norwegian Public Road Administration called Statens Vegvesen (SVV), the client Agder OPS Vegselskab (AOV) and the contractor Construction Joint Venture E-18 (CJV-E18). The relations were established in accordance to the contract.

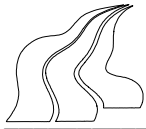
The contract has influence on the power structure and relations of the involved parties. In chapter 4 possible contract types are introduced and evaluated upon risks from the contractor and client. The E18 contract is compared and described towards the analyze.



The contract and national law refer to the requirements of QA in the organization. The internal structure describes the CJV-E18 organization in relation to organization theory, the contract and national law. Positions and purpose of QA Roads in CJV-E18 are described. The product of these chapters is the challenges that QA Roads are facing towards reaching their internal and external requirements.

The cultural analyses are dealing with the challenges that are found in the previous chapter. The chapter describes the theoretical way of implementing QA and comparing it with the situation at CJV-E18. There are in average 33 nations working on the E18 project, which makes the cultural view interesting for further analyses. The chapter describes the reaction patterns when colliding with a foreign culture and categorise cultures in relation to their general reaction patterns. The various cultures have adapted different ways of leading and motivating. These theories are related to the situation at CJV-E18. Effects of the cultural differences towards QA are described.

By the conducted analyses of the factors related to the implementation of QA several questions were asked in the separate discussion subchapters in each chapter. These are discussed and attempted answered in relation to the report and the view of the author. The most important conclusions are summarized and the two previous chapters lead to the recommendations when implementing an effective QA system.



3 The E18 Project

In 2001 the Norwegian government approved the construction of the new E18 highway extension from Grimstad to Kristiansand in their national transportation plan. The government agreed that three of the planned highway projects should be carried out as Public Private Partnering (PPP) projects. During the first four years two of them were started. At the next revision meeting in 2005 the highway was finally approved in 2005 and was offered as a PPP project by SVV. [Statens vegvesen, 2007]

The German contractor Bilfinger Berger and the Danish contractor E. Pihl & Søn (Pihl) made an offer on the project to Statens vegvesen. To help finance the project the Norwegian investment company Sundt were convinced to invest. The consortium won the contract in June 2006 with an offer of approximately €400 million or 3.2 billion NOK. The project started in June 2006 and is planned to finish in September 2009. [Agder OPS Vegselkab, 2008]

The E18 project is the largest infrastructure project ever made in Norway. The project is designed to consist of a 38.3 km four lane highway which in addition to the road 75 km of local roads and corridors, 61 bridges, 18 culverts and 7 tunnels is to be made. The contractor has to design and build the road and afterwards operate and maintain it for 25 years. A map of the alignment is shown below in Figure 2. [Agder OPS Vegselkab, 2008]

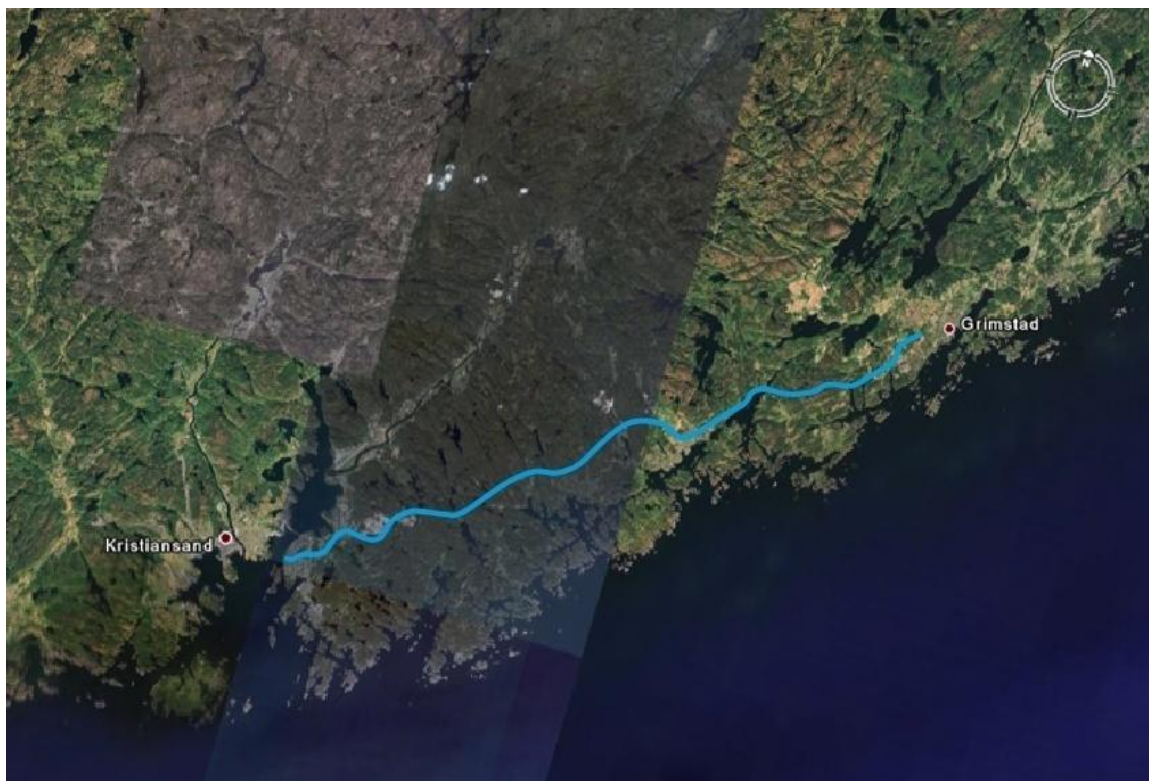
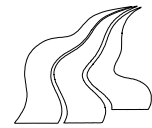


Figure 2: Overview of the main alignment [CJV-E18, 2008]



3.1 Dividing of Companies

After the contract was signed SVV established a subdivision called Region Sør – Offentlig Privat Samarbejde (RS-OPS), which was to be the overall client and secure that the road, is constructed in accordance to especially the safety requirements and that SVV can take over the road in accordance to the contract after 25 years.

The winning consortium of Bilfinger Berger, Pihl and Sundt established the company called Agder Offentlig Privat Samarbejde Vegselskab (AOV). To construct the road AOV made an agreement with Bilfinger Berger and Pihl as main contractors. They formed the company Constriction Joint Venture E18 (CJV-E18). The three companies are described in the subsequent sections.

3.1.1 RS-OPS

RS-OPS are a subdivision of SVV, which during the project acts as an authority with regards to Norwegian construction requirements. They have to participate in quality inspections to secure that AOV provides them with a safe and high quality road in accordance to Norwegian road laws and regulations.

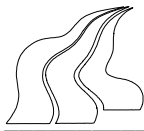
When the highway is handed over RS-OPS is to secure that the project fulfils their expectations described in the contract. To be able to evaluate this at hand over RS-OPS is having focus on all parts of the construction phase and can withhold payment if the work during construction is not done in accordance to the requirements given in the contract. If work during construction are outside the regulated area, conflicting with the public or is unsafe RS-OPS has the authority to stop the work if needed, using different contractual described tools, which are described in chapter 8. The road is by the contract divided into seven sections, when they are opened for traffic the payment of the highway starts. RS-OPS will be paying monthly for the road 25 years after finishing.

RS-OPS are therefore fulfilling the role as the client, however with certain restriction that is described in chapter 4. The contract is established between RS-OPS and AOV.

3.1.2 AOV

Before the contract were made the two contractors had to provide a bank guarantee which means they had to cooperate with an investment company in order to prove that they had the sufficient funds to build the project. The Norwegian investment company Sundt provided the sufficient funds and together with the contractors they created AOV. The ownership AOV is 50% Bilfinger Berger, 35% Sundt and 15% E. Pihl & Søn.

The purpose of AOV is to control the project in all its phases. During the construction AOV secures that their contractor constructs a highway in accordance to the



requirements given in the contract thus the law and that the relation between the quality and the budget is reasonable in the long term.

The overall goal for AOV is to secure that the design and construction of the road are taking the maintenance interfaces into account to lower the overall maintenance cost and secure a total financial balance after 25 years.

AOV has made a contractual agreement CJV-E18 to design and build the highway; therefore their role in relation to CJV-E18 is being the client. If CJV-E18 do not fulfil the contractual requirements AOV has the authority to stop the work and do not pay CJV-E18 for their work. AOV are able to hire another contractor to do the job that CJV-E18 could not perform and afterwards claim them in order to get their expenses covered.

3.1.3 CJV-E18

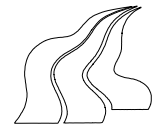
In order to optimize the profit on the project, AOV decided to hire their own companies to construct the highway. Bilfinger Berger and Pihl founded a company called Construction Joint Venture E18 (CJV-E18). The ownership of the company is 70% Bilfinger Berger and 30% Pihl.

Communication with the authority RS-OPS goes through their client AOV. Every time CJV-E18 discovers an issue in the contract in accordance to the law or discover an issue that hasn't been stated in the Norwegian road law CJV-E18 has to apply to their client AOV, then they will present it to RS-OPS if they agree that there is an inconsistency. The contract is build up as a back to back contract which is described further in chapter 4.3.

CJV-E18 has the opportunity to choose to construct the highway with own man power or with subcontractors. The advantage by using subcontractors is often that are local and have an extended knowledge to local conditions and furthermore it is possible to distribute the financial risk to specialize in the relevant subject.

CJV-E18 has the responsibility to construct the highway in accordance to the contract and the Norwegian laws. If they cannot fulfil this either RS-OPS or AOV has the authority to stop them. As the main contractor CJV-E18 has the authority to apply the same regulations as RS-OPS and AOV for its subcontractor in case they don't do their work in accordance to their contract. If not CJV-E18 has the option to employ another subcontractor to do the work and afterwards claim the subcontractor that failed to do the work correctly.

As the main contractor CJV-E18 has the responsibility of designing, planning, controlling and securing all the work that has been performed on the project. In order to create an

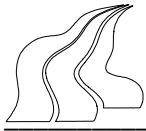


optimal construction process these are important to be dealt as correctly as possible in order to lower the project costs.

3.2 Discussion

According to chapter 3.1.1 to 3.1.3 there are three main companies in this project, one public and two private. The two private parts have shareholders from the same companies which mean that they want to make the highest profit in both companies. The purpose of AOV is to operate and finance and CJV-E18 is to design and construct, but a large part of the shareholders are identical. Is separation in this case a good option?

The communication channel from the CJV-E18 to RS-OPS goes through AOV even if it does not directly concern AOV. Is it necessary to have such communication route and could change save paperwork for all three parties?



4 Relations between Contractor and Client

To secure the contractual requirements between RS-OPS and AOV are included in the work of CJV-E18, the contract between AOV and CJV-E18 where established as a back to back contract. The communication route is kept strict so that CJV-E18 does not have direct contact to RS-OPS. All communication from the contractor runs through AOV. The interest of AOV and CJV-E18 are in generally the same, but as AOV consist of Sundt A/S the agenda varies because the member of AOV is not involved in the construction of the project and therefore requires other documentation, in order to prove the profitability of the project to the investors. [Lehmann, 2008]

The tools and involvement by the client are defined by the type of the contract between the client and contractor. This chapter describes the types of contracts the client are able to use. It evaluates the opportunities and risks for the client and contractor, when choosing the different types of contracts.

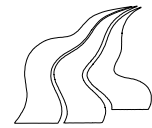
4.1 Type of Contracts

There are four main types of contracts the public client can choose when putting a road project for tender. These four types are called profession-, turnkey-, total supply- and PPP contract. The types of contracts in Norway are similar to the types that exist in Denmark and the rest of the EU. The four types define the extent to which the client and contractor are involved in the project phases. These are described in the following sections which is based on [Erhvervs- & Boligstyrelsen, 2003a], [Erhvervs- & Byggestyrelsen, 2005], [Erhvervs- & Byggestyrelsen, 2007] and [Roesgaard, 2008]. Mr. Roesgaard is contract administrator at CJV-E18 and works with all issues involving the PPP contract at the E18 project. He has mainly provided information about the usage of the contract type and the risks that involves the contractor and client.

4.1.1 The Profession Contract

A profession contract is defined by a specific part of a project that is made by the contractor. The control of the project is put in the hand of the client which has to hire all the necessary contractors in order to complete the project.

The profession contract is established by the client. The client designs and defines the scope of work, when it should be preformed, criteria's for getting the contract and put the offer in tender. Depending of the project value the tender can be national or international. The limit of going national in tender is approximately €3 million for road construction projects. After receiving all the offers of interested contractors, the client chooses an offer upon the criteria's. The criteria's of the profession contract usually is the cheapest offer.



The profession contract is suited to traditional subject division, and gives the client an opportunity to make business with specialized companies. Since there is usually found a significant number of companies within the various disciplines, the competition is increased, which usually leads to lower prices.

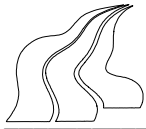
The risks of using a profession contract are for the client the puzzle of planning all the separate work that has to be performed by the involved contractors in the same time. If the timing assumption in the offering basis does not hold, the client may be moved against claims from the late profession contractor. This type of contract therefore requires a careful organization and management of the construction process from the client. The profession contract is the most common of the four contract types and is widely used on large and small- and simple and complex construction tasks in public- as well as in private construction.

4.1.2 The Turnkey Contract

The turnkey contract is defined by one or more contractors who works together to make a proposition of the project that the contractor defines the usages in the tender. The client chooses the turnkey contractor by defined parameters in the tender. The turnkey contractor is responsible of controlling the construction process and for hiring subcontractors if necessary. The turnkey contractor is responsible of creating the design of the road and afterwards for constructing it. Design is not included in the offering specifications, and the contractor can be responsible for the material and design choices. Presentation of project details is fully or partially left to complete for the turnkey contractor.

The turnkey contract normally includes a complete construction task, but certain parts of a task or a part of a task can be offered in turnkey, while other parts of the construction is offered on a client's full detail project. Such a partial turnkey will often be present for technical installations, where the client is the provider of performance and incorporation measurements, while turnkey contractor is responsible of the details. Turnkey tasks can be performed by the construction company alone with own consultants or by a group of turnkey contractors and associated advisers.

When establishing a turnkey contract the client needs to define the usage, function and the selection criteria's of the project they want constructed before sending the project in tender. Upon the criteria the interested contractors starts designing their offer and deliver their proposals the client on an agreed date. The client evaluates the offers and chooses the contractor upon the selection criteria. In this type of contract it is normally the price or the most economically advantageous offer. This is often a combination of the construction price and the maintenance costs.



The turnkey contract is used on projects where the client has less experience in designing and controlling the construction or where the project is not clearly defined of design and function. By using the turnkey contract the client forces the contractor to be creative in the proposition of design, function and materials in order to make the best profit on the construction. The risk of using the turnkey contract for the contractor is not having a carefully planned time schedule. Like the client in a profession contract it is now the contractor that has the planning responsibility and therefore the risks of claims by subcontractors when delays in construction occur. The turnkey contract is used in nearly all areas of construction and can be used by many contractors in the same project, like the profession contract. The most common use of the turnkey contracts is in complex tasks, where the contractor has the experience to complete a task in the best possible way.

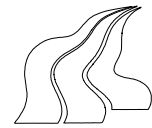
4.1.3 The Total Supply Contract

The total supply contract is a contract where the contractor design, builds or renovates and maintain a construction in a given period of years, typically 20-30 years. Like the turnkey contract it can be made by one or more contractors and the parameters of choosing the proposition is similar. By giving the maintenance responsibility to the contractor it forces the contractor to think in overall economic reasoning. For instance could more expensive materials be likely to have better durability which may be cheaper in the end for the contractor.

When establishing a total supply contract the client needs to define the usage, function, criteria's of maintenance, length of maintenance period and the selection criteria's before sending the project in tender. Upon the criteria's the interested contractor's starts designing their offer and defining the maintenance plan of the project after ending the construction. The interested contractors deliver their proposals to the client on an agreed date. After evaluation upon the selection criteria's, the client evaluates the offers and chooses the winning contractor. In this type of contract the selection criteria's is normally the price cause nearly all other expenses is covered by the contractor.

