Analysis of production of cooled ready-mixed concrete production in an international setting

A case study of the internationalisation of an Austrian small private owned organisation to Qatar

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Colophon

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Preface

This thesis comprises the final part of the study programme 'Civil Engineering & Management' at the 'University of Twente' in Enschede, The Netherlands. It analyses the production of cooled ready-mixed concrete production in an international setting. In particular it focuses on the experiences of a small Austrian private owned company in Qatar. The analysis is based on field observations conducted from November 2006 until March 2008.

I would like to express my gratitude to my supervisors from university, Dr. Ir. Ing. Tijhuis and Dr. Al-Jibouri. Further I would like to thank my co-supervisors, Dr.-Ing. Hornung and Ms. Ortner for their great cooperation and help.

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Sander Odijk

Summary

Concrete is a basic construction material that is applied in construction all over the world. Every region has its specific requirements concerning the composition and characteristics of concrete. Arid environments, such as in Qatar, are challenging for the production of high quality ready-mixed concrete due to high temperatures and humidity fluctuations. During the last decade, Qatar went through a period of high economic prosperity and along with that came the need for large amounts of high quality ready-mixed concrete. This research provides insights in a company that started a production facility in a country outside its domestic region (Qatar). In order to analyse their internationalisation, the objective of this research is:
"To analyse the production of controlled delivery of cooled ready-mixed concrete production in Qatar, in order to identify factors affecting this production."

A field study was undertaken to acquire the information needed whereby the researcher was present in Qatar from November 2006 until March 2008. The field observations disclose three critical incidents.

For analysing the critical incidents, the "3-C" framework (Tijhuis, 1996) is applied. Tijhuis' theory focuses on the aspects of "Contact", "Contract" and "Conflict" and was developed based on the experiences of Dutch contractors in Germany. In this research , the critical incidents are analysed using this 3-C model
The results of the analysis show that during the internationalisation process, there are many indirect factors that significantly influence the performance of the company. This research seeks for patterns among these influencing factors, by using a cross-case analysis that resulted in a matrix with 14 key-aspects. The key-aspects found are:

1. Personal background,
2. Cultural barriers,
3. Communication,
4. Relation between parent organisations & Position of general manager,
5. Allocation, instruction and education of employees,
6. Local standards and regulations,
7. Local industry characteristics,
8. Strategy fit,
9. Contractual specifications,
10. Suitable equipment,

11. Testing procedures,
12. Awareness and control of country-specific conditions,
13. Allocation of authorisations and responsibilities,
14. Practical production techniques.

The research recommends that these 14 key-aspects are particularly needed to be taken into account if a company which is active in ready-mixed concrete production wants to expand its activities in a similar environment.

Zusammenfassung

Beton ist ein Grundbaustoff der überall auf der Welt Verwendung findet. Jede Region stellt deshalb verschiedene Ansprüche an die Zusammensetzung und die Beschaffenheit des Betons. Dürregebiete wie in Katar, die hohe Temperaturen und Feuchtigkeitsschwankungen aufweisen, stellen eine große Herausforderung für die Produktion von Transportbeton dar. Die Wirtschaft von Katar ist im letzen Jahrzehnt immens gewachsen, einhergehend damit wuchs logischerweise auch die Nachfrage nach Transportbeton.
Diese Forschungsarbeit liefert Einsichten in eine Firma, die versucht, eine Produktionsanlage für Transportbeton außerhalb des eigenen Landes aufzubauen und zu etablieren (Katar). Um die Internationalisierung dieser Firma zu analysieren, lautet die Hauptthese dieser Arbeit wie folgt:
„*Die Analyse der Produktion und Auslieferung von gekühltem Transportbeton in Katar – zur Identifizierung von Faktoren, die diese Produktion beeinflussen*“.

Die Methode der Feldstudie wurde so ausgewählt, dass man die benötigten Informationen für die Analyse der These rausfiltern kann. Der Forscher führte seine Studie von November 2006 bis März 2008 in Katar durch. Die Felduntersuchungen deckten drei kritische Störfälle auf.

Damit diese Störfälle analysiert werden können, wird auf das theoretische Konzept des „3-C“-Modells von Tijhuis (Tijhuis, 1996) zurückgegriffen. In der Theorie von Tijhuis geht es um die Erfahrungen, die holländische Bauunternehmen in Deutschland im Gebiet von „Contact“ („Kontakt“), „Contract“ („Vertrag“) und „Conflict“ („Konflikt“) gemacht haben. In der vorliegenden Forschung werden die drei Störfälle in Katar auf die drei Cs hin getestet.

Die Testergebnisse zeigen anschließend, dass während des Internationalisierungsprozesses viele indirekte Faktoren maßgeblich das Ergebnis der Betriebseigenschaft beeinflussen. Bei der Suche nach Zusammenhängen und ähnlichen Mustern zwischen diesen indirekten Faktoren, benutzt der Forscher eine fallübergreifende (cross-case) Analyse, welche in einer Matrix mit 14 Schlüsselfaktoren endet. Die Schlüsselfaktoren sind wie folgt:

1. Persönlicher Hintergrund von Beteiligten,
2. Kulturelle Barrieren,

3. Kommunikation der Beteiligten,
4. Beziehung zwischen der Muttergesellschaft und dem Geschäftsführer vor Ort,
5. Besetzung, Einweisung und Unterrichtung von Angestellten,
6. Lokale Standards und Regeln,
7. Charakteristika der lokalen Industrie,
8. Strategieauswahl und -anpassung,
9. Unternehmerische Spezifizierungen,
10. Passende technische Ausrüstung,
11. Abläufe der Labortests,
12. Bewusstsein und Kontrolle von länderspezifischen Unterschieden,
13. Einteilung von Autorität und Verantwortung,
14. Produktionstechniken in der Praxis.

Will eine Firma, welche gekühlten Transportbeton produziert, in ein Land expandieren, wo ähnliche Voraussetzungen vorzufinden sind, müssen diese 14 Schlüsselfaktoren besonders beachtet werden.

Samenvatting

Beton is wereldwijd een van het meest toegepaste bouwmateriaal. Elke regio heeft zijn specifieke eisen betreffende de samenstelling en eigenschappen van beton. Droge omgevingen, zoals in Qatar aanwezig, zijn een uitdaging voor de productie van kwaliteitsbeton door de hoge omgevingstemperaturen en fluctuaties in luchtvochtigheid. Gedurende het laatste decennium heeft Qatar een periode van economische voorspoed doorgemaakt, dit ging gepaard met een hoge vraag naar beton met hoge kwaliteit. Dit onderzoek geeft inzicht in een bedrijf welk een betoncentrale opgezet heeft in een land buiten hun oorspronkelijke regio waarin dit bedrijf actief was (Qatar). Het doel van dit onderzoek is:
"Analyse van de productie van gecontroleerde levering van gekoelde betonproductie in Qatar, omwille factoren te identificeren welke deze productie beïnvloeden."

De methodologie toegepast in dit onderzoek om de benodigde informatie te vergaren is een veldonderzoek waarbij de onderzoek in Qatar aanwezig was van November 2006 tot Maart 2008. De observaties beschreven in het veldonderzoek omvatten drie kritieke incidenten.

Om de kritieke incidenten te analyseren is het "3-C" model (Tijhuis, 1996) toegepast. In Tijhuis zijn theorie ligt de nadruk op de elementen "Contact", "Contract" en "Conflict" ten aanzien van ervaringen van Nederlandse aannemers in de Duitse bouwnijverheid. In het onderhavige onderzoek worden de kritiek incidenten geanalyseerd op basis van Tijhuis zijn 3-C's.

De resultaten van de analyse tonen aan dat gedurende het proces van internationalisatie er vele indirecte factoren een grote invloed hebben op de omvang van het succes van het bedrijf. Door patronen te zoeken tussen deze factoren heeft de onderzoeker een cross-case analyse uitgevoerd welke resulteert in een matrix met 14 sleutel aspecten. Deze sleutel aspecten zijn:

1. Persoonlijke achtergrond,
2. Culturele barrières,
3. Communicatie,
4. Verhouding tussen moederbedrijven & positie van algemeen directeur,
5. Toewijzing, inwerken en opleiden van werknemers,

6. Lokale standaards en regels,
7. Lokale eigenschappen van de sector,
8. Passen van bedrijfsstrategie,
9. Contractuele specificaties,
10. Passend materieel,
11. Test procedures,
12. Bewustzijn en beheersen van landspecifieke situaties,
13. Toewijzen van bevoegdheden en verantwoordelijkheden,
14. Praktische productie technieken.

Deze 14 sleutel aspecten moeten in acht worden genomen indien een bedrijf welk actief is in de betonproductie naar een vergelijkbare omgeving wil expanderen.

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List of abbreviations

ACI	=	American Concrete Institute
ASTM	=	American Society for Testing and Materials
BS	=	British Standard
CIT	=	Critical Incident Technique
CRMC	=	Cooled Ready-Mixed Concrete
DEF	=	Delayed Ettringite Formation
FDI	=	Foreign Direct Investment
IJV	=	International Joint Venture
ISO	=	International Standardisation Organisation
JV	=	Joint Venture
MBK	=	Main Breakwater
MCQ	=	Mobil Concrete Qatar W.L.L.
QP	=	Qatar Petroleum
RLIC	=	Ras Laffan Industrial City
RLPEP	=	Ras Laffan Port Expansion Project
RMC	=	Ready-Mixed Concrete
SBK	=	South Breakwater
WLL	=	With Limited Liability

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1 Research Design

This chapter describes the design of the research. First, an introduction to the subject of this research provides an insight into the topic. Next, the involved stakeholders are described to identify who is involved. This is followed by the problem definition and the objective of the research. After this, the research model is presented, followed by the research questions. Finally the research approach is described and a summary is given.

1.1 Introduction & Scope

Worldwide, concrete is one of the most common materials used in construction. The global production of concrete is about 6 billion m^3 per year. This is equal to approximately one m^3 for every person on this planet (Cement & Beton Centrum, 2008). The concrete features as plastic and fluid until it is placed in a formwork gives great opportunities and flexibility for the design of a structure. The negative side to this is that concrete is influenced by ambient conditions during the hardening period (and to a less degree after hardening). All different climates worldwide have different influences and thus the concrete needs to be optimised to local conditions to minimise the negative effects from these conditions.

One of the regions in which the climate has a great influence on the concrete is the Arabian Gulf. The high temperatures and the large fluctuations in humidity are only a few of the reasons that the concrete production in this region needs to be managed differently to the production in regions with a more moderate climate. The high temperatures make it necessary that the temperature of fresh concrete is controlled and sometimes even limited. If no precautions are made, the direct adverse effects on the concrete are increased evaporation and an increase in temperature during the hardening period. This can result in reduced compressive strengths and/or a reduction of durability of the structure.

One of the countries in the Arabian Gulf that has recently developed a need for high quality ready-mixed concrete is Qatar. The discovery of large amounts of natural gas and the development of an appropriate technique to extract and liquefy this natural gas gave Qatar a huge economic boost.

The State of Qatar is a small peninsula in the Persian Gulf, which borders in the south with Saudi Arabia. The total length of the country is 180 km. and the width about 80 km (see figure 1). Qatar has an arid climate with high peak temperatures in summer (50 degrees Celsius) and high fluctuations in humidity. There are approximately 180.000 native inhabitants, called Qatari's and in total about 900.000 people live in the country, meaning around 720.000 people are foreigners. The majority of these foreigners are expatriate workers. A large portion of these expats is unskilled labourers from India, Southeast Asia and surrounding Arabic countries. They are all going to Qatar in search for an improvement of their situation from what they experience in their home countries. This multicultural environment incorporates great challenges for all parties to work together.

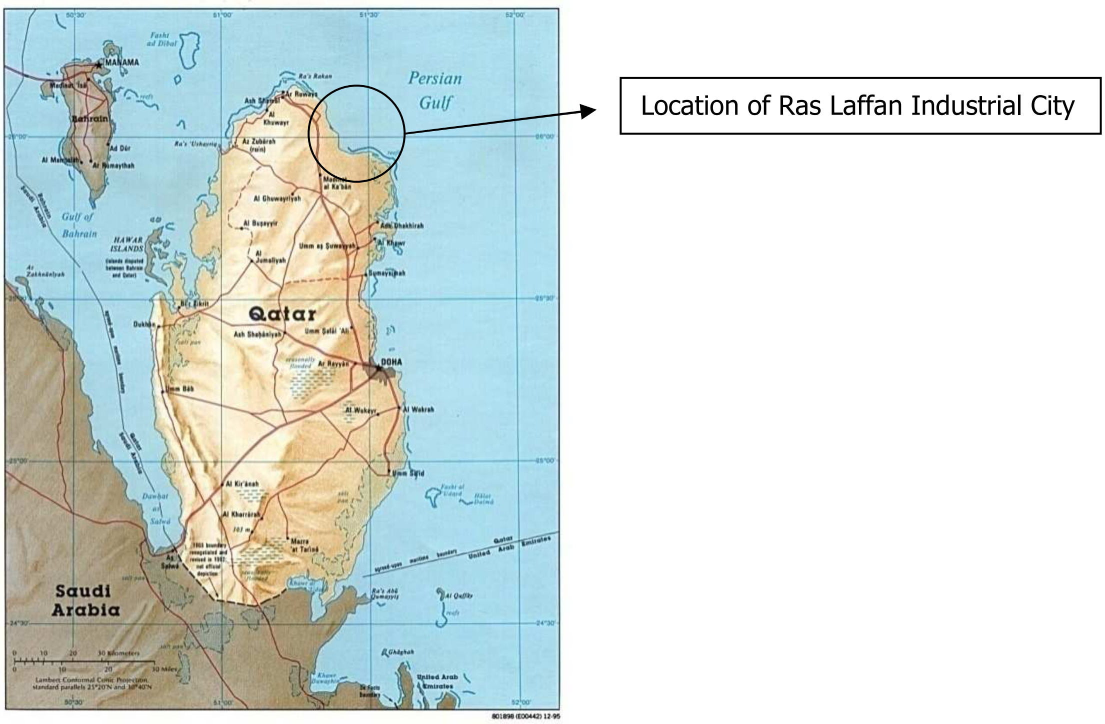

Figure 1, Map of the state of Qatar with indication of Ras Laffan Industrial City (Source: www.nationmaster.com).

Qatar is investing a lot of revenue from the export of the gas in the construction sector. In the last 10 years, the capital Doha has changed from a small city to a capital with skyscrapers everywhere you look. Construction work is performed on a 24/7 base. Besides the development of real estate in Doha, many construction projects are located in the industrial cities of Qatar. Expansion and improvement of the facilities related to the extraction of natural gas is planned and executed. More specific information concerning Qatar can be found in Appendix 5, which contains a PESTEL analysis of Qatar.

The biggest industrial city in Qatar is Ras Laffan Industrial City (RLIC). This area is located in the northeast of the country, about 80 km. away from Doha. This industrial city is connected to the 'North Field', the largest gas reserve of Qatar. The industrial city will grow from around 106 km^2 in 2007 to 248 km^2 by 2015. A total of 6 million m^3 of ready-mixed concrete would be needed until 2012. QP (Qatar Petroleum) will award the greater part of this amount, mostly as part of a larger contract. This national company manages the industrial cities and all facilities on it.

One of the projects in RLIC is the expansion of the existing harbour, the "Ras Laffan Port Expansion Project" (RLPEP). The project consist of dredging works, the construction of two breakwaters and the extension of the existing harbour by means of land reclamation and extension of the existing breakwater. Figure 2 shows the scope of this project.

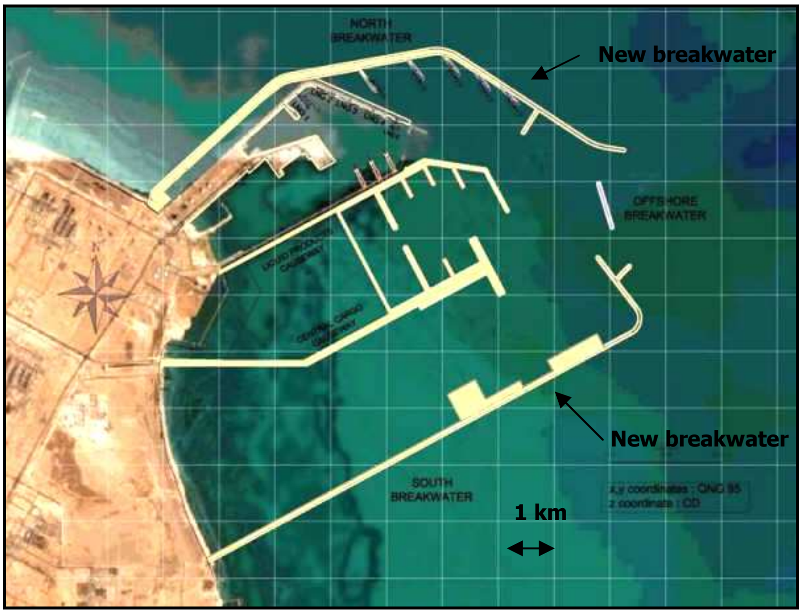

Figure 2, Overview of Ras Laffan Port Expansion Project (Source: Ras Laffan Joint Venture)

One company, which is involved in this project as a subcontractor, is Mobil Concrete Qatar, in short MCQ. MCQ has to deliver all the ready-mixed concrete (RMC) for the in-situ concrete works on the breakwaters in the RLPEP project. This thesis will describe and analyse the first experiences of MCQ in Qatar. Through analysis of critical incidents, factors affecting the production of cooled ready-mixed concrete production in an international setting can be derived and recommendations will be given.

This project is the first project from MCQ in Qatar. The mother company from MCQ is Mobil Baustoffe GmbH, an Austrian based, private owned, ready-mixed concrete producer. Around 2003 the concrete sector in Austria was declining and in order to maintain profitability, the board of Mobil Baustoffe focussed on the Arabian Gulf as an interesting expansion possibility. After some research, a local partner was found in Gulf Beach and MCQ was established in early 2006 in Qatar. To obtain a competitive position in the market in Qatar, MCQ plans to control the temperature of the fresh ready-mixed concrete by an unconventional method, which has never before been implemented on a full-scale. They intend to cool the coarse aggregates by immersion in cold water and with this method, they should be able to produce continuous large amounts of cooled ready-mixed concrete. This method would provide MCQ with an advantage over its competitors in Qatar.

1.2 Stakeholders

To get an overview of the involved organisations that are relevant for this thesis, the main stakeholders and their relation in the Ras Laffan port expansion project are described here. The main stakeholders in this research are:

1. Mobil Concrete Qatar,
2. Gulf Beach,
3. Mobil Baustoffe GmbH,
4. Ras Laffan Joint Venture,
5. Qatar Petroleum (QP).

A visual overview of the relation between those stakeholders is given in figure 3, each of them will be described hereafter.

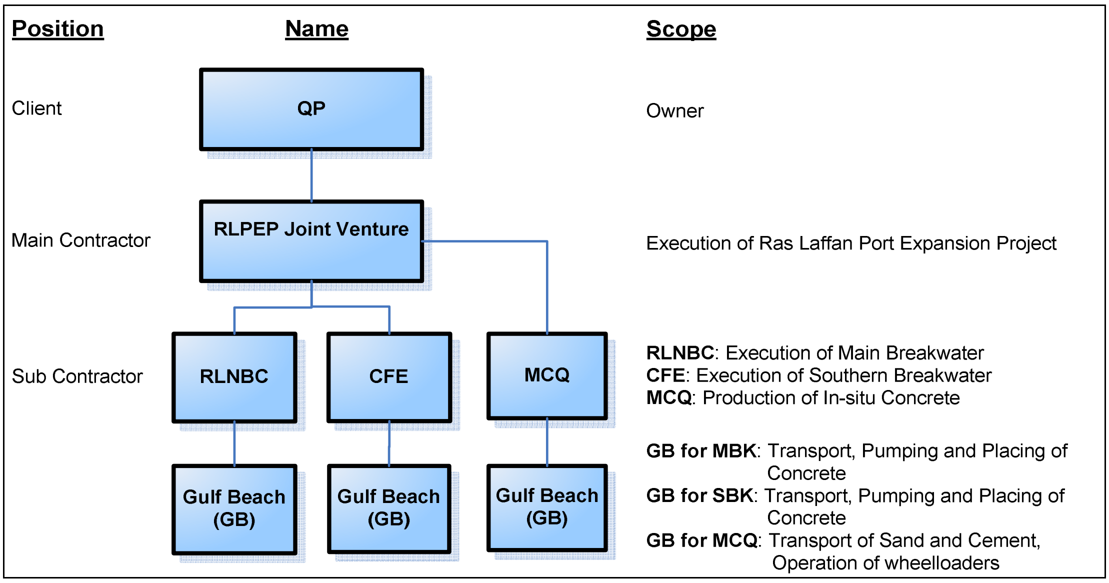

Figure 3, Overview of involved stakeholders in the port expansion project

Ad. 1 Mobil Concrete Qatar

Mobil Concrete Qatar W.L.L. (here referred to as MCQ) is a 100% legal Qatari company, which was founded in the beginning of 2006. It is a strategic alliance between Mobil Baustoffe GmbH, an Austrian company, and Gulf Beach Trading and Contracting, a Qatari company. The latter one is the local sponsor of MCQ, which is a legal requirement in Qatar. This sponsor possesses 51% of the company that is established.

The scope of Mobil Concrete Qatar is: "Design, Production and supply of ready mix concrete, concrete prefabricated products and in-situ concrete construction works" (MCQ - ISO:9001, 2006). MCQ has the objective to deliver ready-mixed concrete for large industrial projects in the industrial cities of Ras Laffan and Umm Said. The first batch plant was operational in Ras Laffan from October 2006, the combined second and third was operational in the summer of 2007 and a fourth is awaiting erection in Umm Said.

Ad 2. Gulf Beach

Gulf Beach Trading and Contracting is a privately owned Qatari company having their activities in residential construction. The CEO is a Qatari businessperson. They do not have experience in the offshore and civil construction sector, neither in the ready-mixed concrete sector. Gulf Beach are the local sponsor of MCQ and a subcontractor at the same time, which might cause a conflict of interest.

Ad 3. Mobil Baustoffe

Mobil Baustoffe GmbH has its origin in Austria with an economic activity in Austria, Germany, Switzerland and they recently also obtained a project in Bulgaria. Until September 2008 they were a privately owned company and are now part of Strabag SE. Mobil Baustoffe will stay a separate daughter company even though they are now part of a large construction company.

Mobil Baustoffe is specialized in large quantities, difficult logistics, high output, tailor-made batch plants and facilities, complex concrete technology, production of sand and aggregates (cp. Website of Mobil Baustoffe, 2008). They focus on their core business, the production of ready-mixed concrete. All supporting activities like transport and testing is outsourced to subcontractors per project. This keeps the organisation structure lean and flexible and gives the possibility to be flexible and responsive to market circumstances and developments.

Ad 4. Ras Laffan Joint Venture
MCQ has a contract in Ras Laffan with a large dredging joint venture (Jan de Nul – Boskalis). This joint venture is named "Ras Laffan Joint Venture".
This contract obligates MCQ to produce all the in-situ ready-mixed concrete for the two breakwaters, which are part of the Ras Laffan port expansion project (RLPEP). Because this contract is the only one MCQ has, the performance of MCQ in this project has a significant influence on the overall performance of MCQ. An impression of this project can be seen in Figure 2.