The total supply contract is relative used on large and complex projects that need a lot of maintenance during the usage time. The contract can be used either in private or in public projects where need of maintenance is required.

By making a contract that is supposed to deal with all the problems 20-30 years in the future is a challenge for the client. There is a risk of using a lot of time working on a contract where specific parts of it, that is not necessary in the future. In order to minimise the economic risk for the client and the contractor it is necessary to make it clear what the requirements are for the project and what is required for the contractor to get paid for constructing and for maintaining. The risk for the client is that the project



is so complex that there is none or only one that makes an offer, which may lead to a more expensive construction. The risks for the contractor is the requirement of skills in maintaining and understanding of the total economic process that is required in order to make profit. The total economic process is to design a construction that makes it easy to maintain and construct it of materials that is durable to whole contractual period or easy and cheap to repair.

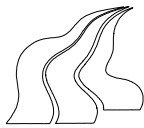
4.1.4 The Public Private Partnering Contract

The definition of Public Private Partnering (PPP) is an offering model for the public part where private company or companies design, construct, operate and finance public projects in a given period of years, typically 20-30 years. By giving the maintenance and finance responsibility to the contractor, it forces the contractor to think in overall economic reasoning. If the contractor is not able finance the project alone then the contractor needs to convince a bank or investment company that the proposition is able to make profit and therefore makes higher demands to the contractor. The public part defines the conditions and standards and the private part delivers it to an agreed price no matter what the actual costs of the project may be. The public buy a complete package of a private provider and not just a physical construction.

As this contract is specifically made for the public part the project is first to be agreed on political level. After the approval the project has to be defined in terms of usage, function, level of maintenance, project length and payment method and the selection criteria's. By giving the finance responsibility to the contractor it removes the risk of extra expenses of maintenance in a given period of time. Therefore the client focuses less on the most economically advantageous offer, because it is covered by the contractor in the maintenance period. The selection criteria will normally be the price of the project. After all the interested contractors has given their offer the public part has a certain amount of time defined in the offering criteria's to evaluate the propositions and choose one of them. After announcement the winning contractor can start the construction- and planning process.

The PPP contract is normally used on large public project due to the amount of contract preparation work. It is used on complex constructions and in fields where the public part is not strong in lack of manpower or qualified employees. The PPP contract offers the public part few risks in relation to the project. The risk for the public part is in relation to landownership and if archaeological remains are discovered in the construction process. The public part has the possibility to choose the instalment agreement and is therefore attractive to the public part which is subject to tight budgets.

The risks of using the PPP contract is for the public part that the criteria's of the project proposition is not well defined and the propositions they will get from the contractors



does not fit to their expectations. By giving away the risks attached with design, maintenance and finance the consequences are that there will only be a small amount of contractors that are willing to bid on the project. The public client has a risk of choosing a more expensive offer compared to using the previous contract types. The risk that the contractor is facing in a PPP contract is the demand of qualified employees, because the contractor needs to control all the phases of construction. Like in the total supply contract the contractor needs understanding of the total economic process in order to make profit. If the contractor has an investment company or bank to cover their financial aspect of the PPP contract the contractor faces a risk of disagreement of the financial partner. In order to prevent any problems a clearly defined contract between the partners needs to be made.

4.2 Comparisons of Contracts

The described contracts covers one to four of the issues that needs to be dealt with by one or more parts in order to realize a construction project which are called design, build, operate and finance. The differences in the four types of contracts for the contractor can be viewed on Figure 3.

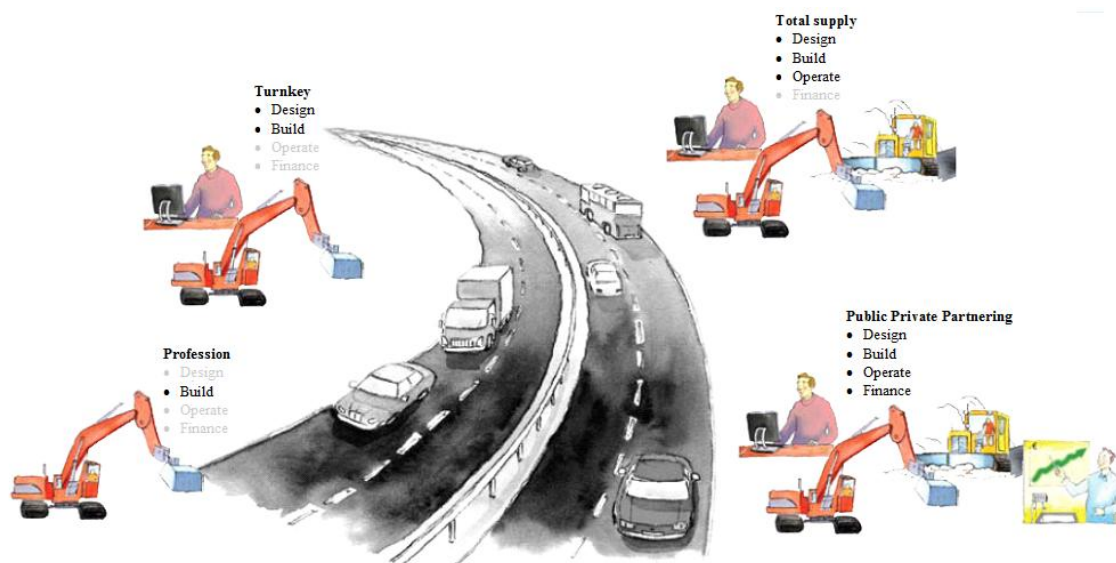
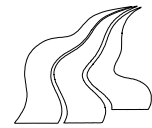


Figure 3: The four common types of road construction contracts for the contractor [Vejdirektoratet, 2008]

The types of contracts vary in influences of the construction for the client and contractor. Before start of the project the client needs to define the level of influence. A general rule is that the more the client participates in the design phase the more influence the client will be able to get.

By choosing the profession contract the client are the controlling the project and by dividing the project in profession the client will be able to get the lowest prices of the work. If the client has experience in efficient controlling the specific type of project the



client will be able to save money. On the other hand the project has potential to get a lot more expensive, if the client fails to control the project.

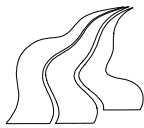
The turnkey contract provides the client with less organizing because they only need to hire one contractor to construct the road. If the contractor is not available to perform the entire tasks in the project, it is the responsibility of the contractor to hire subcontractors. On the other hand the control the contractor gets resolves in more flexibility compared to a profession contract. By hiring a turnkey contractor the economic risks decreases for the client when a fixed price of the project has been made. But it enables the contractor to make more money, if the contractor deals well with the risks.

By choosing the total supply contract the client hands away the operation requirement to the contractor which gives the company an economic interest in constructing the best possible road compared to the total expenses. When building with better materials the durability of the road increases, which properly leads to cheaper maintenance. The advantage of this type of contract is that the extended responsibility should encourage to better solutions from the contractor in order to save money. When giving away more responsibility to the contractor the client has to define a clear function- and output based requirements and specifications.

The Public Private Partnering contract adds the financing part of the project which provides the contractor with the challenge to find financial partners, to cover the expenses in case the contractor cannot. By handing over the financial part the client creates a minimal risk of cost overruns, since the contractor has nearly all risks. With higher risk for the contractor usually resolves in higher prices. Like the total supply contract, the PPP contract should encourage the contractor to make better solutions for saving money. By handing nearly all responsibility to the contractor the client has very little influence in use of methods and solutions. In order to gain as much control the client has to define clear requirement specifications and define their level of controlling in the PPP contract.

4.3 The E18 Contract

The contract used at the E18 project is a Public Private Partnering contract which means that the contractor has the responsibility of designing, building, operating and financing the project. As a large infrastructure project that covers three counties, the project was agreed on national level by the Norwegian government in 2002. The proposal was made by the Norwegian Public Road Administration in 2005. Interested contractors were given six months to make an offer. The Norwegian Public Road Administration used five months to evaluate the propositions, and the offer from Bilfinger Berger and Pihl were chosen. [Statens vegvesen, 2007]



The contract between RS-OPS, AOV, CJV-E18 and its subcontractors are the same contract. In order for this to happen, the contract has to be general, but still cover every aspect of the Norwegian law. This principle is called a back to back. The contract has two appendixes that describe the requirements that AOV has to RS-OPS and CJV-E18 has to AOV. [Birkholm, 2008] & [Roesgaard, 2008]. Mrs. Birkholm was QA Engineer at CJV-E18 until November 2008. She has mainly provided information about the contractual requirements of QA Roads, data and knowledge about QA Roads at CJV-E18.

The PPP contract divides the responsibilities between the three parties and makes RS-OPS the authority, AOV maintainer and financier and CJV-E18 as the designer and constructor. The contract states a hierarchy and a specific way of communication between the involved parties. The contractual organization is described in Figure 4. The dotted line in the figure is meant as only if the construct- and maintenance contractor cannot agree with specific issues they make borderline agreements together with the client. Rectangular boxes are companies and the elliptical boxes are the type of contract or agreement that has been made between the companies. [Roesgaard, 2008]

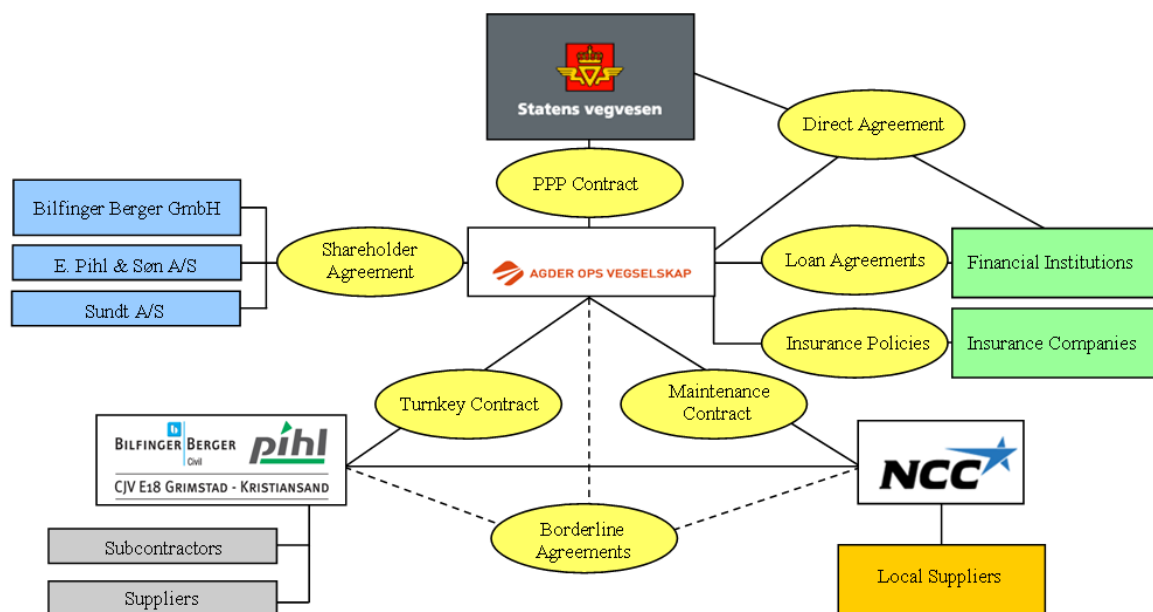
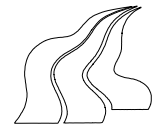


Figure 4: The Contractual Organization [CJV-E18, 2008]



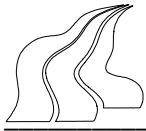
The PPP contract between the parties are divided in a general part that describes the conditions of the contract and eight appendixes. The structure and titles are stated as:

- Contractual conditions
 - Project description
 - Technical descriptions
 - Restitution and Payment
 - Administrative conditions
 - Third party agreement
 - Financial model
 - Commercial and financial terms
 - Technical documentation

The first part is the actual contract and describes the project and terms of involvement the RS-OPS has on the project. The contract states the expectations to what AOV must deliver and their role during construction and maintenance. The contract describes all the expectations and agreements on an overall level. All the details are stated in the remaining eight parts which is appendixes to the contract. The two appendixes that are interested for the contractor is the technical descriptions and technical documentation which describes the requirements to the project that the contractor needs to fulfil. [Statens vegvesen, 2006]

The appendix called technical descriptions runs through all the disciplines and constructions of the project and describes the function and requirements. It is detailed and refers to the Norwegian road law for tolerances and documentation requirements. The other appendix called technical documentation is a description of the E18 project in terms of road geometry, mass deposits etc. This appendix is nearly identical with the final offer that AOV delivered to the client. It has been reviewed by SVV and some of the options in the final offer have been incorporated. [Statens vegvesen, 2006]

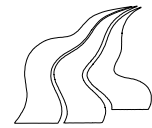
Common for the two appendixes is that they state all the requirements to the construction that the contractor has to apply. In order to fulfil the requirement the contractor has to establish an organization that manage all the tasks.



4.4 Discussion

In this chapter we discovered that the PPP contract has the largest risk but in the same time the largest potential for making profit for the contractor. CJV-E18 is responsible for designing and constructing the highway which generally mean that they are turnkey contractor to AOV, but due to the back to back contract the PPP contract that were made between RS-OPS and AOV counts for CJV-E18 as well. Is this the optimal condition for CJV-E18?

The PPP contract hands over nearly every responsibility to the contractor which requires skilled employees and a strong organization to handle these tasks. Do we have the right employees and the strong organization?



5 Configuration of Organization

An Organization is defined as a unit that manages all aspects required in order to run. To achieve the goals certain actions or tasks has to be carried out. Of practical reasons it is common to collect these in main tasks also called functions. The purpose of the functions is to carry out the tasks that lead to completion of the goals. Functions are normally bounded by the field of work they are covering. In order to establish an organization with functions the work has to be divided. The phases are defined as:

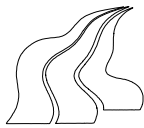
- Defining of work in order to fulfil the company's ideas and goals and establish functions.
- Dividing of functions in departments usually below the management
- In each department - dividing of tasks in the department and sub departments
- In each sub department – dividing of tasks on positions/persons.

Departments which have sub departments are often related to each by the type of work or the process that contributes to the product the department delivers. The department is established on behalf of the purpose and marked orientation. The principal is called marked orientated grouping. [Hansen & Heide, 2000]

5.1 Organization of CJV-E18

The organization of CJV-E18 is generally built on those principles. The project contains the need of constructing roads, bridges, culverts and tunnels. In addition there has been established an Electric and Mechanical department to take care of all the electrical and mechanical tasks in the remaining teams.

To fulfil the contract and the Norwegian laws there is required to establish various departments that cooperate with the four teams. A survey team is required so the structures of the project get placed correct. If during the project there is a need to make changes in the design, a design team is required to correct the drawings and make As-Build drawings for final documentation. To secure that the construction is build in a way that the environment is not harmed, it requires an environmental department. To ensure the quality of what the four teams construct, it requires a Quality Assurance (QA) department. In order to protect the employees when working in a hazardous environment there is a need for a Health Safety and Environment (HSE) department. The HSE team train the employees in safety related issues and visits every construction each day to guarantee that the HSE plan is kept. To order the materials that is used on site, that the IT facility's is running and to take care of Human Resource issues there is a need of an Administration and Finance department.



The departments need to cooperate in a matrix with the four executing teams in order to fulfil the requirements that are stated in the contract. The organization is dynamic and changes regularly due to change in staff and completion of structures. A simplified organization structure can be viewed in Figure 5 and the latest organization chart can be viewed in Annex A.