Ad 5. Qatar Petroleum (QP)
Qatar Petroleum is the client for which the Ras Laffan port is being expanded. They do not have any contractual relations with MCQ, but the fact that they are the end-user of the structures gives them a significant influence.

1.3 Problem definition and objective

Construction projects have the feature that they are unique and made only once. There is no opportunity to construct the project again in a better way (like is possible with batch- or mass production). During the construction of a project, unforeseen events are likely to happen. It is simply not possible to predict all circumstances and occurring events. This fact is even more present when a company expands from their domestic region into an international field. The international production brings along extra dynamics that the company might not have been prepared for.
Controlling these (new) aspects when entering a foreign and unknown market is a challenge and can be quite difficult if the management is not experienced in international ventures.

In general, the main target of a ready-mixed concrete producer is to produce the correct requested amount of concrete on time at the required quality level. If one or more of these main objectives are not fulfilled, the contractor will not be satisfied with the performance of the RMC producer and a critical situation might arise.

In the case of MCQ, the expansion from Austria towards Qatar was not as successful as the mother company had hoped. Many unforeseen events happened during the time span from the intention to internationalise to Qatar until, and after, local production started in Qatar. All these occurrences have led to the fact that the production of ready-mixed concrete was not at the desired level wished by the mother company and the main contractor. The local management was not performing its task appropriately and did not control the production of ready-mixed concrete sufficiently.

The situation described above has led to the following problem definition:
"The production of cooled ready-mixed concrete by MCQ in Qatar has not met the expectations of the main Austrian company or the main contractor of the project".

To be able to analyse the internationalisation of MCQ and the unforeseen events, which have occurred, this thesis uses the critical incident technique as a basis for analysis. This technique is appropriate for because it makes it possible to understand certain situations that involves cultural aspects better (Tijhuis, 1996). Darshi de Saram and others describe this technique as appropriate to overcome typical difficulties in analysing the construction sector, which are: informal processes, low tangibility, high customer participation and low degree of repetition (Darshi de Saram et al, 2004). With the results derived from analysing critical incidents, factors can be identified that affect the production of ready-mixed concrete production in Qatar.

The objective of this research is:
"To analyse the production of controlled delivery of cooled ready-mixed concrete production in Qatar, in order to identify factors affecting this production."

1.4 Research model

All the information the researcher gathered during the assignment in Qatar is collected through field study observations. Field study observations contain comprehensive descriptive details of people, places, things and events (Given, 2008). These observations are described in Appendix 1. From this information, the problem and the research objective as well as the critical incidents themselves are derived. . A review of the scientific literature applicable to the international production of cooled ready-mixed concretehas provided a focus on the theory. The critical incidents, which has been described in Appendix 1, are analysed based on this theoretical focus. This analysis provides the causes of the critical incidents and identifies factors that affect the production of ready-mixed concrete.

An expert panel will validate the factors that are derived from this analysis. This panel consists of members from the board of Mobil Baustoffe GmbH. Finally, conclusions and recommendations will be given.

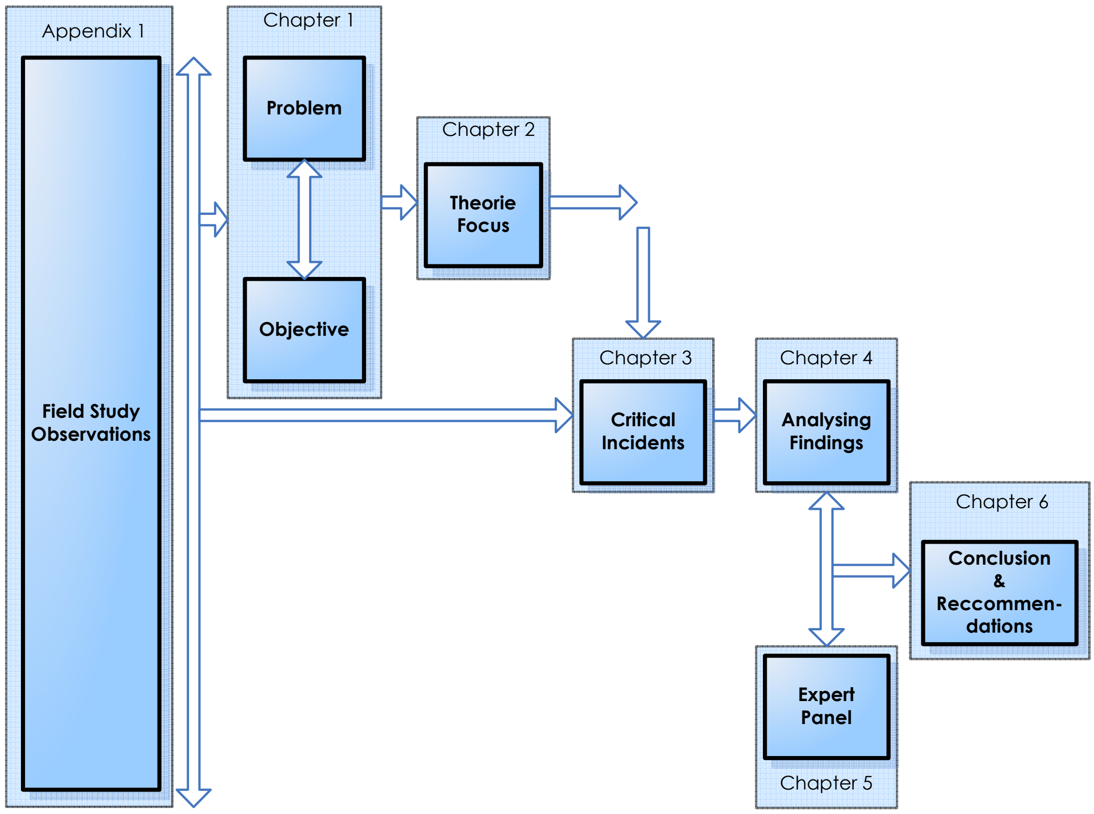

Figure 4, Research model

1.5 Research questions

The objective of this research has been divided in different research questions and sub-questions.

1 What characterises cooled ready-mixed concrete production?
   - 1.1 Which aspects are relevant to control a standard production process of ready-mixed concrete?
   - 1.2 What is the effect of the fresh concrete temperature on the properties of the final product?
   - 1.3 What problems is MCQ facing with the production of cooled ready-mixed concrete production?

2 What aspects have an influence on production of cooled ready-mixed concrete in an international setting?
   - 2.1 What are the influences of cultural aspects on the production of ready-mixed concrete?
   - 2.2 What differences are there between domestic and international production of cooled ready-mixed concrete?
   - 2.3 What problems are MCQ facing with the internationalisation of cooled ready-mixed concrete?

1.6 Research approach

This research includes an intensive period of field study. In the period the information was gathered, the researcher was present in Qatar (November 2006 until March 2008). This provides in-depth first hand information to the researcher, which would have been very difficult to get if the information was gathered by another method. It contains all kinds of information such as personal observations and experiences, documents, interviews with employees and employers and conversations with external objective parties.

One of the most important parts of this research consists of the description and analysis of Critical Incidents. The Critical Incident Technique (CIT) originates from the field of psychology and was developed by Flanagan in 1954. Critical incidents provide a personal perspective of organisational issues (Marelli, 2005).

As already described in section 1.3, the Critical Incident Technique is an appropriate method of analysing construction processes. It gives the researcher the possibility to understand certain situations and the involved cultural aspects better (Tijhuis, 1996). Darshi de Saram and others describes this technique as appropriate to overcome the typical difficulties in analysing the construction sector, which are informal processes, low tangibility, high customer participation and low degree of repetition (Darshi de Saram et al, 2004).

There is an important consideration about the critical incident technique which the researcher has to bear in mind. The researcher has to stay constantly aware that cooperation within the company that is subject of the research might give a coloured view of the facts. This could lead to different analysis and a decline in credibility (Marelli, 2005). Hence, all gathered information has to be checked if it represents complete objectivity and the researcher has to analyse the data taking this aspect into consideration. Sanders also describe this as ‘being a third culture man’, in which the observer acts as sort of a third culture in analysing conflict situations (Sanders, 1995). The other two cultures that are involved are each of the conflicting parties.

1.7 Summary

Concrete is a very common material in construction business. The positive aspect is that it gives flexibility to the design of structures, and the negative aspect is that concrete is influenced by ambient conditions during the hardening period. Especially in the Arabian Gulf, the ambient conditions have a great influence on the concrete if these influences are not acknowledged and controlled.

Mobil Concrete Qatar (MCQ) is a ready-mixed concrete producer with an economic activity in Qatar. The company is a joint venture between Mobil Baustoffe GmbH. (origin Austria) and Gulf Beach Trading & Contracting (origin Qatar). MCQ has a contract to produce the in-situ ready-mixed concrete for the port expansion project, from which the concrete works consist of a concrete road on top of both of the breakwaters. From the start of the project on, the main contractor of the port expansion project as well as the mother company Mobil Baustoffe were not satisfied with the performance of MCQ.

This thesis tries to find factors that affect controlled delivery of cooled ready-mixed concrete production in an international setting. This is achieved by analysing critical incidents on the case of MCQ. The information needed for this is gathered through field study observations by the researcher himself. The critical incidents derived out of these field observations and an expert panel will validate the results of the analysis.

2 Theoretical Focus

This chapter describes the theoretical framework of this research. The first section describes the framework, which provides a focus on the relevant theoretical aspects for this research. Section two describes the relevant aspects of ready-mixed concrete production. The third section focuses on organisational aspects, which are relevant for companies active in an international setting. The fourth section describes the cultural aspects.

2.1 The “3-C” Framework

Analysing situations derived from construction projects, can be a complicated task (see also p.15). If such construction projects are carried out in an international environment, those analyses become even more complex. Different cultures, environmental circumstances and project conditions are only a few aspects that are introduced when construction projects are performed in an international setting.

In this research, MCQ is analysed. The mother company of MCQ is Mobil Bustoffe, an Austrian private owned company, which decided to internationalise to Qatar. MCQ has one contract to produce the ready-mixed concrete for a port expansion project. Such analysis of an international construction project requires a framework, which allocates the items that are relevant on an international level and accordingly provides us with the structure to make a clear and reliable analysis possible. In this thesis, the “3-C” framework from Tijhuis is used. This framework is developed as part of a PhD project, which searched for possible backgrounds for differences between the Netherlands and Germany in the construction management process.

(Tijhuis, 1996) describes eight dimensions, which influence construction processes:

1. Construction process organisations,
2. Tender,
3. Organisation structure and –culture,
4. Contacts and Contracts,
5. Conflicts,
6. Negotiations,
7. People,
8. General.

These dimensions have different levels, i.e. some are more on the surface and directly noticeable whereas others are more in the background and have less obvious influences. A distinction can be made between three levels (Tijhuis, 1996):

1. Surface level,
2. First background level,
3. Second background level.

Ad 1, Surface level

The surface level is the level in which the actual construction processes take place and occurring problems are directly noticeable. The dimensions construction process organisation (1) and tender (2) belong to the first surface level.

Ad 2, First background level

The next level is a background level which can be described as a result of human behaviour. In this level, the causes of actions are not directly noticeable and traceable, but can be retrieved after analysis. The dimensions organisation structure and –culture (3); contacts and contracts (4); and conflicts (5) belong to the first background level.

Ad 3, Second background level

The last level is a deeper background level that has less influence and is more difficult to notice. It is difficult to retrieve causes from actions on this level, because the relation between this level and the noticeable effects is quite indirect and vaguely present. The dimensions people (7) and general (8) belong to the second background level.

It is these items on the first background level that are interesting to analyse, because on the one hand the causes can be retrieved through analysis and on the other hand these items are the ones that are specifically applicable in international construction projects.

If a research is conducted to analyse practical situations in the international construction sector, critical situations first become clear when technical problems are faced. Those technical problems have backgrounds that caused them, e.g. human behaviour of the involved persons and/or ambiguous contract specifications. Next, the persons who are involved act according to their cultural background; hence, this background influences their behaviour. Those circumstances on these different levels lead to a cyclic process, which provides the “3-C” framework. This framework is shown in figure 5.

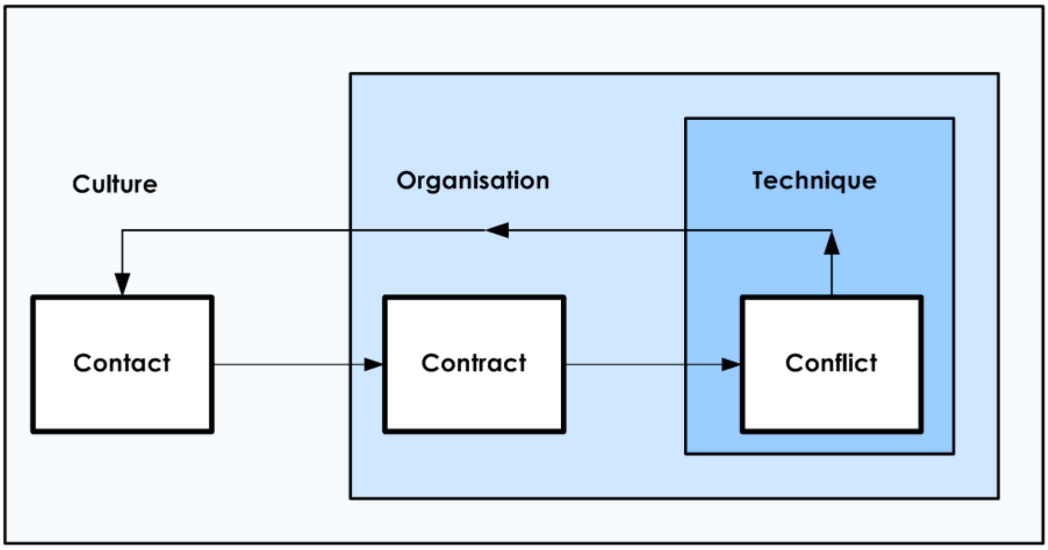

Figure 5, "3-C" Framework (Tijhuis, 1996)

In the next sections, the applicable theoretical aspects will outline the items that are important for each of the three different levels of this framework.

2.2 Technical aspects

This section describes the theoretical aspects of the technical level. In this thesis, technical issues consist of the production of ready-mixed concrete. First, general aspects of the industry, product- and process characteristics are described. Secondly, a more detailed description of the production process is provided and last, the specific item of quality control of ready-mixed concrete is described.

2.2.1 Industry, product and process characteristics

Concrete is one of the most common materials used in the construction sector. It provides the advantages of being cheap and it allows great diversity in the design, because it can be poured into a mould of any shape in its fluid form (Syverson, 2008). However, it faces great transport barriers because it has a low value-to-weight ratio and is highly perishable (Syverson, 2008). From the moment water is added to the mix of dry materials, concrete only has about an hour and a half before the hydration process starts and the workability drops (Although there are some methods to stretch the available timeframe significantly, even up to days, e.g. the adding of set-retarders). Thus, concrete leaves little room for variability of delivery and placement once the process of mixing has started. Furthermore, it also incorporates that production facilities have to be placed in the close proximity of the construction site.

Besides that concrete has a limited workability, it is also a custom specified material. Designers specify the needed compressive strength and other relevant qualitative requirements for concrete. Every project has different requirements and often within a single project, different concrete mixtures are prescribed. This affects the type of materials, which have to be used, and it can even influence the production method. As mentioned in the introduction, local environmental conditions influence the properties of concrete. Specific influences of the environment in the Gulf region on concrete are described in detail in appendix 3, "The effect of the local environmental circumstances in the Gulf region on concrete".

Next to these product characteristics, there are also some specific aspects about the process of producing ready-mixed concrete. Batch plants that produce ready-mixed concrete have a limited production capacity. The batching capacity is determined by the time needed to measure, discharge, mix, and then load the freshly mixed concrete into a truck. Besides the batching capacity, there is also the delivery capacity. This capacity is determined by the amount of trucks that are at disposal to the batch plant. Normally, this capacity is larger than the batching capacity to prevent unnecessary idle times of the batch plant. One of the challenges for cost-effective and reliable batching is to match and optimise the requested delivery rate to the batch- and delivery capacity.

The demand of ready-mixed concrete fluctuates throughout the day, week, month and year. The total amount of concrete that is needed for a project can be estimated quite well, the actual timing and quantity is difficult to forecast until a detailed planning is available. This influences directly the amount of raw materials that need to be available. The higher the uncertainty in the planning, the higher the stock of materials needs to be in order to deal with fluctuations of demand of concrete. This is also depending on the lead time for contractors to order the concrete. An order lead time of about 3 days is reasonable in most situations. This gives the batch plant the time to arrange materials, reserve batching capacity and mobilize the needed trucks. Because the price of ready-mixed concrete consists for a large part of the costs of the raw materials, it is evident that economically efficient production of ready-mixed concrete is greatly dependent on the management of all the factors concerning raw materials.

The demand of ready-mixed concrete is also dependent on the size of individual placements. Large concrete pours require an uninterrupted supply of concrete in order to avoid unwanted construction joints. On-time delivery is therefore of the utmost importance to contractors (the buyer of the concrete). Before the commencement of a large pour, the concrete producer needs to make a good plan in coordination with the contractor whereas during the pour, the batch plant and the construction site where the concrete is placed have to communicate continuously about the progress. In an ideal situation, the speed of the supply of concrete from the batch plant is exactly the same as the speed of placing at the site. This is not that easy to monitor and achieve, because an empty truck returning to the batch plant is in fact a delayed request for more concrete; delayed because of the return cycle from the construction site to the batch plant. If the return cycle takes longer than planned, the progress at the site will have lowered (unless a truck faced problems on the way back). This delay in request of production at the batch plant requires the full, continuous attention of the batch plant operator. Some batch plants use modern technologies to overcome these classical complications related to the production of ready-mixed concrete. These producers use geographical information systems (GIS) on trucks and have real-time information available instead of the delayed information. Another, more cost-effective method is when a truck driver sends a short SMS with a mobile phone to the plant operator. Either methods can support the plant operator to coordinate the production rate more accurate than in the traditionally way.

The basic production of ready-mixed concrete is quite straightforward. It consists of sand, aggregates, cement, water plus admixtures. According to mix design specifications, these materials are dosed, mixed and then loaded into a truck mixer. The process itself has not changed since the beginning of ready-mixed concrete but there are some important developments in the ready-mixed concrete and adjacent industries that provided greater flexibilities (Syvenson, 2008):

1. The development of automatic batching control systems,
2. A substantial increase in the capacity of central mixers (production capacity) and truck mixers (delivery capacity),
3. The continuing increase in the variety of chemical admixtures,
4. Improvements in logistic coordination,
5. The introduction of concrete pumps and their continuous growth in capacity.

Ad 1, Automatic batching control systems

The production of ready-mixed concrete, also known as batching, was a manual operation before the development of computers. The operator would control the mechanical hopper gates by an analogue gauge. He had to close the hoppers on time to prevent over dosing of materials. Nowadays, an automated batch system uses a control system, which receives information from a variety of sensors, processes it and automatically generates commands for corrective action to bring the variable of interest to its desired value (Wang, 2002). The most recent control system uses advanced Graphical User Interfaces (GUI) providing the plant operator with real-time information in an easy to understand visual projection. This user interface gives them the possibility to interfere easily if needed.

Ad 2, Increase in production- and delivery capacity
Approximately 50 years ago, central mixers from batch plants had a capacity of 0.25 up to 0.50 m^3. Nowadays central mixers have an average capacity of 2.25 m^3 to 3.3 m^3 and in some cases even up to 4.5 m^3 and 9.0 m^3. This greatly reduces the amount of batches to fill a truck mixer and hence production time. The truck mixers about 50 years ago had a capacity to load about 2.5 to maximum 6.0 m^3 concrete. Today the typical truck capacity is 10 m^3 and in some cases even 12 to 15 m^3. Increasing the capacity of trucks logically decreases the number of trips needed to transport a typical amount of ready-mixed concrete.

Ad 3, Increase in variety of chemical admixtures
Chemical admixtures can be added to concrete while batching to influence its properties. There are admixtures, which increase the workability (plasticizers), influence the setting time (set-retarders), colour or porosity. This increases the range of use for ready-mixed concrete and provides greater flexibility to the application of the concrete.

Ad 4, improvements in logistic coordination
Ready-mixed concrete producers have to deliver a perishable product to time-sensitive buyers in multiple locations. Some producers moved towards centralized delivery dispatching, which means they coordinate their deliveries centrally for all their production facilities and make more efficient use of the available resources. Other logistic trends are the use of geographical information systems, which were also described previously.

Ad 5, Concrete pumps and their continuous growth in capacity
Concrete pumps allow virtually an uninterrupted placement of concrete, making it possible to reach difficult locations and are easy to move from one site to another. The alternative is to pour concrete with a skip hanging on a crane, which moves in between the truck and the mould. The only restriction in placing concrete with a

pump is the capacity of the pump and, if a mobile or truck mounted pump is used, the length of the boom. Typical pumps have a boom length of 42 meters and a placing capacity of more than 100 m^3 per hour, although pumps are available with a maximum boom length of 70 m.

2.2.2 Production process of ready-mixed concrete

The production of ready-mixed concrete involves typically four stakeholders (Tommelein and Yi Li, 1999):

1. Designers,
2. Contractors,
3. Ready-mixed concrete producer (batch plant),
4. Raw material providers.

These stakeholders and their relations are visually shown in figure 8 and 9. Designers (Line I) specify the concrete mixes needed for a project by either recipe or performance. The contractor (Line IV) obtains information from the specifications and decides the size of individual pours and the method of construction and placement of the concrete. After identifying the concrete producer (described as "batch plant" in the figure, Line II) that will supply the concrete, advance orders are given with approximate quantities and delivery times. The concrete producer makes a raw material planning based on these advance orders. Some raw materials have to be ordered from suppliers (Line III), in most cases with a certain lead-time. The concrete producer has to bear these lead times on mind to be able to receive them by the time the actual batching will take place. A few days prior to the execution of works, the contractor has to inform the concrete producer and make a release order to confirm the agreed quantity and time or make any changes if needed. The production only takes place on demand and is therefore a classical pull system (Tommelein and Yi Li, 1999).

The production processes are illustrated by using value stream mapping symbols that in its original intention have been used by Rother and Shook to identify opportunities to make processes leaner (Rother and Shook, 1998 in Tommelein and Yi Li, 1999). The applied symbols might differ slightly from the standard way of identifying production processes, but because Tommelein and Yi Li focus specifically on ready-mixed concrete production, their method is applied in this thesis. An overview and explanation of the symbols is shown in figure 6.