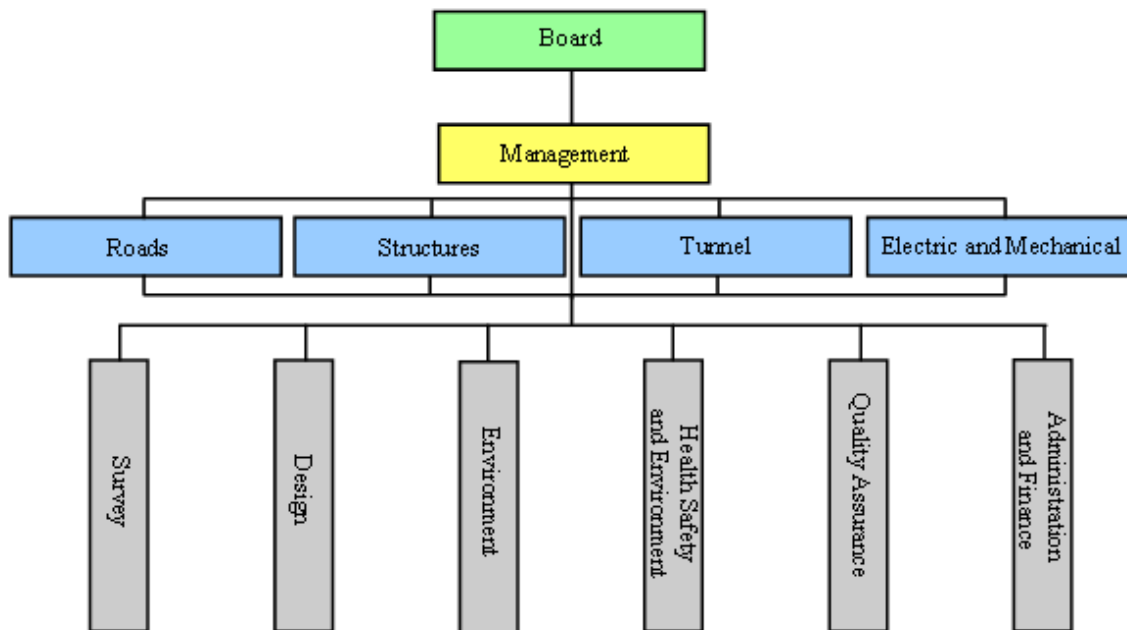
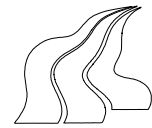


Figure 5: Simplified Organization Chart

All the specified departments below management have specific requirements in order to fulfil the contract. By looking further into the contract there is one of the departments that have special requirements in order to be able to hand over the project. The contract states, that if the contractor cannot prove that the construction fulfils the requirements, the client is allowed to hold back the monthly instalment, until the contractor delivers the sufficient documentation. According to the contract the Quality Assurance is one of the vital organs in the organization in order to complete its goals. [Statens vegvesen, 2006]

5.2 Quality Assurance

Quality Assurance (QA) is defined as a tool to prevent injuries and other failures in construction. Prevention is usually cheaper than repairing for the construction as well for social economic reasons. By securing quality in construction the involved parties are able to avoid or minimize redesigning, waste, failures and damages and thereby saving money on not redoing work and replacing materials. The product of QA is a cost-effective construction. Quality Assurance counts in the complete construction process. By having an effective QA system, possible claims of the client can be avoided and thereby time and money in judicial showdown. The goal is not an unblemished



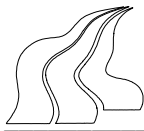
construction. This would be technically impossible and even the approximate degree prohibitively expensive. The goal is partly to avoid the greater harm, and the many failures in the building. Many studies have shown that systematic Quality Assurance has paid off. [Erhvervs- & Byggestyrelsen, 2003b]

QA ensures that all planned actions deemed necessary to provide confidence to all stakeholders to a project satisfy given requirements. Suppliers, distributors and other providing products and projects were beginning to be held responsible for any damages caused by the product to persons or property – product liability. To ensure safety and to limit consequences of any damage, additional factors were incorporated into quality activities. [Smith et. al, 2008]

The scope of QA is defined by the national law and the requirements to quality that the client requires in the contract. All the involved parts in a construction process have the responsibility of securing their own work. The client of the project has the responsibility to secure the work the contractor by checking and controlling the data provided by the contractor and taking tests in order to validate the data from the contractor. Before starting the work the contractor are required make a quality plan that define the scope of QA during construction. A major part of the control effort will typically aim the internal control of the contractor, which is irrelevant for the client. The part of the control plan, which concerns the client, should be stated in the contract agreement. [Erhvervs- & Byggestyrelsen, 2003b]

The QA system is supposed to work in the whole company. Before materials are ordered product certificates about content, lifespan and maintenance has to be checked in accordance to national law. When the materials are delivered on site the serial numbers or product codes is to be filed in order to create total traceability of all products. If a product fails the maintainer knows were other materials of the same series are placed and is then able to replace before failure occurs. Tests of the material before and after placing if necessary will be preformed and authored. The contractual required documentation is then to be collected and processed and afterwards handed over to the client.

Handing over documentation continuously during the construction is an advantage. The intention is that the evidence must be more useful, and to prevent that the documentation is simply a set of formal papers, drawn up by its completion, without connection with the activities it should cover. This forces the client to be active and respond regularly, if the documentation justifies this. Commitment to keep the system and regular communication with the client is to be considered essential. [Erhvervs- & Byggestyrelsen, 2003b]



In QA there exist essential elements that are described as an undertaking which has a beginning and an end is carried out to meet established goals within cost, schedule and quality objective. These elements of QA should be considered both internally and externally and not in isolation. The elements are:

- Confidence
- Control
- Consistency
- Cost-effectiveness
- Commitment
- Communication

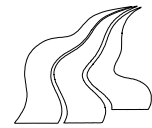
5.2.1 Advantages and Disadvantages

The advantages of QA are mutual security for the client as well for the contractor that what is constructed fulfils the requirements and will last as predicted. A QA system should intercept a large amount of the mistakes that is made during the process. Early correction is cheaper than late correction. When maintaining the total traceability principle is important in order to correct mistakes after the end of the project. This makes claiming easier when the supplier and serial number is known. [Erhvervs- & Byggestyrelsen, 2003b]

A frequent appeal against QA is that the documentation requirements leads to too much paperwork, and that effort does not have real meaning, but solely of a formal nature. This may be linked to the way in which control plans previously were developed and deployed. By using QA all problems are not unveiled when evaluating the quality documentation. The QA system is not alone able to catch all human made mistakes during the construction. The problems that are noticed are incomplete design, lack of instructions in the right execution, execution errors, too minimized materials, weak penalties and poor use of technical and organizational experience. [Erhvervs- & Byggestyrelsen, 2003b]

5.2.2 Obtaining a QA System

In order to meet the described elements in chapter 5.1 it requires planning. The solution is a Quality Plan (QP) which defines the support, structure and formats, identifying the major quality processes, development of a quality manual and procedural documentation, development of communication training, implementation and support plans and establishment of a tracing and review system. [Smith et. al, 2008]



A QP is a document setting out the specific quality practices, resources and activities relevant to a particular process, service or project. The QP should define:

- The quality objects to be attained.
- The specific allocation of responsibility and authority during the different phases of the project.
- The specific procedures, methods and work instructions to be applied.
- Suitable testing, inspection and audit programmes at appropriate stages.
- A method for changes and modifications in a quality plan as projects proceeds.
- Other measures necessary to meet objectives.

To be of value, the first issue of a QP must be made before the commencement of work on site. It is also essential that it should be a document that should be commenced at tender stage as a part of the normal routine of project planning. Quality Plans should be succinct as possible and discussed with all those involved in its implementation. [Smith et. al, 2008]

A QA system must always be adjusted to suit the projects operation and final product. It must be designed so that the emphasis is put on preventive actions, at the same time allowing the project manager to correct any mistakes that do occur during the project life cycle. In most projects control documentation provides the data required to improve the system and hence the project quality. The Deming circle on Figure 6 specifies the relation between the four important processes that is required to perform and improve QA. [Smith et. al, 2008]

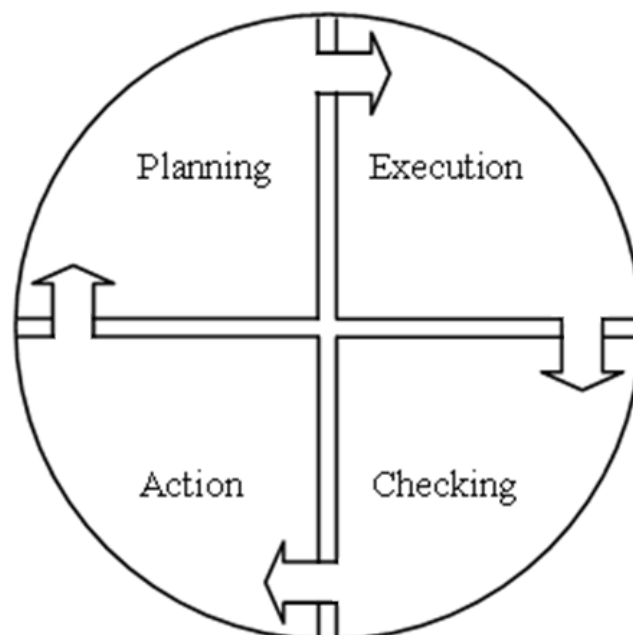
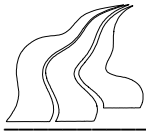


Figure 6: The Deming circle of quality improvement [Jonson, 1988]



To achieve a satisfying result, all activities and tasks requires planning. Execution should be based on necessary expertise and resources, and results must be checked. Checking must be followed by action. Deflective products or sections of work must be removed. Information gained must be analyzed and recorded to prevent the same defects from appearing again. [Smith et. al, 2008]

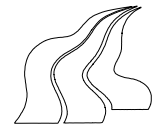
5.2.3 Dividing of responsibilities

To achieve the goals of the QA System, responsibilities needs to be divided. According to the previous titles in this chapter there are six elements; confidence control, consistency, cost effectiveness, commitment and communication. To create confidence there is a need of a strong and transparent QA system for the client. Confidence to the QA system can be created by having consistent control procedures and regular communication with the client. To fulfil the first four requirements there is a need for staff to control on site and to evaluate and present the data to the client. By applying consistent QA cost-effectiveness should be applied automatically. To create commitment there is a need of implement the QA system in such way that the executing part of the construction feels ownership of the preformed work. Implementation will be treated in chapter 7.

To plan the QA department and run it in accordance to the contract and national law a QP is necessary. Creation, evaluation and keeping the plan updated is the responsibility of the QA department. QA staff is needed for executing the planned tests and for evaluating and refining the methods. The QA department is responsible of covering all the aspects in the Deming cycle.

5.3 The QA Roads Department at CJV-E18

The purpose of QA Roads Department at CJV-E18 is to minimize mistakes and failures as described in chapter 5.1. In order to fulfil the roles, responsibilities has to be divided into the positions of the department. The following chapter describes the positions and describes the tools of the QA Department.



5.3.1 Positions and tasks

The QA Roads Department at CJV-E18 is organized in accordance to the contract. The organisation structure can be viewed at Figure 7.

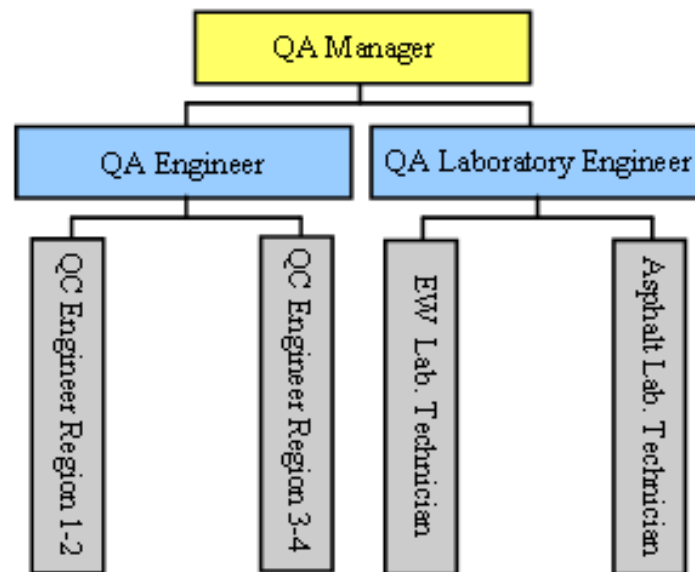
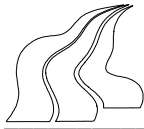


Figure 7: Positions in QA Roads Department

The QA Manager is responsible for reaching the goals of the QA Department in accordance to the contract, Norwegian laws and regulations and the internal goals that CJV-E18 has to the department. The QA Manager at CJV-E18 is also responsible of the HSE department. To keep in touch with the progress and tasks of the departments, meetings are being held every second week. The QA Manager is often used by the QA staff as a mentor and used for advice in specific issues.

Below management a QA Engineer takes care of the administrative work. The QA Engineer evaluates incoming QA data and servicing the executing departments on site. When a site engineer or supervisor has doubt of the work in relation to the Norwegian laws, they can be helped by the QA Engineer. In relation to site inspections internally as well as official with the client, the QA Engineer participates in the inspections together with one of the Quality Control (QC) Engineers. The QA Engineer is the person that AOV contacts if they have any questions regarding the quality, tests and procedures performed by CJV-E18.

The QC Engineers work mostly on site to ensure the work is performed on site is in accordance to the contract and laws relevant for road construction. They are in daily contact with site engineers and supervisors to assist in QA related issues. The QC Engineers visits every road construction site and act as an internal quality control. Due to the scale of the construction, it is divided in four regions which are divided between the two controllers. If the QC Engineer finds a non conformance they inform the



responsible site engineer and discuss how to solve the problem. The QC Engineer creates a Non Conformity Report (NCR) and writes a description of the problem, corrective and preventive actions needed for solving. On site the QC Engineer collects data for the QA Engineers to evaluate and file.

The QA Laboratory Engineer is responsible of all test results from Earth Works and Asphalt. The QA Laboratory Engineer has prepared a test plan in accordance to the requirements in the law. When collecting samples for tests they are taken before and after placing. Earth Work samples are taken at the crushing plant, on site before placing. The samples are analyzed by the Laboratory Technician. When the material is placed and compacted the QA Laboratory Engineer performs a plate loading test of the material to secure that the material fulfils the static requirements. Asphalt samples are taken at the mixing plant and before placing on site. The samples are analyzed by the Laboratory Technician. After placing all the layers of asphalt the QA Laboratory Engineer drills a core. The core is pressure tested to secure that the material fulfils the requirements.

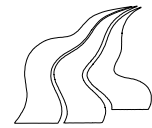
The Laboratory Technicians collect and analyze samples provided by the QA Laboratory Engineer. The EW Laboratory Technician performs a sieve analysis of the subbase and frost protection layer. The purpose of this analysis is to confirm that the delivered stone has the composition in accordance to the Norwegian tolerances. The Asphalt Laboratory Technician performs similar test of the asphalt layers by dissolving the asphalt and in addition determine the bitumen content.

5.3.2 Tools of the QA department

To secure that the construction is built in accordance to the contract and national laws the QA Roads Department has established a filing system for saving all the relevant documentation. The main alignment and side roads have been divided into four regions and 40 sections as reference points. When filling documentation the reference point is either the section name or the chainage of the main alignment or side road. The dividing is shown in Annex B.

To secure that the quality of the road QA has authored sheets for the executing staff to fill out after performed work. This insures that the employees take responsibility of the performed work, and make it easy for CJV-E18 to trace the contractor and claim, if problems later on occur. The papers are made by a QA Engineer in accordance to the contract and national laws. All types of sheets made by QA at CJV-E18 can be viewed on enclosed CD named QA Roads Templates CJV-E18.

QA Roads use staff for daily inspection of the construction sites as described in chapter 5.3.1. In CJV-E18 QA Roads are planned as advice and control department. As the internal



control QA Roads is often negative viewed on site and seen as “an expense” and change is hard to accomplish without approval from management. The reason to this is often cultural differences and lack of knowledge in relation to QA. It is therefore important that QA has respect on site to conduct their work. The project and worker should be suited to QA.