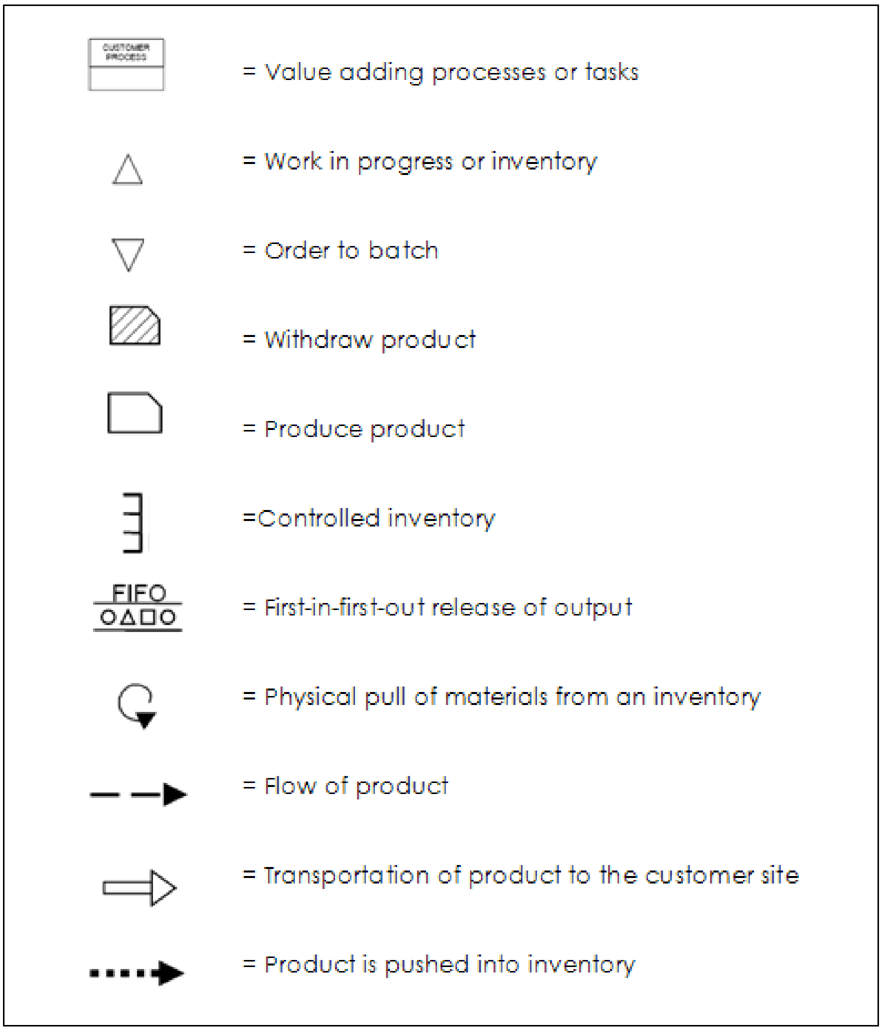

Figure 6, Explanation of the symbols that are used in figure 8 and 9

There are two distinctive ways of ready-mixed concrete production:

1. Integration of batching and delivery,
2. Integration of delivery and placement.

Both of these will be discussed hereafter.

Ad 1, Integration of batching and delivery

This type of production characterises that the ready-mixed batch plant is producing the ready-mixed concrete and delivering it to site. Trucks, which are owned by the producer or by a third-party transporter, take care of delivery. The contractor expects from the ready-mixed concrete supplier that the ordered amount will be delivered on time to the requested place with the agreed quantity and quality. The logistic characteristics can be seen in figure 7.

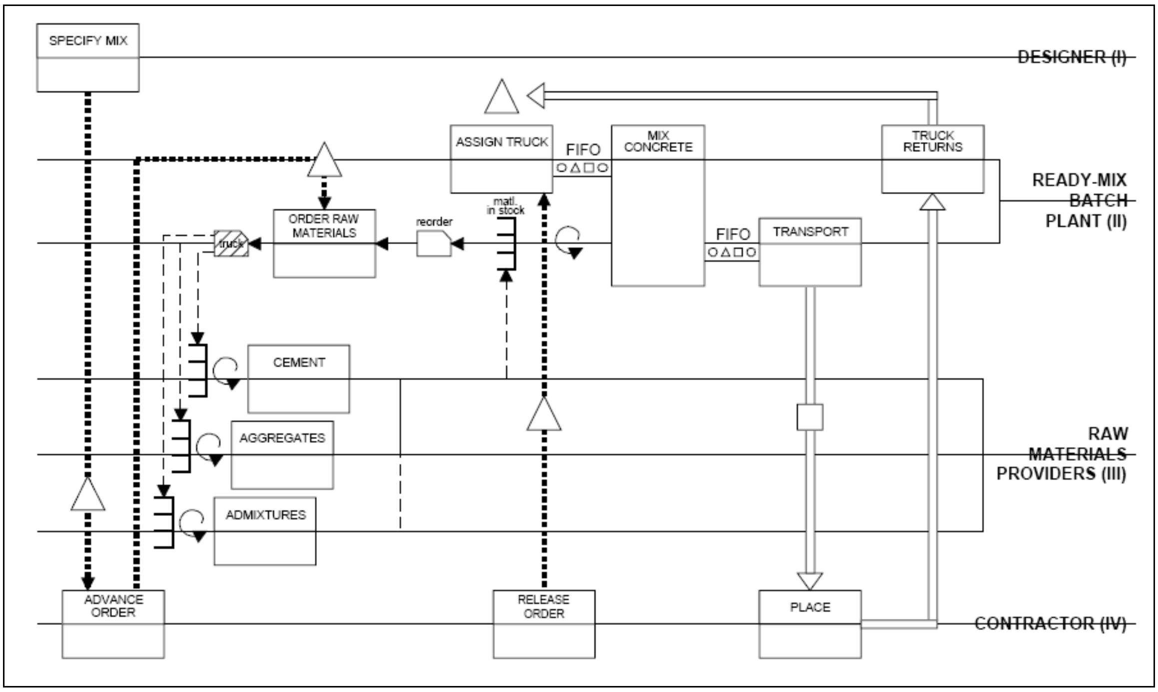

Figure 7, Ready-Mixed Concrete Production and Delivery by Batch Plant (Tommelein and Yi Li, 1999)

The above described type of production has the two advantages that the whole process from start of mixing until delivery at site is under supervision and control of the batch plant. This gives more options for interaction and control. At the same time, here also lies a disadvantage for the batch plant. Scheduling is the full responsibility of the batch plant, from the moment the order is placed until the delivery at site. The concrete is ordered at a specific time on site and it is the obligation of the batch plant to fulfil all the contractor's requirements. If a third party transports the concrete, the performance of this party is the responsibility of the concrete producer.

Ad 2, Integration of delivery and placement

This type of production characterises that the contractor has his own trucks at disposal for hauling the fresh ready-mixed concrete from the batch plant to the construction site. These trucks can be either owned by the contractor or contracted from a third party. The ready-mixed concrete producer transfers the goods to the contractor when the fresh concrete is discharged from the batch plant into a truck mixer. The logistic characteristics are visually shown in figure 8.

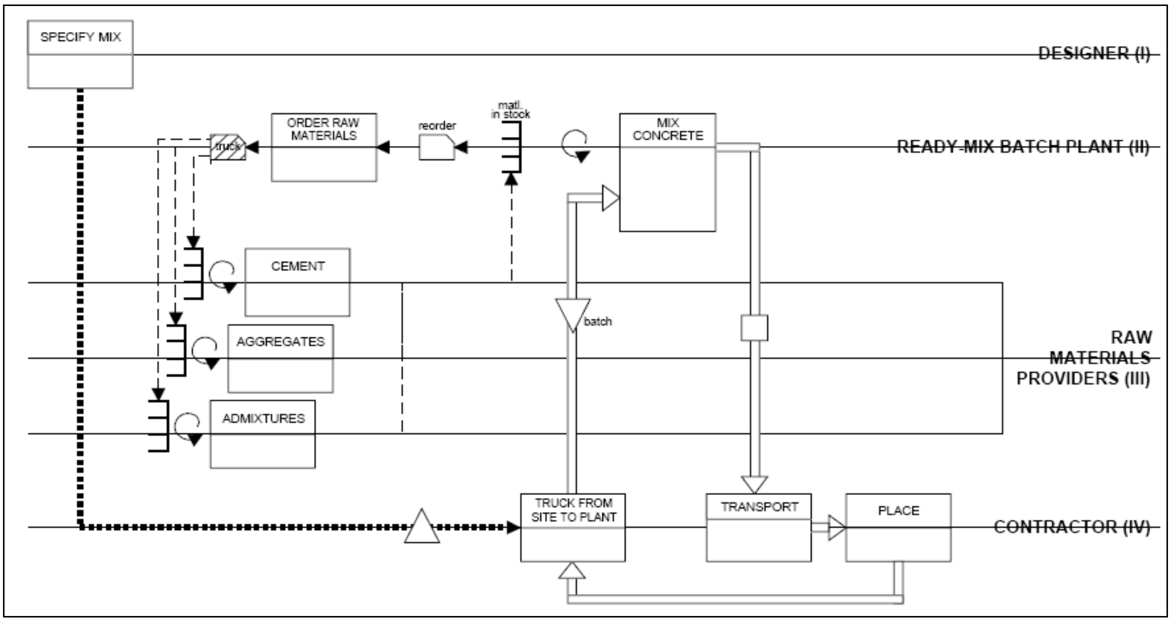

Figure 8, Ready-Mixed Concrete Transport and placing by Contractor (Tommelein and Yi Li, 1999)

This type of production has the advantage for the ready-mixed concrete producer that the responsibility for delivery ends at the batch plant. The official handover of the goods is at this location and any delays in delivery are full responsibility of the contractor himself. Because the batching capacity is usually greater than the needed delivery capacity of the contractor, it is often not a problem for the batch plant to schedule the requested concrete (even in between other jobs). A disadvantage of this system is that the contractor expects the producer to take responsibility for his product until the moment the concrete is placed, although not all aspects are completely in the producer's control and influence after the concrete is discharged from the batch plant.

The two different ways of production and delivery of concrete are both very common. In most projects, the main contractor decides how the delivery of the ready-mixed concrete should be organised. It depends upon project characteristics and risk allocation by the main contractor which method is adopted. This main contractor has to be aware of those risks and make clear contracts with subcontractors to avoid conflicts.

2.2.3 Quality Control of ready-mixed concrete

An important part of the production process is the quality control of ready-mixed concrete. The nature of the raw materials used in the concrete and the large number of factors which affect the strength of ready-mixed concrete, make it a highly variable product (Newman & Choo, 2003b). The variations in the production process could have serious technical, quality and commercial implications to the batch plant if not monitored and controlled in some manner. The interpretation of quality control differs among different people. Therefore, a definition of quality control is given here: “The operation of procedures to maintain product quality at the selected level. This involves decision and actions by technical, production and general management.” (p.129, Dewar and Anderson, 1992).

An associated feature of the quality control is that even within a desired (target) mix the inherent variability in the materials and the production process will always result in a final product that differs slightly from the target requirements. The coefficient of variation is typically between 10 per cent and 20 per cent (Newman & Choo, 2003b). When the concrete remains within specified tolerances on key attributes, the product is acceptable. Effective management must include a quantitative knowledge of the key attributes, monitoring techniques, decision methods, their limitations and an ability to interpret the measured values (Newman & Choo, 2003a). For a client to have assurance about the quality of ready-mixed concrete, the producer needs to make sure that:

1. The qualities of the fresh and hardened concrete are objectively defined,
2. The production and delivery processes are carried out under controlled conditions which allow the whole process to be able to be traced from the constituent materials up to the final structure where the concrete is embedded,
3. All the testing is carried out and the results are valid.

Quality control of ready-mixed concrete can be divided into three areas (Dewar and Anderson, 1992):

1. Forward control,
2. Immediate control,
3. Retrospective control.

Ad 1, Forward control

Forward control covers those aspects of quality control, which prevent the occurrence of any unwanted influences that could possibly influence the quality of the concrete. The most important aspects are:

1. Proper material storage; prevention of contamination, drainage facilities, reliable feed systems,
2. Monitoring the quality of raw materials; visual checks, certification and information by suppliers, sampling of materials,
3. Reliable weighing equipment; controlled flow of materials, calibrated scales,
4. Plant maintenance; maintenance of mechanical installations, mixer condition and truck mixer operation.

Ad 2, immediate control

Immediate control covers the aspects with instant action to control the quality of the concrete. It consists of the following aspects:

1. Weighing; accurate weighing and correct reading of data,
2. Visual observation of concrete; assessment of workability and uniformity,
3. Use of equipment to measure moisture content; batch plants can be equipped with moisture sensors to measure the water content of fine aggregates to correctly adjust the water content according to the mix design,
4. Real-time adjustments; batching control systems can automatically adjust according to measured values of material quantities or mixing quality (workability).

Ad 3, Retrospective control

Retrospective control covers the aspects which provide information about the quality of the concrete, but from which the effect cannot be influenced anymore. The most important aspects are:

1. Sampling and testing of fresh concrete; testing of setting time, air content and compressive strength provide important information about the concrete,
2. Testing of raw materials; some tests on raw materials take more time than the shelf life of these materials, hence the influence on the final product cannot be influenced anymore,
3. Diagnosis and corrective actions; the implementation of corrective actions prevents the re-occurrence of faults.

Many aspects regarding immediate control are centrally monitored and controlled through the control system of the batch plant. Nowadays, most batch plants use automatic control systems for production process control. Process control can be described as the knowledge and control of parameters, which could influence the process, and the monitoring of the process itself in real-time to influence the production (Wang, 2002). The fundamental component in an automatic control system is the so-called "controller". It could either be a piece of hardware or software code in a computer. Its job is to receive information about the system from a variety of sensors, process it, and automatically generate commands for corrective action to bring the variable of interest to its desired value or trajectory (Wang, 2002). In the case of ready-mixed concrete production, an automatic control system can correct in between individual batches so that a full load in a truck mixer meets the target mix requirements as closely as possible. A typical truck mixer with a capacity of 10 m^3 is loaded in 3 to 5 individual batches (depending on central mixer capacity). This method of automatic correction reduces the variation in batch quantities and is one of the main advantages of automatic control systems. Another important aspect of modern batch control systems is the real-time information of the workability of the concrete. The workability of the concrete is related to the power consumption of the central mixer. These two items have to be calibrated during trial mixes and optimised during the period of concrete production to obtain the best results. It gives the plant operator instant information about the raw material characteristics and water demand of the mixture.

The output of the control system, which assures the quality towards the client, is the delivery ticket. Every truck mixer, which leaves the batch plant, receives such a ticket and the receiving party (contractor) will not accept any load without such a document. It contains information about the type of mixture and the total quantity of concrete. It can mention additional information like batch quantities of all materials and test results from samples, which are taken from the corresponding truck mixer. Basically, the delivery ticket contains all information regarding immediate control that the client would like to know.

The most important aspects regarding retrospective control are checked after the concrete is mixed and before it is placed. Most often they are performed upon arrival at the site in coordination with (and sometimes witnessed by) the client. A typical flowchart of quality checks can be seen in figure 9 (Sarkar, 2007). The figure describes the stages from the moment that the concrete is loaded into a truck mixer at the batch plant until the final placing at the construction site. The first aspect, which is always checked, is the delivery ticket. The correct mixture, truck number, travel time and quantities are checked. After this, a sample of concrete is taken from the truck. It depends on the project if every truck has to be checked or only a given number of trucks from the total ordered amount for a random check. Different projects can have different requirements on the type and frequency of testing and also local practices and standards have an influence on this.

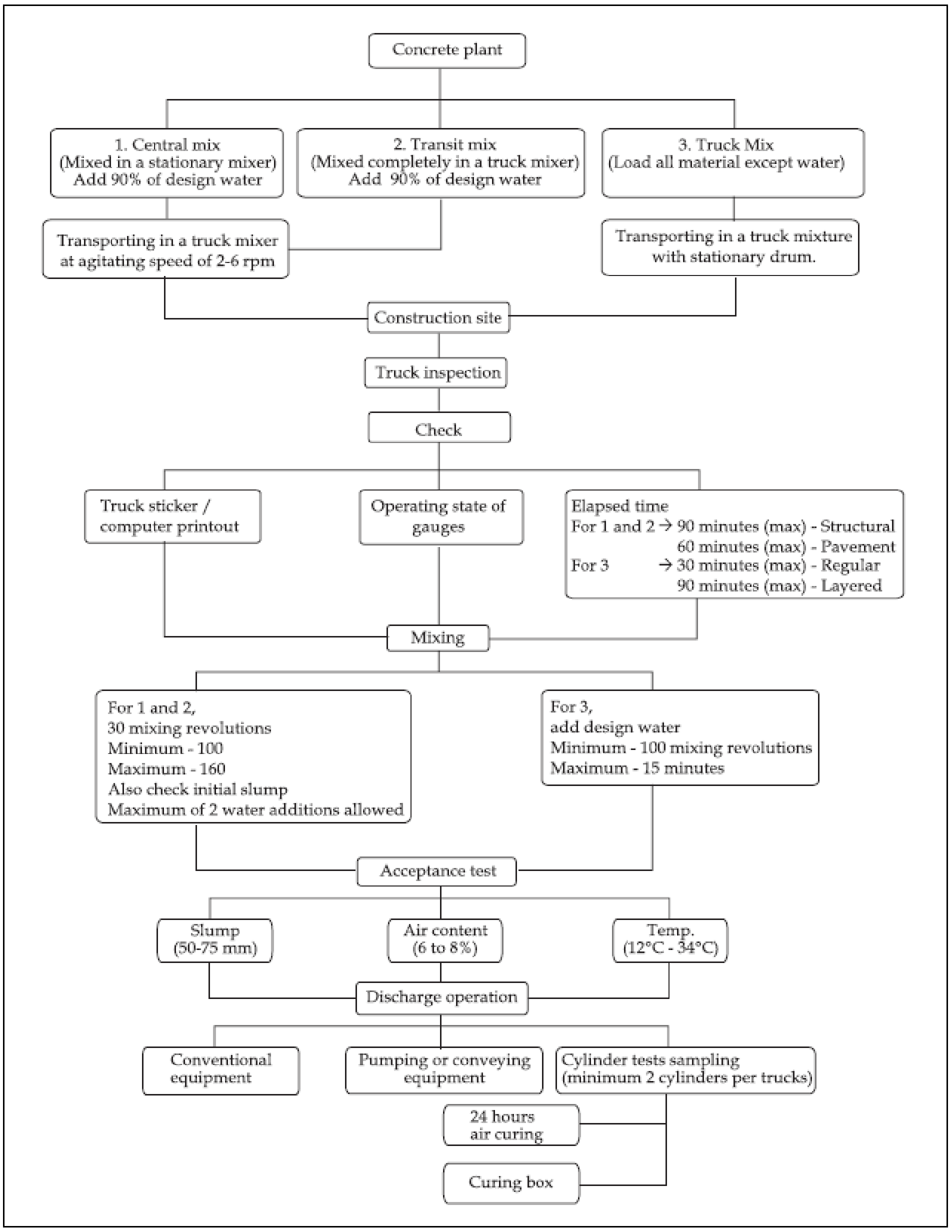

Figure 9, Flowchart of quality control of ready-mixed concrete (Sarkar, 2007)

From this sample of fresh concrete, one test that is more or less always performed is the slump. Additional tests can be the measurement of the air content or the temperature of the fresh concrete (Many projects in the Gulf region prescribe that from every truck the temperature has to be measured and the acceptable fresh concrete temperature is most often limited). Depending on the contractual mentioned frequency, standard cubes (150 x 150 x 150 mm) are filled with fresh concrete to test the compressive strength after 28 days.

This 28-day compressive strength is a very important aspect in the final acceptance of the concrete. In contractual agreements, there is a strength class prescribed for the structure and it is the task of the ready-mix supplier to provide a suitable concrete, which meets this requirement. The compressive strength of a cube gives a clear quantitative result, which allows clear interpretation and judgements of the final acceptance of the concrete. However, it is evident that the results of this test have to be perfectly valid. This includes observation of procedures and equipment, but can also go further in cases that are more complex, e.g. the curing method might have to be validated by investigating the ratio of 7- to 28-day strength in comparison with date from the ready-mixed concrete producer and even cement company data.

In figure 10 the most important influences on 28-day compressive strengths can be seen. This figure shows that most of the influences have a negative impact on the cube strength if they are not performed at the level, which is prescribed in standards. It is evident that a combination of negligence of these factors increases the deviations. Personnel that is responsible for sampling and testing of concrete need to be fully aware of the applicable standards and the effect of any deviations in the process. Besides these general influences, there are specific influences from the local environment which affect the quality of concrete. These are describes in appendix 4, “Concrete characteristics”.

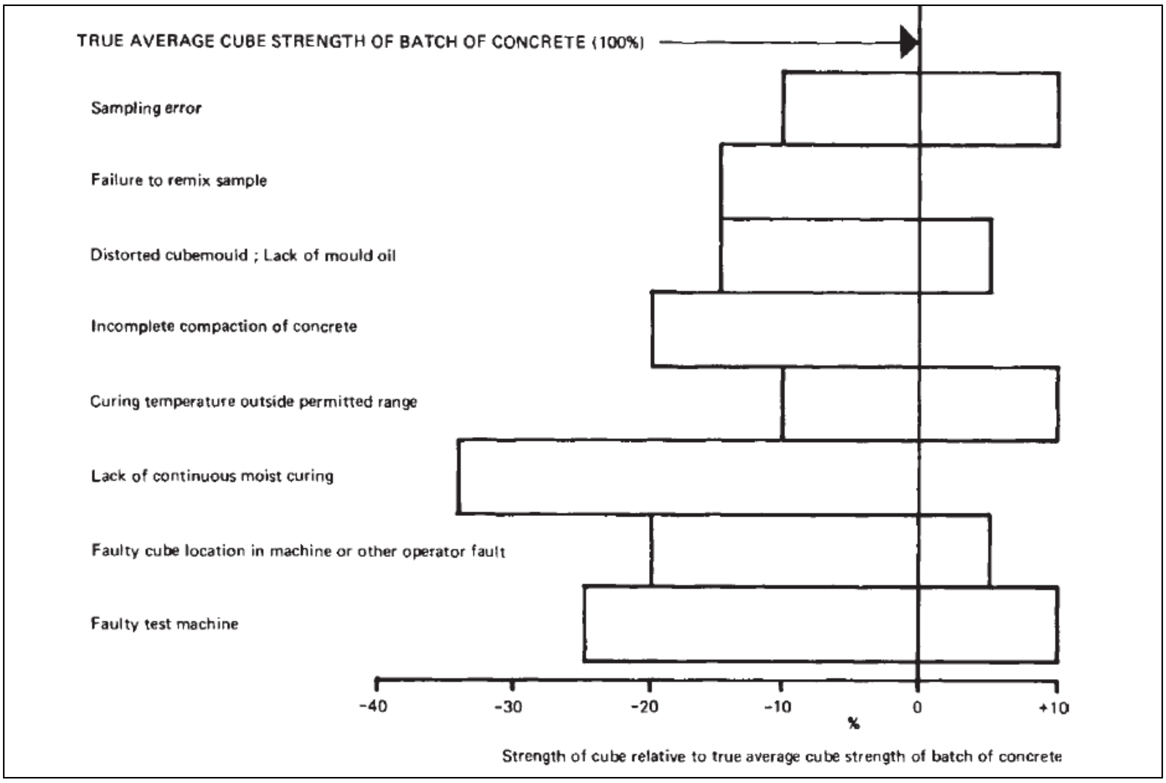

Figure 10, Overview of the influences on cube strength (Newman and Seng Choo, 2003b)

The topics described in this section are applicable to the "Technique" level of the "3-C" framework, as is visualised in figure 11.