5.4 Project vs. QA

The project and organization of CJV-E18 is based on the agreed contract and therefore gives space to a QA department. The impact of QA in construction creates a lot of paperwork. To avoid this it requires preparation and planning in order to figure out the requirements to the construction.

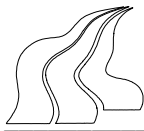
To create a QA department it is important to fulfil all the requirements of the contract, nation laws and internal goals in the company. A tool to inshore this is to create an instruction of position for every position. The staff has lots of responsibilities and tasks. To be able to control and assist on site, QA Roads has created lots of sheets and relies on the region managers and site engineers to fill out the sheets, admit and correct mistakes.

5.5 Discussion

According to this chapter is important to know the scope of work before developing an organisation to take care of all the tasks. In relation to QA the purpose of it is to evaluate all the necessary data required by the national law and to assist the executing teams on site. Does QA Roads fulfil this purpose or do they take more responsibility than that?

We know that a QA system is not alone able to catch all the mistakes during construction. According to Figure 7 there is only two QC's to cover the complete project. Is this enough to catch all mistakes?

The QA system for roads is modified templates that fulfil the national requirements. Have they been evaluated by the client and QA Roads shore that they fulfils all requirements?



6 QA's relations

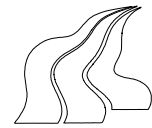
When creating a Quality Assurance system there are relations and requirements that the system needs to cover before the implantation process can start. As an advising organ in the construction process the QA department needs to keep in touch with many actors in the construction process internally as well as externally. There are relations and that needs to established and dealt with before the project start. These are the relations and requirements to the contract and national law which will be described in this chapter.

6.1 The Contract

The PPP contract which applies for CJV-E18 is a contract with eight appendixes. The general contract and two of the appendixes is interesting for the contractor is technical descriptions and technical documentation as stated in chapter 4.3.

In relation to Quality Assurance the contract states in requirements to fulfil the contract that "All the services of the PPP Company should be in accordance to every applicable law, regulation and other government plans, inclusive adoptions by Statens vegvesen." [Statens vegvesen, 2006]

The Technical Descriptions appendix states the requirements to the construction that varies for the Norwegian road laws. The contract states the responsibility of securing the construction phase. "The PPP Company has full responsibility to secure the construction." To prevent damage in the construction the contract states: "The PPP Company should establish their company so damages don't occur on surrounding constructions and/or installations..." The requirements to the documentation is; "The PPP Company should establish and maintain a system for documentation of inspection, surveillance and completed work" and "The quality of the public road should as minimum be documented in accordance to Handbook 018." If mistakes during the construction occur "The PPP Company should give a message to the Norwegian road Authority about mistakes, missing bits and other relations the PPP Company observes and knows about..." The requirements to the road before handing it over is; "The construction should at the end of the contract have a good technical and aesthetical standard so it can be driven and maintained with normal costs. The construction should be clean, all damages should be repaired and other requirements that follow the contract documents should be satisfied. Electrical constructions and wired equipment should satisfy current laws at the end of the contract. All pipes, manholes and other water re-circulation should be cleaned before the end of the contract." In relation to the constructed roads; "Roads, side areas, vegetation, noise barriers etc. should be in a condition that fits to the intention that formed the basis for the design." The remaining part of this appendix divides the responsibility between the involved parties and specific states the requirements of the construction parts. [Statens vegvesen, 2006]



The remaining appendix named Technical Documentation describes the requirements for documentation. In relation to a QA Roads system the appendix states; "In construction there will be conducted internal control that specially follow up the important requirement specifications that is defined in the construction plan." The construction plan states that it should follow the Norwegian road laws. [Statens vegvesen, 2006]

6.2 National Law

As described in the last chapter the contract has been build up in accordance to the structure of the Norwegian laws. The law consists of Norwegian Standards (NS), Handbooks (HB), Directives and Guidelines (DG). This chapter and subchapters describes the structure and difference in the three types of laws and the hierarchy of them.

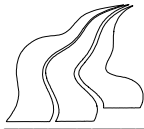
6.2.1 Handbooks

The handbooks are defined as a simplification of the Norwegian road law approved by the government of Norway. The handbooks has basis in road law and requires approval the road department of the traffic department before publishing. [Wikeland, 2008]. Mr. Wikeland is employed by Statens vegvesen and works with law- and expansion issues. Mr. Wikeland has contributed with his knowledge of the Norwegian road law structure.

The purpose of the handbooks is to secure consistency and quality when constructing roads. The handbooks disseminate what to do and how to do it and are some cases also explain why to do it as described.

Handbooks are divided in specific subjects and are given a unique number when approved. The majority of the handbook is available at the homepage of Statens vegvesen. The book's cover all aspects of road construction.

They are divided in two levels. The first level is coloured yellow in the cover. This level includes regulations, Perpendicular and guidelines. The second level is coloured blue in the cover and includes guides, textbooks and road data.



HB's identifies three terms which define whether the rules should be respected. The terms are defined in Table 1 and how to interpret them.

Verb.	Significance
Must	Requirement
Should	Recommendation
Can	Alternative or example

Table 1: Terms of significance in the handbooks

6.2.2 Norwegian Standards

Norwegian Standards are defined as strict law that is to be followed all time. In relation to the HB's the standards is not to be interpreted in must, should and can. The NS are approved by a standardization committee that consist of people from SVV and private companies and has no governmental relations.

The purpose of the Norwegian Standards is to produce specific roles of constructing infrastructure in Norway. Tolerances and other requirements are normally found in NS. The Standards is often referred to in the handbooks as guideline for construction issues.

6.2.3 Directives and Guidelines

Directives and Guidelines are defined as local laws that are approved by the county and the local department of SVV. They describe specific problems that are present in the county which needs to be dealt with in a specific way.

6.2.4 Weighting

The Norwegian road laws approved by the government are simplified and procedures to conduct the work have been written in handbooks. The handbooks are based on the Norwegian road laws and are to be considered as the most important of the law types. Handbooks refer to the Norwegian Standards which has no basis in the Norwegian road laws. Norwegian Standards gives specific requirements and tolerances to the construction. Directives and Guidelines are local laws that count for specific local conditions. The hierarchy and correspondence of the types of publications regarding the Norwegian Road Laws are shown in Figure 8. [Wikeland, 2008]

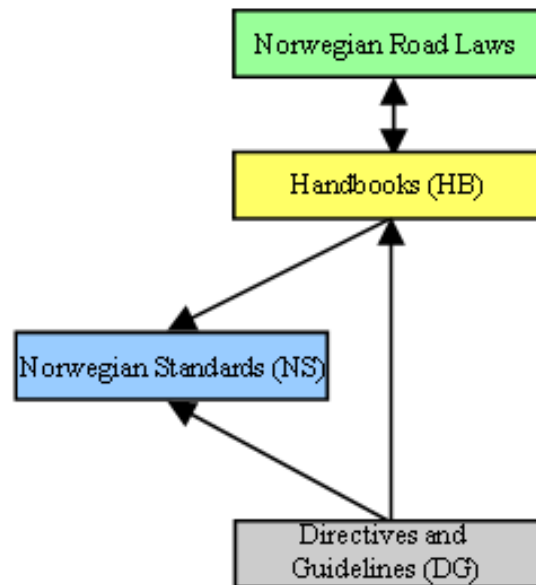
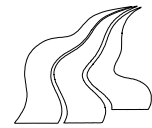


Figure 8: Hierarchy and correspondence of the Norwegian Road law publications. [Wikeland, 2008]

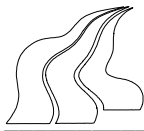
6.3 Challenges of QA Roads

According to the previous chapters QA has requirements according to the contract, in the organization and to the national road laws. The QA system is required to adapt to all requirements that is defined in the contract. The contract refers to the standards and handbook but states that the QA system needs to deliver documentation at least in accordance to the minimum requirements of the law. The scope of work for QA Roads is stated in chapter 5.3 and the contractual requirements defined. QA needs to create a system that fits to all the requirements, but in the same time are divided in accordance to the preformed work on site. The challenges that QA is to:

- Meet all requirements
- Keep the overview
- Minimize the paperwork
- Implement an effective QA system

6.4 Discussion

We have discovered that the PPP contract for E18 project is generally based on the requirements of the national road laws. The contract states very little on the physical requirements to the QA Roads Department and nothing about quality management standards it should fulfil besides of the actual requirements of the law. Do we need to fulfil such standard?



7 Dealing with the Challenges

As described in the earlier chapters a QA Road department are dealing with challenges in relation to the:

- Contract
- Organisation
- National Road Laws

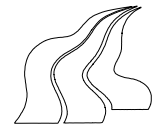
The above mention challenges needs to be dealt with early in construction phase to create the best condition and profit for the contractor. The challenges are dealt with by preparation. In order to execute and operate the QA system in accordance to intentions and challenges it needs to be implemented. To implement QA common understandings of quality and purpose if the paperwork is important in order to secure an effective QA system. The following chapter describes the challenges of implementation QA in roads construction.

7.1 In Accordance to Projects

Implementing a project specific quality system involves identifying terms, regulations and requirements to the project. [Smith et al, 2008] has identified following to be clarified:

- Determine the size and characteristics of the project, project term and its locations.
- Identify the status of existing documentation and determine whether or not existing documentation is compatible with the proposed project activities.
- Determine the range of project activities within the specific project.
- Identify the level of activities within the project and the method of work allocation.
- Determine the responsibilities and commitment of the project management team.
- Evaluate what customers really want and then map the processes relevant to improving customer's satisfaction.

By clarifying these, the consequences would be a clear plan in relation to the scope of work, need of staff and documentation to the client and makes planning of dealing with the challenges possible. Implementation requires knowledge of the QA department about the conditions of the project, from the executing worker to the client. To implement an effective quality system it requires commitment and understandings of all involved parties of its purpose.



7.2 In CJV-E18

The challenges at CJV-E18 towards the contract are to fulfil all requirements as effective as possible. In accordance with the previous chapter CJV-E18 has to clarify the six described points in order to start implementation.

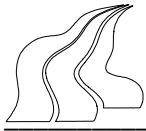
CJV-E18 is constructing the largest infrastructure project ever made in Norway. QA Roads has to perform QA on a four lane highway of 38,3km and 75km of additional roads. The roads consist of drainage, manholes, earthworks layers, asphalt layers, etc which needs QA attention. The Norwegian landscape is mainly mountain and some of them are sulphuric. Attention and experience of dealing with this is necessary. CJV-E18 has hired 217 subcontractors to assist the constructing the project. There is up to 1050 employees from 33 nationalities working on the project.

Since this is generally a completely new road that CJV-E18 is constructing, hardly any previous documentation exists. In few places old subbase layers are reused but stability test are conducted to inshore the stability of the road.

The range of the project is to inshore the quality requirements in the contract are kept. According to chapter 5.3 the QA Roads department consists of seven employees that generally need to cover following tasks:

- Assist team Road in QA related issues
- Evaluation of requirements, method statements and audits
- Write general procedures
- Perform daily site inspections
- Collect documentation on site
- Collect samples
- Perform tests
- Evaluate test results
- Collect documentation and filing them in the QA system
- Create packages for final documentation

The level of activities within the project is defined by the contract. According to chapter 6 the road should be constructed accordance to every applicable law, regulation and other government plans, inclusive adoptions by Statens vegvesen. To fulfil this the QA Roads Department have created templates that is filled by the performing part to document the work in addition test results and a survey are conducted to fulfil the requirements. The methods of how to conduct the work are described by the QA department in general procedures. The general procedures describes the responsibilities



of the work, use of tools how to conduct the work and perform tests and the acceptable tolerances.

The overall responsibility of running the QA department is the QA manager. The QA manager is used by the QA staff for clearing important issues, coaching and discussing specific problems. It is expected that the QA staff is working independently. Every second week all QA departments meet and discuss current issues to keep the manager updated.

When CJV-E18 started a QA meeting where made with AOV where CJV-E18 presented their quality plan, what they are filling and what they are collecting and delivering as final documentation. It were agreed that CJV-E18 deliver a digital data base with recipes, correspondence to keep their total traceability requirements. A second database where created with a digital copy of the final documentation which are required as a hard copy. Only minor improvements of the system have been made.

7.3 Implementation of QA

The scale and involvement of nationalities at the CJV-E18 project makes the implementation process interesting for further investigation. In order to implement a QA system it is necessary according to chapter 5.2.2 that the QA system is accepted and respected by the construction worker. Commitment from all involved parties is required for effective implementation of a QA system. To implement QA it is necessary to analyze the conditions, scope of work, requirements by contract and national law which have been done in the previous chapters.

7.3.1 Tools

To secure an effective implementation CJV-E18 has written a quality plan which states the basis of the project, organisation, the inspection plan, procedures and inspection documents that are needed to inshore the quality. The plan can be viewed at Annex C. The quality plan is based on the ISO 9001 Quality Management Standard. The product of standard has resolved in a QA system which can be viewed on Figure 9.

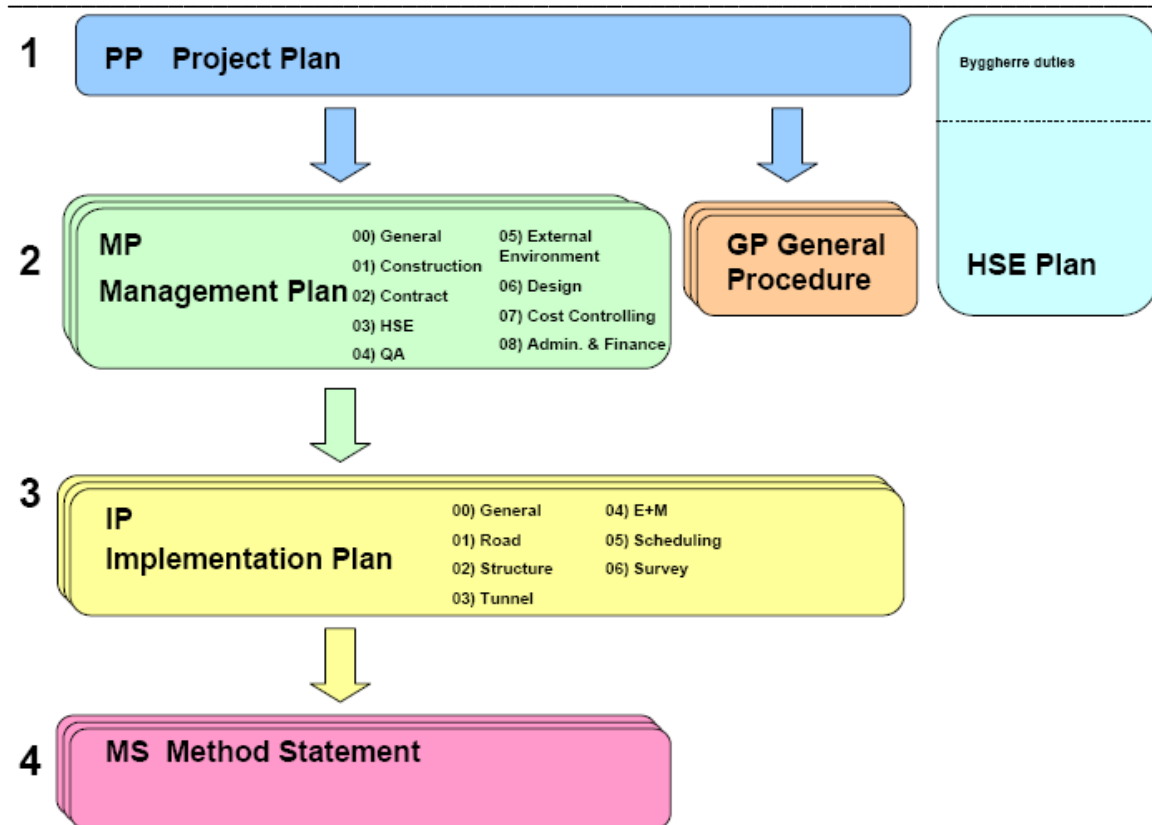
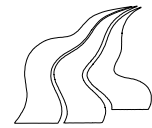
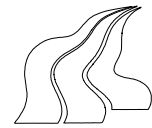


Figure 9: The QA system of CIV-E18 based on the ISO 9001 Standard. [CJV-E18]

The QA system consists of four levels of plans, procedures and statements which are the responsibility of the QA staff to prepare and regularly evaluate. To secure a unified execution of the conducted work on site QA Roads have made general procedures which are described in the previous chapter. The procedures are a tool for the responsible site engineer or supervisor, to easy and effectively get knowledge of specific work and advise the executing employees.