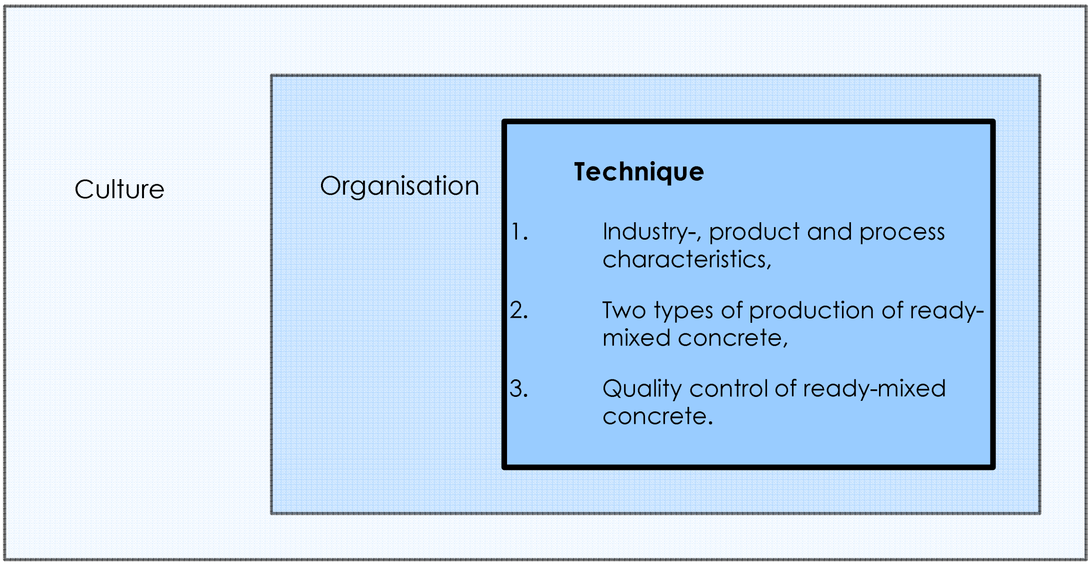

Figure 11, the applicable theoretical aspects for the "Technique" level of the "3-C" Framework

2.3 Organisational aspects

This section describes the following theoretical aspects of international organisations:

1. Definition of internationalisation and international joint ventures,
2. The control and management of international joint ventures,
3. Partner selection and trust between the partners,
4. Key aspects of international construction projects.

2.3.1 Definition of internationalisation and international joint ventures

Internationalisation is a word which is described in numerous different ways in the scientific literature. One which is adopted by several studies is that internationalisation of an organisation is a process in which the organisation increase their international involvement gradually (Johanson and Vahne, 1977). To be able to produce alongside indigenous organisations in these markets, an organisation must possess additional advantages to outweigh the extra costs of servicing a distant or unfamiliar environment (Dunning, 1987).

Empirical observations from studies in international business resulted in the Uppsala stage model, the most frequent used model to describe the internationalisation process (Chetty and Campbell-Hunt, 2003). This model describes that firms expand slowly and stepwise from their domestic base into distant areas to minimise risk and overcome uncertainty. Typically, firms start exporting to a country via an agent, then they establish a sales subsidiary and eventually start production in that host country (Johanson and Vahne, 1977). The time order between those stages seems to be related to the psychic distance between the home and the host country. The psychic distance is defined as the sum of the factors which prevent the flow of information from and to the market. These factors include for example differences in language, culture, business practice and industrial development (Johanson and Vahne, 1977).

Criticisers of this model argue that it is seen that firms also leapfrog into internationalisation (Chetty and Campbell-Hunt, 2003). This is exactly the fact which applies to the case in this thesis. The characteristics of the produced product and local legislation introduce two major restrictions in the options for the organisations' internationalisation strategy. The inseparability of the production and consumption of concrete (due to the time-limited workability) make it necessary to have physical production available in the close proximity of the location where the concrete is used (Syverson, 2008). A further restriction derives from national legislation in Qatar. Foreign investors may invest in all sectors of the economy of Qatar provided that they have one or more Qatari partners whose share is not less than 51% of the capital (law 13, 2000).

Taking the two above mentioned restrictions into account, the focus of relevant theories regarding organisational aspects can be restricted to international joint ventures (IJVs), which are active in the production sector and which have local production facilities available.

Joint ventures occur when two or more legally separate bodies form a jointly owned entity in which they invest and engage in various decision-making activities. A joint venture may be termed international where at least one of the parents is based outside the country where the venture is taking place (Al-khalifa and Peterson, 1998). Another description is that an international joint venture can be defined as a joint venture that involves at least two organisations that contribute equity and resources to a semi-autonomous legally separate entity with at least one partner headquartered outside the JV's country of operation" (Ozorhon et al, 2007).

In a joint venture, each of the joint venture parents invests resources with the intention of getting as much as possible in return for the investment. Organisational learning, with the ultimate goal at acquiring the strategic resources of the partner is seen as a major factor in IJV formation (Mjoen and Tallman, 1997) and at the same time it is also causing instability (Beamish, 1996). However, in this thesis those factors are not likely to be relevant to both of the parent organisations. For the foreign partner it would legally never be possible to operate without a local partner in Qatar and the local partner seems to have a high profit as a sole objective.

2.3.2 The control and management of international joint ventures

IJV's are difficult to manage due to their complex structures. They involve stake-holders (parent companies) which might have different and competing objectives and strategies. Furthermore, the failure rate of IJVs is higher than those for domestic joint ventures because the IJV generally face greater challenges. They have to operate in settings with which they have little familiarity, cope with significant geographical separation and they must bridge cultural boundaries (Ozorhon et al, 2007). This environmental uncertainty in which an IJV has to operate is associated with customers, suppliers, competitors, regulatory groups and technological conditions (Bourgeois, 1980). The need for autonomy by an IJV seems to rise as the environmental uncertainty gets higher (Kumar and Seth, 1998).

Key to managing an IJV is the integration, exploitation and protection of strategic resources (Mjoen and Tallman, 1997). They mention three different control constructs:

1. The equity share held by each of the parents,
2. The overall or strategic control,
3. The control over specific operational activities.

A parent wants control because this implies the ability to determine how best to use the capabilities of the venture and it helps to protect the technological core of the IJV. Parental control implies that the parent firm can ensure the most effective use of whatever strategic resources it shares with the IJV, a great concern in turbulent environments (Mjoen and Tallman, 1997).

All the described difficulties can lead to instability of an IJV. An IJV is called unstable when they experience a drastic shift in the parent control structure. Factors leading to instability are conflicts in shared management, cross-cultural differences, ownership structures, characteristics of the parent and external environmental forces (Yan and Zeng, 1999). Industrial dynamics also influence the stability, and IJVs are found to be less stable in industries that experience intensive consolidation of volatile growth (Kogut and Singh, 1989). In a lot of researches the relation between performance and instability is complex, but performance is seen as a major factor (Yan and Zeng, 1999).

Important aspects which make it easier to manage and control an IJV are the selection of the right partner and having a trustworthy relationship between the involved partners. These aspects are described next.

2.3.3 Partner selection and trust between the partners

If, like in this thesis, local legislation obligates the company to establish an IJV with a local organisation, it is important to select an appropriate partner. This becomes more important if the psychic distance between the two partners is bigger. Future partners need to understand the impact of differences in culture before they begin to work together. They are often characterised by problems of misunderstanding and limited effectiveness because of a lack of compatibility of the cultures represented in the joint ventures (Swierczek and Hirsch, 1994). The more unfamiliar the expanding firm is with the values and operating methods of the foreign parent, the more it would be reasonable to avoid high-equity entry modes (Mjoen and Tallman, 1997). Another reason for an appropriate partner is that this local partner has got access to market knowledge. This knowledge relates among many other things to demand and supply, competition, channels for distribution and payment conditions (Johanson and Vahne, 1977).

A partner has to be complementary, since such a choice depends upon the balance of resources and skills and hence the success or failure of a venture in reaching its objectives (Buckley, 1999 and Das and Teng, 1997). In searching for a complementary partner, managers should determine the partner related and task-related skills they may need from a partner. The former one applying to the effectiveness of co-operation and the latter one to the operational skills and resources needed between the parties (Al-Khalifa and Peterson, 1998). Most studies prove that critical factors in partner selection are related to the reputation, experience and personal knowledge of the organisation. Some also showed parent size, nature of business and the stated motivation behind IJV formation as relevant factors (Al-Khalifa and Peterson, 1998).

Once the most appropriate partner is selected, a relationship with this partner is a fact. In order for this relationship to fulfil the expectations, the partners need to trust each other. A trusting relationship can be built by minimizing perceptions of asymmetry in value creation or in value appropriation (Parkhe, 1998). Value creation in alliances depend on whether the market and competitive logic of the venture is sound, and then on the efficacy with which the partners combine their complementary skills and resources (Parkhe, 1998). Trust itself, consists of two components: one is forward-looking to expectations of a promising future and the other one is backward looking to the past history. It may deepen as a relationship matures, but this process is hardly automatic. The partners have to work on improving it continually, because trust is hard to build and easy to destroy (Parkhe, 1998). Building trust may be harder when cultures are highly dissimilar, since homogeneous expectations and shared assumptions about the alliance may not exist as readily. Those differences can be subtle or obvious, trivial or fundamental. Trust reduces opportunistic behaviour and can facilitate conflict resolution. Familiarity enhances transparency and reduces the costs of monitoring its activities.

Greater assurance of cooperative behaviour can be achieved by structuring an alliance relationship so that the attractiveness for cheating is reduced, the costs of cheating are increased and the gains from cooperation are increased. Prevention is done by creating costly obstacles or exit barriers to casually abandoning the relationship, so called safeguards. Reducing potential gains can be done by prospective punishment after the fact and penalties for violative behaviour or omission of cooperative behaviour. This gives clear expectations and few surprises.

These provisions are preventive and not punitive. Adding these items in a contractual agreement before commencement of operations can be extremely tricky and can lead to an adverse effect. If there is not yet enough trust between the partners at the time these restrictions are presented in contractual agreements, they can give the partner the impression that the other partner is only interested in settling conflicts instead of 'getting things done'.

Another critical element in building trust is the management and filling its positions with the right people. These people are like diplomats. They are able to create an environment of trust and feel empathy for both of the partners. Some characteristics which these managers should posses are optimism, cleverness, creativity, pragmatism and vigilance (Parkhe, 1998). The bonus packages of alliance managers should be controlled and best minimized. Limiting this ensures continuity, preserves institutional memory and helps inter partner and interpersonal trust (Parkhe, 1998). Some more aspects about these (expatriate) managers are described in 2.4.3. A last remark about managing positions is that the partners should not pursue predominant managerial control; they can better give more attention to omitting the best personnel, keeping these personnel for a long term and blend their cultures (Das and Teng, 1997).

2.3.4 Key aspects of international construction projects

International construction projects logically involve organisations from outside the country where the project is undertaken. Projects with larger contract sums are likely to attract more foreign consultants, contractors and in some cases even subcontractors. Because those foreign companies have to be compensated for the fact that moving outside their domestic region brings along extra costs, it seems logical that projects with larger contract sums provide the needed headroom for this. The success of construction companies carrying out projects in international markets significantly depends on how the risks that stem from the host country conditions are managed as well as the project-specific risk factors (Dikmen et al, 2006).

Producing ready-mixed concrete as a subcontractor for large construction projects brings along dependencies and influences of these projects to this subcontractor. If a subcontractor is only involved in one large project, it is evident that this project has a significant influence on the performance of the whole organisation. Probably the most evident of all circumstances which has an influence on all organisations involved in projects is delay of this project, because its effects are directly noticeable. Delay related to construction projects can be described as "the time overrun beyond the completion date which is specified in a contract or beyond the date that the involved parties agreed upon for delivery of the project" (Assaf and Al-Heji, 2005). In some cases a delay means higher costs for the contractor. These costs are caused by a longer work period, labour cost increases and higher material costs through inflation (Assaf and Al-Heji, 2005).

Assaf gives several recommendations to minimize and control delays in construction projects, especially for projects in the Gulf region. His survey is performed on different types of construction projects in Eastern Saudi-Arabia. Separate recommendations are given for owners, contractors and consultants. These recommendations are quite straightforward, but still their importance cannot be emphasized enough, especially if one looks at the significant amount of delay that occurs in the Gulf region (Assaf and Al-Heji, 2005). The recommendations are listed here to give an impression of important aspects of construction projects in the Gulf region.