7.3.2 QA Roads

To document the conducted work in accordance to contractual requirements templates has been created by QA Roads. The templates have been simplified so only consist what is necessary in accordance to the requirements. Due to the many nations that are working on site these templates has been translated into varies of languages to secure that the employees fully understands what they sign. The procedure for QA Roads of dealing with documents is shown at Figure 10.



Every human is raised with values and core beliefs. These are hard to abandon and when they are challenged we instinctively defend them. On Figure 11 our paths for core beliefs is illustrated when interacting with different culture types.

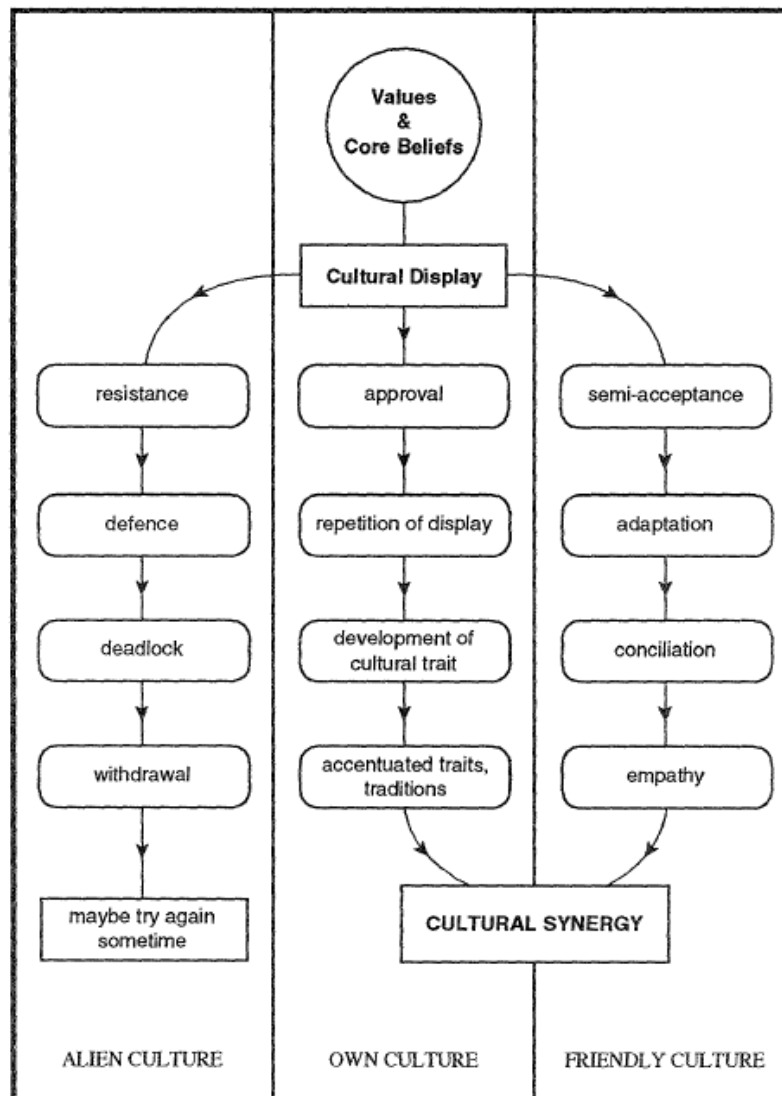
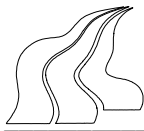


Figure 11: Paths for core beliefs. [Lewis, 1999]

The figure shows the reaction pattern for the three possible outcomes with cultures. It shows the end result of a collision with a friendly culture creates cultural synergy which is defined as an understanding and acceptance of each others. The key to an easy cooperation between nations is if they possess the same values and core beliefs. All nations can be roughly divided into three groups which has different values.

- The task orientated, highly organized planners called linear active.
- The people orientated loquacious interrelators called multi active.
- The introvert respect-orientated listeners called reactive.



The linear active nations are characterised as introvert and quiet that minds their own business. They work on fixed hours, do one thing at a time, plan their day and rely on facts, logic and experience.

The multi active nations are characterised as extrovert and talkative they are inquisitive. They work on any hours and do several things at once, plan the grand outline only and rely on emotion and oral information.

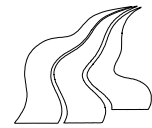
The reactive nations are characterised as introvert and quiet and respectful. They work on flexible hours and reacts on the co-operators values in relation to planning and executing work. The reactive nations are able to have the same tendencies as the linear active and multi active when reacting.

The linear active and multi active nations are according to their characteristics the complete opposite of each other. On Figure 12 the cultures has been spread out according to their average values corresponding to the linear active and multi active characteristics.



Figure 12: The Linear Active and Multi Active Scale. [Lewis, 1999]

The reactive cultures are mainly found in Asia. The strongest reactive cultures are Japan, China and Taiwan. Finland is on the fifth place and is the only expectance of strongly



reactive cultures that is not Asian. Besides of Finland, Sweden and Brittan have tendencies of being occasionally reactive.

The effect of these cultural collisions in a company resolves in misunderstandings, anger and lack of respect to each other if the cultures are not aware of their differences. The cultural differences do not only count in cooperation with each other but also in the leadership style. On Figure 13 the preferred style of leadership in different cultures are shown.

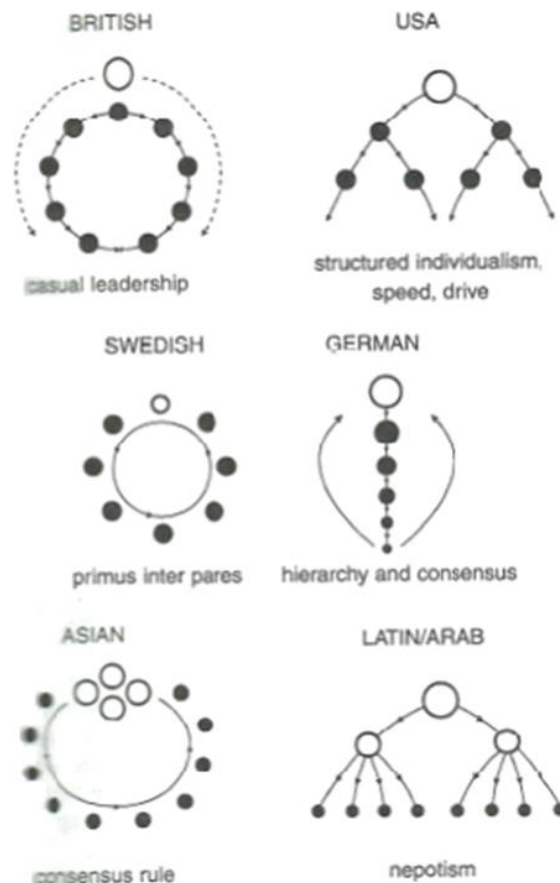
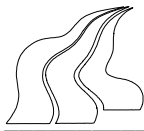


Figure 13: Leadership styles [Lewis, 1999]

7.4 Effects on QA Roads

At CJV-E18 the effects described in chapter 7.3 are present. According to chapter 7.3.1 the QA system is based on the ISO 9001 system and the product are shown at Figure 9. In order to keep such system it requires planning and completion of method statements and general procedures to create a homogeny construction process. The intention is fine, but the situation is, that many of them are not made. This count for the plans of the remaining plans in Figure 9. The flowchart at Figure 10 describe the processes which are supposed to take place when dealing with QA documentation, but problems starts before the documentation even reach the QC Engineers. The documentation is in some



cases not filled in correctly the reasons are believed to be that the employees do not know how to fill out the documentation. This leads to lack of commitment by staff on site because of this misunderstanding.

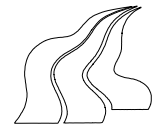
The awareness of communication failures between QA and its co-operating departments leads to chapter 7.3.3 where the collation of cultures where investigated. As mentioned in chapter 7.2 there is working up to 1050 people of 33 nations on this project. By comparing chapter 7.3.3 to the condition of CJV-E18 all nations that in their sub consciousness in most cases are restrained of people with other values and believes as shown in Figure 11.

In order to tackle this obstacle there is a need of knowing these values. According to [Lewis, 1999] it is by knowing where on the linear active and multi active scale shown in Figure 12, the co-operating nations are placed, it is easier to understand their way of working and believes inn working culture. Nearly all mentioned nations in the scale are working at this project which means that different approach is necessary. Linear active nations have difficulties working with multi active nations. The approach to work is completely different, but in the end the result is theoretically to be identical to each other.

Acceptance of differences are vital, but awareness is usually not existing which leads to disagreements and misunderstandings between the nations. The differences in values and believes are present in relation to leadership as shown in Figure 13.

By applying the theory on CJV-E18 in relation to the two main contractors, as an example, the differences are not large in relation to the scale on Figure 12. The Germans are placed on top as one of the most linear active nations while the Danes are to be found on the third row. In relation to leadership the differences between the nations are more obvious. The Germans operate with hierarchy and the Danes like the Swedes in the figure operate with primus inter pares or everybody is equal. Both nations have proved individually that they are able to reach goal with the leadership style, but the challenge for CJV-E18 is to combine these cultures to work effective together.

The awareness of the challenges are known, but in most case not considered or dealt with. At the mother company of Pihl are not considering the implantation challenges between cultures. The responsibility of creating an equal understanding between the cooperating nations is the manager, QA Engineer etc. In general all employees with leader authority are responsible. [Asklund, 2008]. Mr. Asklund is QA Manager at the mother company of Pihl in Denmark. He has provided information about the QA in Pihl and how it is implemented on projects.



7.5 Discussion

In chapter 7 we have focused on theoretical implementation which where basis of the analyses of the situation on CJV-E18. The analyses showed that there were problems with the information flow in the documentation flow chart shown at Figure 10. Do we tackle the challenges right and could the information flow be simplified?

The analyses of the implementation process have shown factors that are not taken care of. We are operating with a QA system that is not completely described in relation to the ISO 9001 standard. We have plans, general procedures and method statements that are not created or ongoing which creates regularly questions to QA Roads that could be avoided. Is the focus on the tasks that QA Roads are performing wrong? Is the capacity of QA Roads too small? Do we implement our QA system the right way in relation to the issues in this chapter?

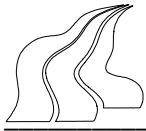
Mr. Asklund from the mother company of Pihl has stated their view on implementing and adapting to the cultural differences in projects. In the report there is no view by a key person of the mother company of Bilfinger Berger. Do they have the same opinion as Pihl? What do they do about the cultural differences when implementing QA?

7.6 Part Conclusion

According to chapter 7 dealing with challenges in the QA Roads department are affected by the contract, organisation and the national laws. When implementing QA it is important according to Smith et al, 2008 to identify, determine and evaluate specific processes described in chapter 7.1 to figure out the scale of the work and what is required to implement a QA system in a construction site.

Due to the scale and task of the project many nations have been involved in this project which makes it interesting to focus on effect on cultural diversity on site. The different believes and values that all nations' posses are affecting the view on work and the way of working. By analyzing the two contractors of CJV-E18 the differences on the linear active and multi active scale where minor, but in relation with leading style the difference where large. The effects of the difference are most likely to be present in the organisation.

At the mother company of Pihl the awareness of the challenges are known but in most case not considered or dealt with. The responsibility of making good co-operation between different cultures is all employees with leader authority in the company or department.



8 Clients role

The role of AOV is in relation to QA to secure that the construction is in a quality in accordance to the contract. As AOV has the responsibility to operate and maintain the next 25 years, they have an interest in quality since the guarantee by the contractor is 5 years. This chapter describes the role of the client and the expectations from their client RS-OPS and to the contractor CJV-E18. This chapter is based on [Kussel, 2008]. Mr. Kussel is QA Engineer at AOV. He reviews and the QA data provided by CJV-E18 treats QA related issues between the three parties and participates in the official site inspections. Mr. Kussel has provided information about AOV and their goals in relation to the contract and the shareholders.

8.1 AOV

The purpose of AOV is QA wise during construction to convince the investors that the highway is constructed in accordance the contract and Norwegian road laws. AOV needs to prove monthly what progress where made since last time in order to get money for the project. If they prove less progress than stated in the time schedule they get less money until CJV-E18 has obtained it. To please the investors AOV needs a constant flow of information about progress, test results and documentation from CJV-E18. The mother companies of CJV-E18 have to cover the expenses until it has been reached.

For further securing of the investors AOV has hired Asplan Viak for performing tests of quality, which is required by law that the client performs. Asplan Viak has been hired to avoid a double role in project due to the shareholder relationship described in chapter 3 and 4.

Giving less money to the contractor until the time schedule is kept is the only tool that the client has. The tool is according to AOV effective cause CJV-E18 is required by the contract to make a highway which fulfils these requirements as stated in the earlier chapters.

8.2 Contractual Balance

By being the client in relation to CJV-E18, AOV are facing the three interrelations called time, money and quality, shown on Figure 14, when dealing with primary objectives. The use of an equilateral triangle in this context is significant, because, while it may be possible to meet one or two of the primary objectives, meeting all three is nearly impossible.

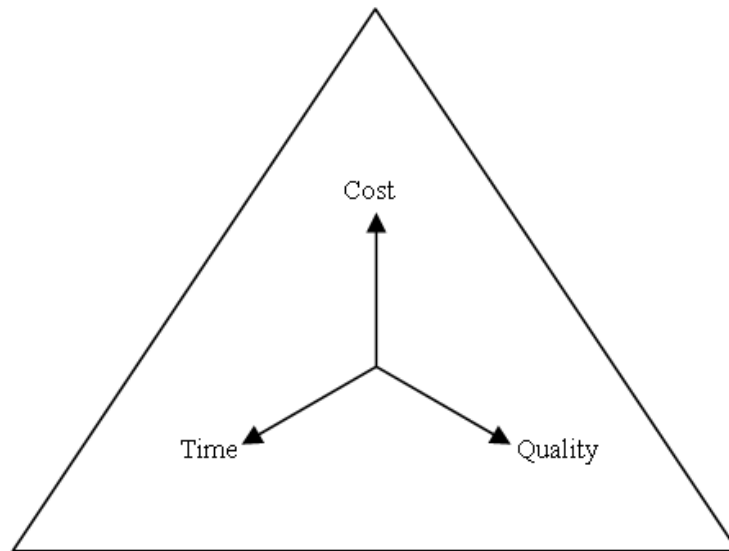
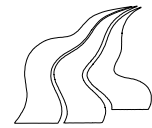


Figure 14: Triangle of primary objectives. [Smith et al, 2008]

Being client with company relation to the contractors puts AOV in a special case where they as the client are a part of defining the requirements to the contractor which has substantial influence on the economy of them.

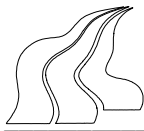
AOV does not prioritize any of the three primary objectives. They are looking at the whole process and are aware of all the objectives. They have a responsibility to the shareholders, banks and insurance companies that they deliver a road to the agreed price that fulfil all quality requirements and constructed in accordance to the time schedule. The consequence of failing one of the objectives is getting less money from the investors and later monthly payment by RS-OPS for the project.

8.3 Expectations to CJV-E18

The expectations to CJV-E18 is mainly concerning the quality of the road and keeping them updated about changes in plans, materials, etc. AOV expects CJV-E18 to keep the schedule of handing over the project.

Besides of these tasks AOV expects CJV-E18 to provide them with all quality related documentation as described in the contract and agreed on during construction. They expect to get a paper copy and a digital copy collected in a database. As the maintainer and financing player in the PPP project AOV has focus on the total economy regarding materials used in the construction and are aware that CJV-E18 keeps their total traceability obligations.

AOV take care of all communication from CJV-E18 to RS-OPS. They provide CJV-E18 with funds to construct the project. Due to this constellation AOV expects CJV-E18 to provide and perform all necessary information that needs to be dealt with by them and their



cooperative companies. The focus area of AOV is to ensure RS-OPS, the banks and insurance companies that the project is running as planned and the finance plan of the project is reliable. They conduct monthly meetings and are reliable of the data provided by CJV-E18, Asplan Viak and their site inspections. The amount of funds is decided in relation to the progress compared to the time schedule.

Since the existence of the earlier mentioned relation between AOV and CJV-E18 the two companies have a common economic interest in the project and are both working to fulfil the requirements that are agreed in the contract.

8.4 Expectations from RS-OPS

The expectations to AOV are to providing RS-OPS with a highway of highest quality that fulfils all requirements in the PPP contract. RS-OPS have different focus areas in the whole construction process. In the construction period they expect AOV to evaluate their contractor in fulfilling the contract. RS-OPS conduct tests and compare them with the data provided by AOV. During construction and inspections RS-OPS acts actively with specialists to evaluate the work conducted on site and check that the product that AOV delivers fulfils their expectations.

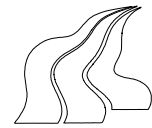
To ensure that AOV fulfil their requirements they are allowed to not accept the constructed road, if they believe that it is not constructed in accordance to the contract. The effect is a later payment and the consequence would be a more expensive project for AOV and the contractors. RS-OPS are allowed to pay the percentage that they believe is finished and keep it until the work is conducted.

When the construction period ends RS-OPS have focus that AOV fulfils their operate and maintenance responsibilities in accordance to the contract. RS-OPS have the same tools as in the construction period in relation to payment.

AOV and RS-OPS cooperates parallel in the whole project period. The relationship between them is client and contractor like AOV and CJV-E18. AOV has an interest of keeping their client RS-OPS as happy as possible and would do that as far as the contract allows. AOV are responsible of constructing and operation a highway that is as total economic and profitable as possible. They share the total economic interest with their client as the future owner at the end of the contract.

8.5 Discussion

The relation between CJV-E18 and AOV is defined by the construction by the contract and the need of staff to please their cooperation companies. AOV is kept external to CJV-E18 due to the influence of the shareholder Sundt A/S which is not a part of CJV-E18. But is this an advantage that they separated that much if they technically are



working together to fulfil the requirements from RS-OPS and consist of similar shareholders?

Due to the need of work to be conducted to please the financial connections AOV is considered large compared to similar AOV constructed companies in PPP projects. But is there a need for such size and could some of their tasks be dealt with by others?

AOV has no special focus of the triangle of primary objectives which are one of the essential tools of the client to the contractor according to [Smith et. al.] is this a mistake and is it correct by AOV to have a clear goal in relation to these equilateral goals?

8.6 Part Conclusion

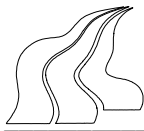
AOV is a company that takes care of communication between RS-OPS and CJV-E18. They provide CJV-E18 with funds in relation to their progress compared to the time schedule. As the client of the contractor CJV-E18 they are focusing on the total economy of the project because they are responsible of designing, constructing, operating and financing the project. They are entangled by their many relations to their client RS-OPS, shareholders banks and insurance companies as shown in Figure 4.

To take care of some of their tasks and obligations to their clients they have hired Asplan Viak. Due to their obligations they are reliable of the data they get from them and CJV-E18 in order to please their clients they meet with every month to convince them to keep their placing monthly payments to finance the project.

AOV has their focus in relation to quality that it fulfils all the requirements in accordance to the contract and Norwegian Road Laws. They assist CJV-E18 in site inspections and point out mistakes made by CJV-E18 before RS-OPS is involved.

In relation to the triangle of priority, AOV has no special focus. They have focus on the whole process in order to satisfy their clients that they get a highway that to the agreed price that fulfil all quality requirements and constructed in accordance to the time schedule.

In relation to RS-OPS, AOV is constantly cooperating with them in order to inshore that the project runs as planned. AOV is working to please them as much that they require in relation to the contract. They have to be critical in relation to the requirements of RS-OPS due to their shareholders.



Discussions

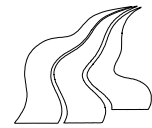
During the writing of this report the product of each ended chapter has been a discussion of the accumulated knowledge. Some of the questions have been answered in later chapters. The ones that have not been answered will be treated according to the view of the author. These questions could be interesting for further research.

We know that we have three parties involved in the design and construction phase. Two of them are private and one of them is public. The two private parties consist of identical shareholders. According to chapter 8 the two parties are separated due to Sundt A/S which is not a part of the contractual Joint Venture Company. Bilfinger Berger has a similar project in Canada where the private client is a part of the contractor. According to Mr. Kussel this relationship has been an effective solution to improve the communication between the parties, but do not think is technically possible due to the shareholder that is not a contractor. The author shares the same belief. As the contractor a unified company will properly be able to reduce paperwork for the contractor as well as the client. The understanding and awareness of the situation of each company will properly be clearer to everyone.

AOV has signed a PPP contract and handed over the design and construction responsibilities to CJV-E18. The PPP contract is according to chapter 4 designed as back to back contract which means that CJV-E18 are able to use this contract directly on its subcontractors. This solves the contractual requirements that CJV-E18 has towards QA and HSE issues which the PPP contract takes care of. The scope of work, deadlines and penalties of contractual failure is generally the only thing that needs to be defined.

The responsibility that the PPP contract hands over to the private parties creates risks for the contractor which we discovered in chapter 4. In order to take care of all the risks and challenges it requires a strong organization and employees that are able to perform the required task. We discovered in chapter 5 that the CJV-E18 organization is constructed in accordance to organization principles. Motivation and commitment of the organization is vital according to chapter 7. The question about the right employees is hard to answer and must be up to the management to evaluate.

In chapter 5 we discovered the constellation and purpose of the QA Roads department in CJV-E18. The QA Roads department is meant to function as an advice and control department. The author believes that the department fulfills these requirements. QA Roads conducts more work than required towards collecting and requesting for documentation. The author believes that this is because of the different understanding towards QA that the different nations have that conducts the work.



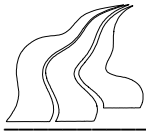
According to the organization chart of the QA department located in chapter 5.3.1 we have two QC engineers to control the whole project. The job of the QC engineers involves paperwork and they usually spend 2-3 hours at office for preparing to inspections and conducting paperwork. Due to the size of the project and the need for QC engineers to be at the office, we have a situation where we rely on the honesty of the region managers, site engineers and supervisors.

The QA system is based on the ISO 9001 standard. CJV-E18 is not certified by this standard but required by the contract to follow the standard according to chapter 6. The templates that can be views on the enclosed CD contain the templates that CJV-E18 use to document QA at the PPP project. The author believes that the templates fulfil the requirements and actually more than required. We are conducting plate loading tests to inshore the static quality of the road. According to the national law this is not required. When surveying the different layers of the road it is required by the law that it is measured every 100m but we are measuring every 20m. Further investigation for optimizing the system is required.

The chart on Figure 10 describes the documentation flow of CJV-E18. We discovered in this chapter that that where problems with this information flow. The author believes that the information flow could be simplified. In general we need to decrease the paperwork by covering larger parts if this is allowed by the law. Further investigation of this issue is required.

At CJV-E18 we discovered in chapter 7 that the company have outdated plans and incomplete general procedures and method statements. The author believes that this is an important issue that needs to be dealt with. But on the other hand the author thinks that the general procedures and statements are not used actively enough. We need to be better to use these for further minimizing of mistakes. In order to correct this, the author believes that there is a need for more employees at QA Roads or there is a need for outsourcing some of the work to the other department of the company.

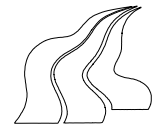
Implementation of QA by applying the theory described in chapter 7 is not used. The cultural issues are not dealt with at the mother company of Pihl. We learned by Mr. Asklund that the responsibility of solving these issues is on the leaders of the project. Is Bilfinger Berger in the same opinion? The author had not taken contact to key personal in Bilfinger Berger, but believes that they have the same opinion. For further investigation of the issue an opinion from Bilfinger Berger would be necessary. We learned in this chapter that in order to implement QA is it is important to analyse the situation and what to deliver described in chapter 7.1. The author believes that we in general have tools in order to inshore the contractual requirements is fulfilled, but we



are not aware of the consequences of ignoring the cultural aspects that this report treats.

We became aware of the similar PPP that Bilfinger Berger runs in Canada. Mr. Kussel explained that the AOV Company in Canada consists of only one person, which means that AOV may be considered as large. Mr. Kussel is not aware of the situation in Canada and is not able to compare the two companies. The employees at AOV are mainly working with financial issues and have hired Asplan Viak to perform and evaluate tests from CJV-E18. Evaluation of AOV of the size and dividing of work needs further research.

In chapter 8 we discovered that AOV did not have a fixed goal of one of the primary objectives in Figure 14. As the PPP contractor with responsibility for design, construction, maintenance and finance, the author believes that it is reasonable that there is no specific focus. AOV needs to be aware of all the three goals in order to make the most profitable project.



Conclusions

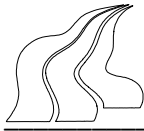
The E18 project constellation consists of three companies, two private and one public. There are common shareholders in the two private companies except for the investment company Sundt A/S. According to chapter 3, 4 and 8 the agenda of the two companies are not completely identical. AOV is the PPP contractor with responsibility for designing, constructing, maintaining, and financing and CJV-E18 is the turnkey contractor with responsibility for designing and constructing. There are opportunities in a fusion of the companies. Possible effects could be reduction of paperwork, better communication between towards external collaborators. Since Sundt A/S is not a contractor this action is considered as not possible.

The PPP contract offers the contractor lots of risks and opportunities. Possible risks are not well defined proposition, lack of qualified employees and total economic understanding. The PPP contract is considered the most expensive solution for the public client compared to the other contractual propositions mentioned in chapter 4. Positive effects for the public part is a project with nearly no risks and unforeseen expenses.

Creation of an organization involves careful planning in regards of the contractual requirements. It is important to create positions and departments that are able to fulfil this. QA-Roads at CJV-E18 are an advice and control department. According to chapter 5 and the discussion chapter the potential of the department is not used. The scope of work that QA Roads needs to perform is large and relies on the honesty of the region managers and site engineers.

The challenges that QA Roads are dealing with is a product of the different cultural views that exist. The mother company of Pihl is not dealing with this issue and hand over the responsibility of the leaders of the project to solve this issue. According to chapter 7 different approaches towards dealing with problems, leading and motivating cultures. Awareness of the issue exists, but the presented theory is not used in the E18 project.

AOV takes care of communication between RS-OPS and CJV-E18. They are focusing on the total economy of the project as the PPP contractor. For external test they have hired Asplan Viak. Every month they present the status of the project to the banks and provide CJV-E18 with funds in accordance to their progress compared to the time schedule.



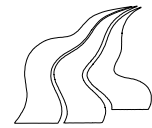
Recommendations

Based on this report following general recommendations for implementing an effective quality assurance system is:

- Determine clear requirements to the QA department.
- Determine range of project activities within the specific project.
- Identify the level of activities within the project and the method of work allocation.
- Determine the responsibilities of the staff and compare with the contractual requirements.
- Create databases for storage of the required documentation.
- Determine the values and beliefs of the nationalities that are using the QA system. Resolve their way of working and how to create commitment and believe in the QA system. Interface meetings might be an option.
- Create simple templates for filling by the executing worker. Determine what the minimum requirements are and explain it to the responsible staff.
- Conduct regular meetings with key personal from site for knowledge exchange.
- Make regular evaluations of the incoming documentation, QA related plans, method statements and procedures for further improvement. Consider involvement by the client.

Based on the report following recommendations to CJV-E18 for improving their QA system is:

- Complete all method statements and make awareness of them to the key personal on site
- Determine the values and beliefs of the nationalities that are using the QA system. Resolve their way of working and how to create commitment and believe in the QA system.
- Conduct an evaluation meeting with key personal from site and discuss the experiences of the previous hand over's and make knowledge exchange.
- Make an evaluation of the current QA system. Compare the system with the national law and the expectations of AOV.



Acronyms and Abbreviations

AOV – Agder OPS Vegselskab = The Client

CJV-E18 – Construction Joint Venture E18 = The contractor of the project.

DG – Directives & Guidelines = Laws for special issues that is not treated in the road law.

DR – Daily Report = Report that describes all work performed in a day.

DCC – Document Creation & Copy – Department that files and copy documentation.

E&M – Electrical and Mechanical = Department which deals with E&M in the project.

HB – Handbook = Norwegian name for their road law books.

HSE – Health Safety and Environmental = Department that deals with HSE in the project.

NCR – Non Conformity Report = Report for deviations in construction.

NS – Norwegian Standard = The standardization comity of Norway.

Pihl – E. Pihl & Søn A/S = Danish contractor and part of CJV-E18.

PPP – Public Private Partnering = Work relationship between the public and private companies.

QA – Quality Assurance = Tool to minimize the failures and mistakes in the construction process.

QA Roads – Quality Assurance Roads = A sub division of the QA department.

QC – Quality Control = Tool to inshore Quality

QP – Quality Plan = A plan that defines the tools to obtain QA.

RE – Region Engineer = Position in team Roads.

RS-OPS – Region Sør OPS = Sub division of the Norwegian Road Authority Statens Vegvesen.

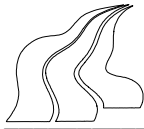
SC – Sub Contractor = Contractor hired by CJV-E18

SE – Site Engineer = Position of an Engineer working on site.

SR – Site Report = Report that describes specific issues on site.

SV – Supervisor = Position of a foreman working on site.

SVV – Statens vegvesen = Norwegian Road Authority.



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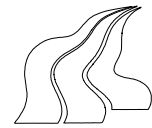
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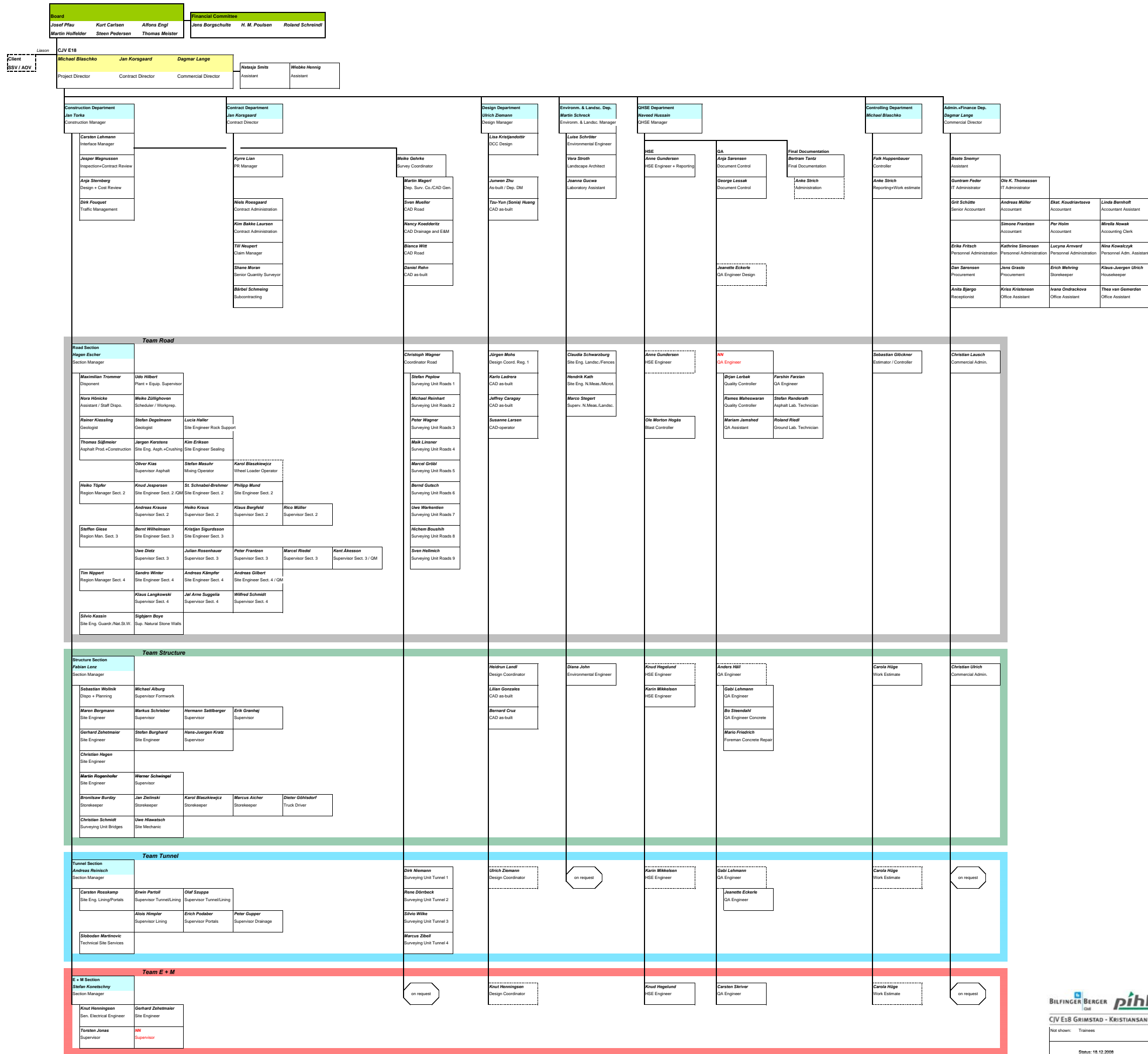
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Annex B - Dividing of the Main Alignment

Region	Section	Chainage
1	1	0+000 - 1+920
	2	1+920 - 2+550
	3	2+550 - 3+120
	4	3+120 - 4+050
	5	4+050 - 5+790
	6	5+790 - 9+410
2	7	9+410 - 11+810
	8	11+810 - 13+515
	9	13+515 - 14+015
	10	14+015 - 15+010
	11	15+010 - 15+340
	12	15+340 - 15+530
	13	15+530 - 17+020
	14	17+020 - 17+470
3	15	17+470 - 18+492
	16	18+492 - 19+587
	17	19+587 - 19+920
	18	19+920 - 20+960
	19	20+960 - 21+880
	20	21+880 - 22+350
	21	22+350 - 23+911
	22	23+911 - 25+019
	23	25+019 - 27+230
	24	27+230 - 27+835
	25	27+835 - 28+140
	26	28+140 - 29+592
	27	29+592 - 29+890
4	28	29+890 - 31+260
	29	31+260 - 31+970
	30	31+970 - 32+670
	31	32+670 - 33+170
	32	33+170 - 33+620
	33	33+620 - 34+230
	34	34+230 - 34+510
	35	34+510 - 35+670
	36	35+670 - 36+270
	37	36+270 - 36+620
	38	36+260 - 37+270
	39	37+270 - 37+980
	40	37+980 - 38+300

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Project Plan

PP 01

Content Control

Number of pages	Number of appendix
24	4

Revision Control

Rev.	Date	Description	Prepared	Checked	Approved
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01	13. Dec. 2006	General Revision	JB/ SBL	KKB	WHE/ JTH

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1 Quality Policy

CJV E18 has the following goals for the Project:

- There shall be conformity between the works performed and the requirements demanded in the Contract, the QA System, standards, handbooks, laws, regulations, agreements, etc.,
- The Project shall be executed efficiently and profitably,
- All activities shall be planned and managed throughout all levels.

In order to achieve these goals, the following shall be in place:

- Procedures and relevant parts of QA System shall be reviewed with those involved,
- Personnel executing OPS Works shall at all times be sufficiently informed of the Project Requirements,
- Personnel executing OPS Works shall have the opportunity to monitor if the Project requirements are met,
- Personnel executing OPS work shall have the opportunity to make corrections if the Project Requirements are not met,
- Feedback on achieved quality shall be given to everyone executing OPS Works.

The goal for the QA System shall be:

- Contribute to a better planned and managed project,
- Ensure that activities and products meet requirements and specifications,
- Ensure against faults during planning and execution,
- Identify measures to assure quality in execution and product,
- Document implementation of specified measures,
- Ensure efficiency/effectiveness of the QA System,
- Ensure that experience is recorded and relied on for later projects.

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1.1 Project Objectives

As a means to measure CJV E18's performance the following objectives have been set by CJV E18.

⇒ **Quality and Customer Satisfaction**

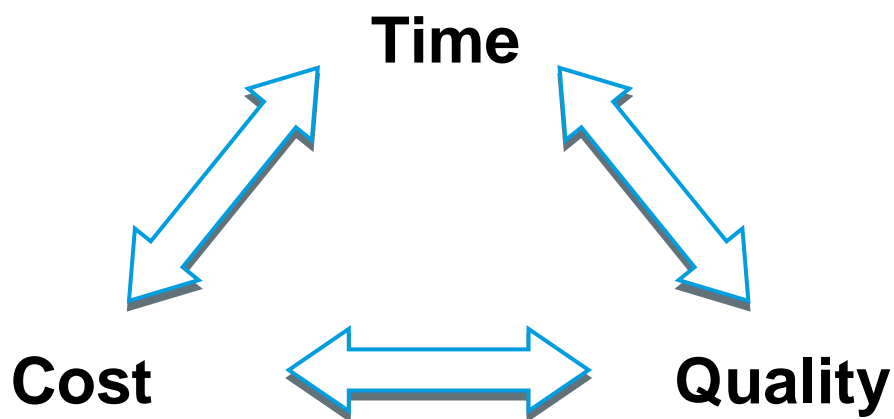
To ensure the finished Works meet the Project Requirements,
To carry out the Works in a planned and systematic manner.

⇒ **Time**

To complete the Project within the contractual completion dates, or approved extensions thereto, respectively.

⇒ **Cost**

To complete the Project within the project budget.



QA-Manager

Project Director

Deputy Project Director

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1.2 Scope

Bilfinger Berger AG Civil and **E. Pihl & Søn AS** have entered into a Joint Venture Agreement dated 26th June 2006 to execute the design and construction of the OPS Works required to complete the E18 Grimstad -Kristiansand Project.

On 23rd June 2006 both companies concluded the Design and Construction Contract for the Project with Agder OPS Vegselskap AS.

Reinhold Meister GmbH has entered into the existing Joint Venture Agreement after the commencement of the works.

The 38 km road of the E18 between Grimstad to Kristiansand is part of the trunk road from Oslo to Kristiansand, a key element of the transport corridor between southern Norway and the Continent, as well as an important connection between the two cities.

The Project consists of the design and the 4 lane road construction of more than 60 bridges, 30 concrete structures, one cut & cover tunnel, seven excavated tunnels with a total length of 6km, and all required Electrical & Mechanical fit-outs.

The design for the Project is executed through the Design Service Agreement by DCE18, a design consortium between Rambøll Norge and Bilfinger Berger AG Civil. The quality assurance of the design works is described in a separate document ("QA plan for the engineering phase").

CJV E18's Health, Safety and Working Environmental Policy is described in the dedicated HSE plan.

CJV E18's External Environment Policy is described in Management Plan PP-5-0-MP.

This Project Plan is structured in accordance with guidelines set by ISO 9001:2000, especially with regards to planning, organization- and managing processes. CJV E18 has incorporated the essence of these processes in its quality control system to ensure the proper quality and management during the performance of the OPS Works.

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1.2.1 Reference

A	Design & Construction Contract for the E18 Grimstad - Kristiansand Road	Contract Department
B	Joint Venture Agreement dated 26 th June 2006	Contract Department
C	NS-ISO 9001:2000	Technical Library and QA Department

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2 Definitions

CJV E18 means the construction joint venture formed by Bilfinger Berger AG Civil and E. Pihl & Søn AS in the joint venture agreement dated 26.06.2006 and internally joined by Reinhold Meister GmbH in August 2007.

CJV E18 Partner Companies means the companies Bilfinger Berger AG Civil, E. Pihl & Søn AS and Reinhold Meister GmbH that have entered into the joint venture agreement.

CJV E18 Staff means all staff directly employed or seconded by the CJV E18 Partner Companies to CJV E18.

Contract means the Design and Construction Contract.

Contract Works means the contract works as defined in the Contract.

Consultant means the consultants appointed by the Lenders, the OPS Company or the Partner Companies from time to time to monitor the performance of the Contract Works.

Department is a section of the organisation. The CJV E18 in total is divided into eight Departments: Construction, Contract, Quality Assurance, HSE, Environmental, Design, Controlling and Administration & Finance.

Department Section is a part of a Department such as Bridges, Tunnels, Earthworks, Asphalt, Road Furniture or E&M.

Instructions of Position mean descriptions for each position within the organisation.

Lenders means all or any of the persons, who provide financing or funding in respect of the Project under the Finance Documents and any financial agreements entered into by the OPS Company in relation to the financing of the OPS Company's obligations under the PPP Contract

NS-ISO 9001: 2000: This international standard specifies requirements for a quality management system. The standard can be used by internal and external parties, including

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certification bodies, to assess the organisation's ability to meet customer regulatory and the organisation's own requirements.

OPS Company means Agder OPS Vegselskap AS.

Post Completion Works means the works to be carried out in relation to the OPS Works during the Operational Phase, as set out in Schedule 9 of the Contract.

Project means the design and construction of the Road Section and all other obligations of the CJV E18 under the Contract.

Project Plan sets out the structure and the content of the Quality Assurance System, while linking the policy and objectives with system elements and procedures. It also sets out the project's organisation and responsibilities.

Project Management consists of the Project Director, the Contract Director and the Technical Director.

Project Requirements means all requirements demanded by the Contract and by any standards, handbooks, laws, regulations effective under the Contract.

PPP Contract means the agreement entered into between Vegdirektoratet and the OPS Company on or about the date hereof, including the Contractual Documents as defined in Article 2 of the PPP Contract.

QA System means the quality assurance system of the CJV E18 consisting of the Project Plan, the HSE Plan, Management Plans, Implementation Plans, General Procedures and Method Statements.

Statens vegvesen means Statens vegvesen or Statens vegvesen Vegdirektoratet in its capacity of being a government authority.

Sub-contractors means suppliers, contractors, designers, advisors and others who through a contract with CJV E18 or one of CJV E18's Sub-contractors (of any tier) is entrusted with carrying out or have undertaken responsibility to carry out parts of the Contract Works.

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Vegdirektoratet means Statens vegvesen Vegdirektoratet in its capacity of being a Party to this Contract.

Vegdirektoratet Works means the Construction Work (as defined in the PPP Contract) relating to section 7 of the Road, which does not form part of the Road Section under the PPP Contract during the Operational Phase and is to be handed over to Vegdirektoratet on or before the Operational Date for the relevant Section in accordance with Article 15.4 of the PPP Contract.

Works means OPS Works and Vegdirektoratet Works.

2.1 Abbreviations

AOV	Agder OPS Vegselskap
CJV E18	Construction Joint Venture E18
DCE18	Design Consortium E18
DBE	Directorate for Fire and Explosion Protection
DSB	Directorate for Civil Protection and Emergency Planning
ISO	International Organisation for Standardisation
HSE	Health, Safety and Environment
NCR	Non-Conformance Report
QA	Quality Assurance
SVV	Statens vegvesen
VD	Vegdirektoratet
WEC	Working Environment Committee

3 Quality Assurance System

3.1 Philosophy

To ensure that construction works in major projects such as the E18 Grimstad-Kristiansand Project are conducted in accordance with the project's objectives, it is essential to establish and adhere to quality guidelines and routines.

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To ensure that such routines established for CJV E18 are recognized and followed by all CJV E18 Staff, it is the philosophy of this QA System not to predict procedures that are to be followed by the organisation, but to review and integrate the procedures lived by the organisation into the framework of the QA System

Thus, it is also required and an objective of this Project Plan to reduce the amount of procedures to the essential.

3.2 Structure of the QA-System

The QA System is structured modular into different sections as shown in Figure 1 to allow the different Departments and Department Sections of the CJV E18 to define their objectives, organisation, management and working routines independently within the framework outlined by this Project Plan.

3.3 Quality Audit

An Audit is a systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled.

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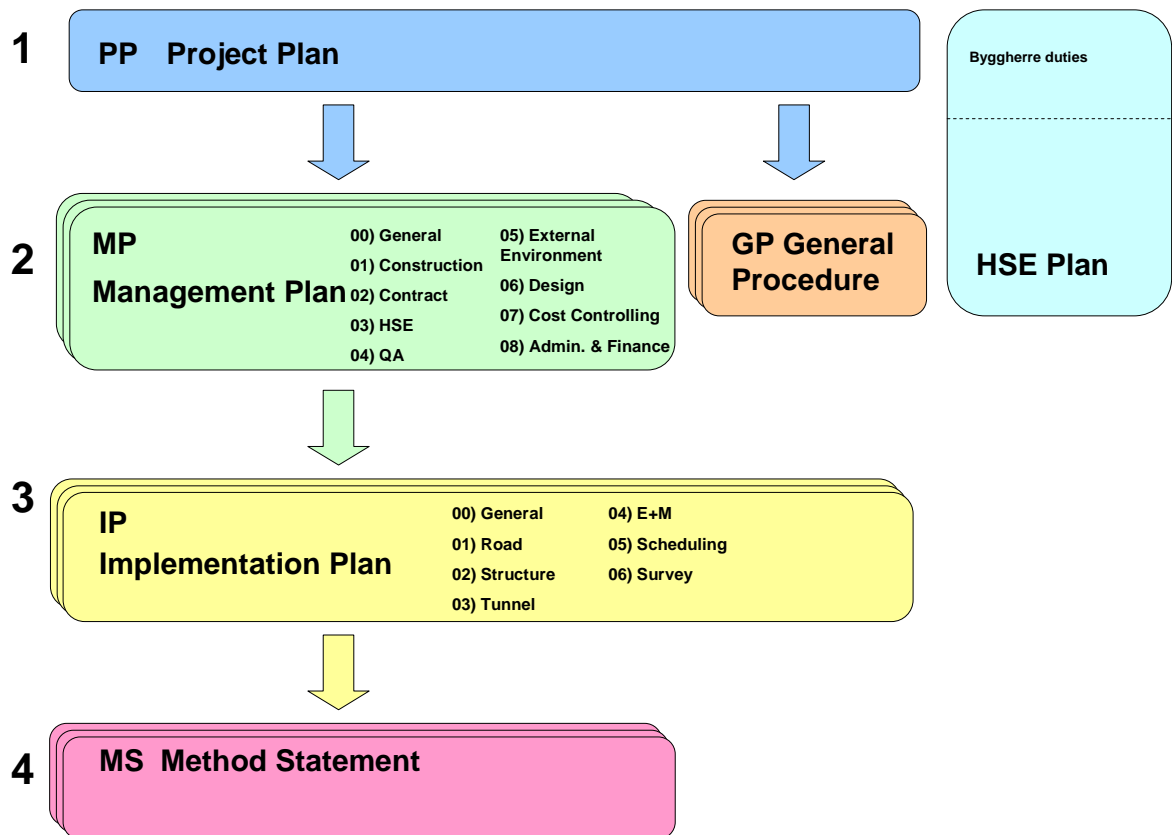


Figure 1 Structure of the QA System

For the full structure of the QA System please refer to Appendix 5.4.

3.3.1 Project Plan

The Project Plan sets out the structure and the content of the QA System as well as CJV E18's organisation and responsibilities. It links the policy and objectives with system elements and procedures.

The Project Management is responsible for establishing, enforcing and review of the Project Plan. The regulations in the Project Plan are binding to all CJV E18 Staff.

3.3.2 Management Plan

The Management Plans describe the managerial organisation of CJV E18's Departments. The Management Plans are an integrated part of the QA System of CJV E18.

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The Department Managers are responsible for establishing and maintaining the Management Plans for their Departments. Management Plans must be approved by the Project Management.

3.3.3 Implementation Plan

The Implementation Plans describe the organisation of Department Sections. Implementation Plans are an integrated part of the Management Plan of the relevant Department.

The Section Managers are responsible for establishing and maintaining the Implementation Plans for their Department Section. Implementation Plans must be approved by the Department Manager.

3.3.4 General Procedure

A General Procedure provides general instructions on how particular processes in the project are to be carried out in relation to quality, production responsibilities, inspection and testing methods, frequencies, acceptance criteria, and verification records. These records are to be maintained. General Procedures are valid for the total Project and binding to all CJV E18 Staff.

The Department Managers are responsible for establishing and maintaining General Procedures that regulate essential routines within, or related to, their Department that affect the works of CJV Staff in their Department or the total project. General Procedures must be approved by the QA Manager and the Project Management.

3.3.5 Method Statement

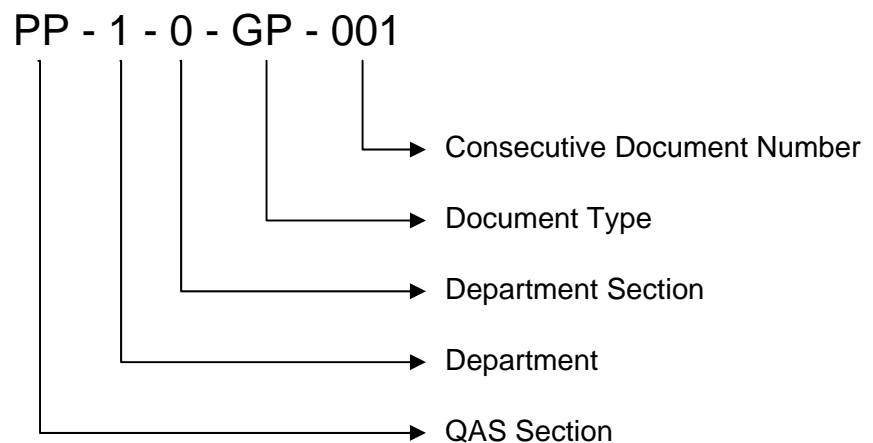
Method Statements provide instructions and information on how particular works or one-time operations on specific locations or structures shall be carried out in relation to quality, production responsibilities, inspection and testing methods, frequencies, acceptance criteria, and verification records. These records are to be maintained. Method Statements are valid for specific operations or structures and are binding to all CJV E18 Staff involved in the operation.

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The Site Engineers are responsible for establishing and maintaining Method Statements that regulate essential routines for specific operations on the various construction sites. Method Statements must be approved by the relevant Section Manager.

3.4 Document Numbering

All documents in the QA System can be identified by a 9-digit code:



3.4.1 QA System Section

The first two digits of the document code define to which section of the QA System belongs:

PP	Project Plan
HS	HSE Plan

3.5 Filing of the QA System

- Technical Library
- Primas Database “ CJV E 18 QA System”
(Source: noli0s002/ CJVE18/ SCAN/ NO/ primas/ CJVE18 QA System)

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3.5.1 Department

The third digit of the document code defines the Department to which the document belongs:

0	General / Total Project
1	Construction Department
2	Contract Department
3	HSE Department
4	QA Department
5	External Environmental Department
6	Design Department
7	Cost Controlling Department
8	Administration & Finance Department

3.5.2 Department Section

The fourth digit of the document code defines the Department Section to which the document belongs:

0	General / Total Department
1	Road
2	Structure
3	Tunnel
4	E&M
5	Scheduling
6	Survey

3.5.3 Document Type

Digits 5 and 6 indicate the type of document:

MP	Management Plan
GP	General Procedure
IP	Implementation Plan
EP	Emergency Plan
AP	Action Plan
MS	Method Statement

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3.5.4 Consecutive Document Number

Digits 7 to 9 form a consecutive number identifying the document.

3.6 Quality System Improvements

The QA System defined in this Project Plan provides the basis from which improvements will be continually initiated. Such improvements may be identified by:

- As result of review of non-conformance/deviation report leading to corrective and preventive actions,
- Through internal and external audits,
- Through the formal management reviews,
- By project staff during routine work.

If an improvement is identified, it shall be documented. QA System improvements may be initiated by any CJV E18 Staff. All project staff is encouraged to participate in the Quality System Improvement process.

A copy of the QA's improvement proposal must be submitted to the QA Manager and the CJV E18 Staff responsible for the work or the procedure. The QA Manager must ensure that the raised improvement issues are reviewed and addressed within the organization.

3.7 ISO 9001 System Element Comparison Schedule

The following table cross references the ISO 9001:2000 system elements to the CJV E18 management system.

ISO 9001:2000		The CJV E18s Quality Management System	
Section	Title	Section	Title
4.1	General requirements	1 3.2.1	Quality Policy and Objectives Project Plan
4.2	Documentation requirements	3.2.1 1	Project plan Quality Policy and Objectives
5.1	Management commitment	1 4.2 4.4 3.6	Quality Policy and Objectives Project Organisation Chart Responsibilities Management Review

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ISO 9001:2000		The CJV E18s Quality Management System	
Section	Title	Section	Title
5.2	Customer focus	4.8	Client complaints
5.3	Quality policy	1	Quality Policy and Objectives
5.4	Planning	1	Quality Policy and Objectives
5.5	Responsibility, authority and communication	4.4	Responsibilities
5.6	Management review	3.6	Management Review
6.1	Provision of resources	3	Quality Assurance System
		3.4	Quality System Improvements
6.2	Human resources	4.3	Management Personnel
		4.3.2	Key Personnel
6.3	Infrastructure	4.3.1	Project Management
6.4	Work environment	HS	HSE Plan
7.1	Planning of product realization	4.3.1	Project Management
7.2	Customer-related processes	3.2.1	Project Plan
7.3	Design and development	3.3	Design
7.4	Purchasing		Reference to Procurement Procedures
7.5	Production and service provision	4.3.1	Project Management
7.6	Control of monitoring and measuring devices	4.3.1	Project Management
8.1	Measurement, analysis and improvement; general	3.4	Quality System Improvements
		PP	Audit PP-4-0-GP-007
8.2	Monitoring and measurement	1	Quality Policy and Objectives
		PP	Auditing PP-4-0-GP-007
8.3	Control of non conforming product	PP	Handling of Non-Conformancies PP-4-0-GP-003
8.4	Analysis of data	4.3.1	Project Management
8.5	Improvement	1	Quality Policy and Objectives

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3.8 Management Review

The Purpose of the Management Review is to ensure the QA System's ongoing suitability, adequacy and effectiveness.

The QA System of the Project shall be reviewed every 6 months and on substantial completion of the works with the following participants:

- At least one member of the CJV E18 Supervisory Board,
- Project Director,
- Deputy Project Director / Contract Manager,
- QA-Manager,
- Construction Manager,
- Design Manager,
- Administration & Finance Manager.

The review shall be chaired by the Project Director and undertaken in accordance with the following agenda:

- Review of actions from previous review,
- Review and analysis of non-conformances and system non-compliances,
- Review and analysis of Client complaints,
- Review and analysis of audits carried out by internal and/or third party auditors,
- Review from each attendee considering improvements of the efficiency/effectiveness of the QA System,
- Review of the policy and objectives.

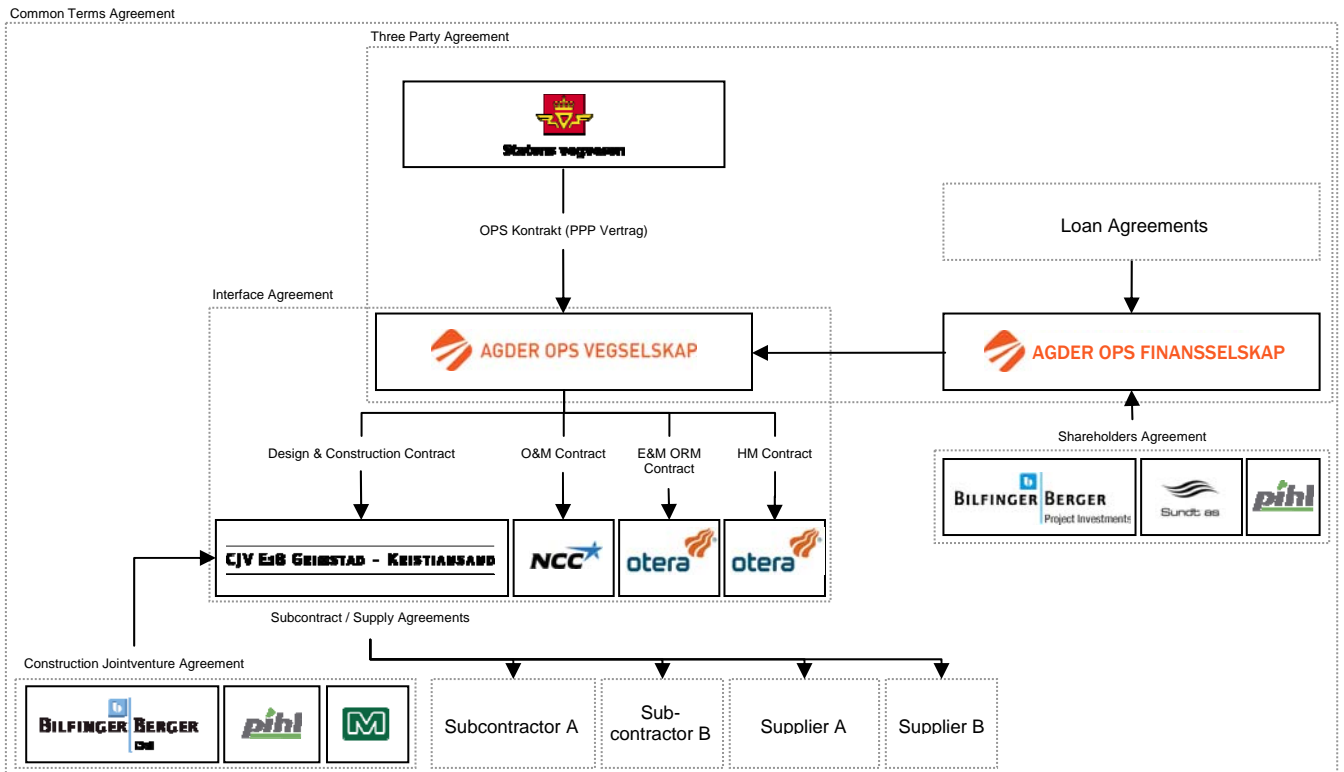
Note:

To maximise the benefit of these reviews, attendees are to carry out preparation related to their area of responsibilities in cooperation with the Project Director.

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4 Organisation and Management

4.1 Project Contractual Structure



Figur 2: Project Contractual Structure

4.2 Project organisation chart

The Overall Project Organisation Chart shall at all times be maintained, with functions and names, by the Project Director. The Project Director is responsible for the progressive updating of the Organisation Chart.

The Project Organisation Chart is attached to this Project Plan as Appendix 5.1.

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4.3 Management personnel

The performance of the CJV E18 under the D&C Contract will be directed and supervised by the Supervisory Board and the Project Management.

4.3.1 Project Management

According to the Joint Venture Agreement the Project Management is formed by the Project Director and the Deputy Project Director. The Supervisory Board has appointed the following persons to be in charge of the daily management of the CJV E18:

Project Director	Jan Torka
Deputy Project Director / Contract Director	Jan Korsgaard

By decision of the Board of Managing Directors of the Parent Companies dated January 2008 the Project Management is with effect of February 2008 supplemented by a Technical Director:

Deputy Project Director / Technical Director	Bernhard Pawlitschko
--	----------------------

The split of responsibilities within Project Management is outlined in Appendix 5.1.

4.3.2 Key Personnel

In addition the following key personnel have been selected by the Supervisory Board:

Administration and Finance Manager	Dagmar Lange
Design Manager	Dr. Andres Zachlehner
HSE Manager	Naveed Hussain
QA Manager	Naveed Hussain
Environmental Manager	Martin Schreck
Project Control Manager	Michael Schütte
Construction Manager/Section Manager Asphalt	Dr. Karl Ludwig Kley
Section Manager Earth Works	Hagen Escher
Section Manager Road Furniture	Jesper Magnussen
Section Manager Bridges	Niklas Vetter

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Section Manager Tunnels
Section Manager E&M

Andreas Reinisch
Stefan Konetschny

4.4 Responsibilities

The individual responsibilities are described in the Instructions of Position attached to this Project Plan (Appendix 5.3)

4.4.1 Project Personnel

All project personnel must be familiar with the content of this Project Plan and must participate in implementing and maintaining the management system.

It is the responsibility of the respective operative functions to ensure that the requirements for quality are fulfilled for works under their responsibility.

All new staff and staff who are given new responsibilities are to be given an introduction into the requirements of this Project Plan in general and into their function and responsibilities in particular.

Detailed responsibilities are described in the instruction of position.

4.4.2 Management Representative

The QA Manager is the management representative as required in ISO 9001.

The QA Manager is responsible:

- to ensure that the requirements of the quality plan are fully established, implemented and maintained,
- to report the performance of the quality system to the Project management for review,
- to ensure that the quality plan is promptly amended when improved practices are identified,
- to liaise with the Agder OPS and Consultants on matters relating to the quality management system.

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4.5 Subcontractors

The Contract Manager shall prepare and maintain a list of subcontractors (including sub-subcontractors) used in the project.

4.6 Contract Parties and Representatives

4.6.1 OPS Company

Company: **Agder OPS Vegselskap AS**
Address: P.O: BOX 1003, 4794 Lillesand, Norway

Representative: **Finn Aasmund Hobbesland**
fah@agderops.no
Tel.: +47 91 31 92 65

4.6.2 Contractor

Company: **CJV E18 Grimstad-Kristiansand**
Postal Address: P.O. Box 79, 4791 Lillesand, Norway
Visiting Address: Prestegårdskogen, 4790 Lillesand, Norway

Representative: **Dr. Michael Blaschko**
michael.blaschko@bilfinger.de
Tel.: +47 97 55 42 48
Fax: +47 37 26 75 01

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With issuance of the Power of Attorney effective of 5th November 2007 the authorisation to represent the CJV E18 has been delegated to

Project Director **Jan Torka**
jan.torka@civ-e18.no
 Tel.: +47 97 55 42 00

Deputy Project Director **Jan Korsgard**
jan.korsgaard@civ-e18.no
 Tel.: +47 95 84 08 72

4.7 Signature authority

All correspondence by CJV E18 shall be signed with two signatures.

The Project Director and the Deputy Project Director have the power of attorney to sign all documents, deeds and instruments on behalf of CJV E18.

The Project Director has appointed the Technical Director to sign on his behalf and he has appointed the Administration and Finance Manager to sign on his behalf during his absence. The Deputy Project Director has appointed the QA Manager to sign on his behalf during his absence.

Further signature authority has been delegated as outlined in the responsibility and signature matrix (see Appendix 5.2).

4.8 Client Complaints

For Clients Complaints please refer to 1.1 Quality Policy.

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5 Appendix

5.1 Organisation Chart incl. Schedule of Responsibilities

5.2 Signature Matrix

5.3 Instruction of Positions

5.4 Overview of QA Documents