The owners should give attention to:

1. Pay progress payment to the contractor on time because it impairs the contractors ability to finance the work,
2. Minimize change orders during construction to avoid delays,
3. Avoid delay in reviewing and approving of design documents,
4. Check for resources and capabilities, before awarding the contract to the lowest bidder.

Some recommendations for contractors are:

1. Shortage and low productivity of labour is a fact: enough number of labourers should be assigned and they should be motivated,
2. Contractors should manage his financial resources and plan cash flow by utilizing progress payment,
3. Appropriate planning and scheduling: the resources should match with the time to develop the work to avoid cost overrun and disputes,
4. Site management and supervision: administrative and technical staff should be assigned as soon as possible to make arrangements to achieve completion within specified time with the required quality, and estimated costs.

Some recommendations for consultants are:

1. Reviewing and approving design documents should be fast,
2. They should be flexible in evaluating contractor works.

The topics described in this section are applicable to the "Organisation" level of the "3-C" framework, as is visualised in figure 12.

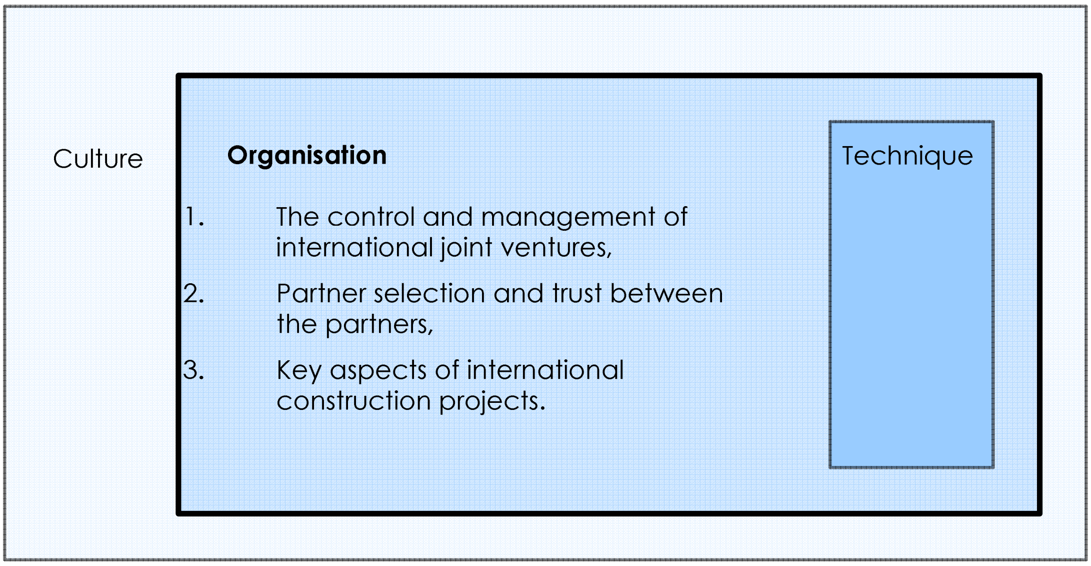

Figure 12, the applicable theoretical aspects for the "Organisation" level of the "3-C" Framework

2.4 Cultural aspects

This section describes the following theoretical aspects of cultural aspects:

1. Theories about cultural differences,
2. Cultural problems in the construction sector in the Gulf region,
3. Specific aspects about expatriate managers.

2.4.1 Theories about Cultural Differences

Construction is a labour intensive sector. Combine this with the fact that the Gulf region is a melting pot of a workforce with different nationalities it is evident that cultural aspects play a major role in everyday situations for companies that work in this region. In the Gulf, religion guides everyday behaviour to a far greater extent than it does in the west (Loosemore and Al Muslmani, 1999), because Islam is deeply embedded into daily life. These aspects make cultural differences an important item to take into account when conducting business in the Gulf region.

A unified definition on culture is difficult to give, because there are numerous different authors who use different interpretations. Because in this research the work of Hofstede is applied, his definition of culture is used: "Culture is the collective programming of the human mind that distinguishes the members of one human group from those of another. Culture in this sense is a system of collectively held values" (Hofstede, 2003)

In this subsection the focus lies on the research from Hofstede's. His work was first published in 1980 and is based on a survey within IBM across their subsidiaries all over the world. Although there are more theories which describe cultural differences (for instance Trompenaars), the work from Hofstede is widely accepted and used in social science. This and the fact that the cultural dimensions from Hofstede provide a good explanatory base for analysing cultural differences is why this theory is adopted in this research.

Hofstede identifies five major dimensions upon which the cultures in countries differ (Hofstede, 2003):

1. Power distance,
2. Uncertainty avoidance,
3. Individualism versus Collectivism,
4. Masculinity versus Femininity,
5. Long-term versus Short-term orientation.

These dimensions will be described shortly hereafter.

Ad 1, Power distance
The power distance defines the extent to which less powerful people accept that power is distributed unequally. It focuses on the relationships between people of different status within a society.

Ad 2, Uncertainty avoidance
Uncertainty avoidance defines the extent to which people tend to avoid ambiguous situations and look for structure in their relationships and institutions. Cultures with high uncertainty avoidance prefer things to be clearly interpretable and predictable. They have little tolerance for deviant ideas and behaviour. Cultures with low uncertainty avoidance see difference as curious and are more comfortable with risks.

Ad 3, Individualism versus Collectivism
Individualism versus Collectivism defines if the extent is placed on individual or group goals. Individualistic societies focus on self-achievement, the individual goals are more important than the goals of the group. In a more collectivistic society, the good of the group is more important than the individual achievement.

Ad 4, Masculinity versus Feminity
Masculinity versus Feminity defines how gender roles are clearly distinct. In masculine societies, differentiated roles are emphasized. Men are assertive and material, women are tender and concerned with the quality of life. In more feminine societies, roles are more equal and both sexes are concerned with the quality of life.

Ad 5, long-term- versus short-term orientation
Long-term orientation focuses on future rewards and attitude that affects the future. Short-term orientation focuses more on past and present, respect for tradition, preservation of 'face' and fulfilling social obligations.

2.4.2 Cultural problems in the construction sector in the Gulf region

The construction sector is a labour intensive industry. Exactly this characteristic item causes some of the largest problems in the Gulf region, combined with a lack of skilled (and availability of) workforce. This problem is solved by attracting a work force from several countries, which all vary in culture and development. Most construction projects have a mixed work force that comes from several countries. The majority comes from India, Pakistan, the Philippines, Thailand, Egypt and Syria. The managers mainly come from western countries. This causes a complex situation in managing such a variety of nationalities. A choice has to be made between management structures from the manager's home country, the Arab host country or the third country from which the work force is drawn.

A study on construction project management in the Gulf region stated that there is a low level of sensitivity to Arabic values and to their concept of time. There is even a clear insensitivity towards the importance of Arabic language and an Arab's attitude towards uncertainty (Loosemoore and Al Muslmani, 1999). Inter-cultural communication has been ranked as the greatest problem, which faces international managers (Loosemoore and Al Muslmani, 1999). The consequences of mismanaging cultural diversity are serious and increase stress, confusion, frustration and conflicts which all lead to lower morale, productivity, quality problems and higher accident rates.

In construction works there is a need for accurate understanding when interpreting technical terms. A study on communication problems with ethnic minorities in the construction industry stated that non-English speaking groups are more reluctant to communicate with managers than English speaking employees are (Loosemore and Lee, 2002). If employees speak English, then there is a great variety of accents and intonation (Enshassi and Burgess, 1990). Most communication with groups that are not fluent in the English language relies upon the use of so-called 'gatekeepers' (Loosemoore and Lee, 2002). These individual members are willing to act as translators. This means that direct communication is not possible and information is received third-hand by personnel through untrained interpreters. Another issue is that these gatekeepers are often not in the position to distribute messages according to the rigid power structures of the group. The ones that speak English are often the younger members and they come last in the cultural order of many cultures.

The effectiveness of site managers was found to decrease when managing multi-cultural groups and the productivity hence decreased (Enshassi and Burgess, 1990). In such a complex situation, site managers need special human skills and understanding in order to obtain a high level of productivity.

2.4.3 Specific aspects of expatriate managers

The use of expatriate employees is unavoidable in Qatar. There are not sufficient indigenous people available to staff all the positions and their wealth does not create a necessity for them to work. A logical step for a company internationalising to Qatar is to send employees from the home branch to a new subsidiary on managerial positions and acquire low-cost labour from surrounding Arabian or Asian countries for lower positions.

Both of these groups of employees have to adapt to a new culture and new business practises. Because the costs for expatriate managers are significantly higher the firm wants to get the most out of this group, both during the overseas assignment and after repatriation. Statistics show that the failed assignment rate of expatriates from the United States lies between 10 and 45 percent (Cassiday, 2005).

Often a dual allegiance comes up and stands in the way of success of both the employee and the firm. The employee can get low or high commitment to both parent firm or local firm (Black and Gregersen, 1992). If individuals get too committed to the local operation, it becomes difficult for the home parent to coordinate with them. If they stay too committed with the home parent, they probably do not adjust to local circumstances and their effectiveness is limited. The high competitive pressure, great geographical distances and wide cultural diversity combined with the ineffective management of expatriates can set off a vicious circle that can destroy a firm's global strategy (Black and Gregersen, 1992).

Expatriate managers can be grouped into one of four allegiance patterns. Those patterns are shown in figure 13. The employees with a low allegiance to both the parent firm and the local firm gets attracted to the overseas bonus packages. Most often they do not get cross-cultural training before departure, which also decreases their commitment (Black and Gregersen, 1992).

The employees with a low commitment to the parent firm and a high commitment to the local firm are described as those who 'go native' (Black and Gregersen, 1992). As managers spend more time overseas, the connection to the parent firm becomes looser. Those employees can have the advantages that they understand the local customers, suppliers and employees so they can adopt a management approach that suits the local environment best.

The employees with a high commitment to the parent firm and a low commitment to the local firm are poorly adjusted to the host country and its culture. They are most of the time selected on their domestic performance, which does not automatically mean that their performance will also be high if they are overseas. Most often, they work for a long period for the parent firm and have no or little international experience. Supply of housing and transport by the company isolates them and decreases the possibility for integration in the local environment.

The final category consists of managers who are highly committed to both the parent firm and the local firm. The expatriates who match these descriptions are highly valuable for international operations. They can bridge conflicting interests between firms. Their high commitment derives from a great degree of autonomy which they get from the parent firm.

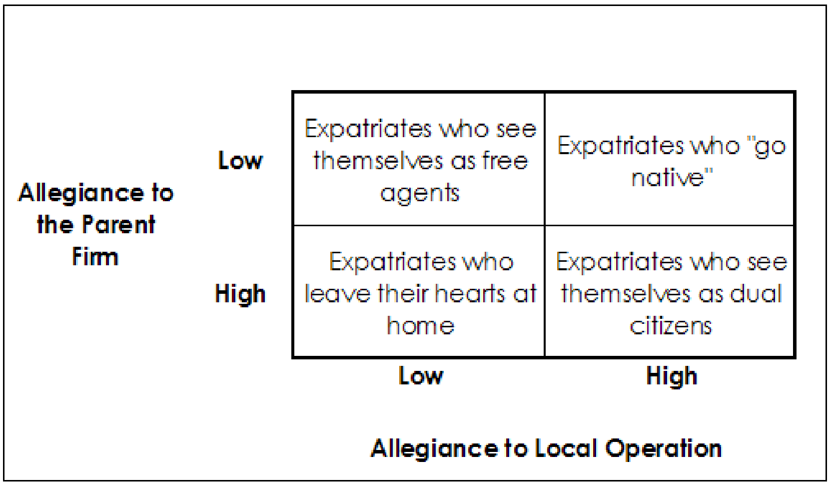

Figure 13, Forms of Expatriate Allegiance (Black and Gregersen, 1992)

The topics described in this section are applicable to the "Culture" level of the "3-C" framework, as is visualised in figure 13.

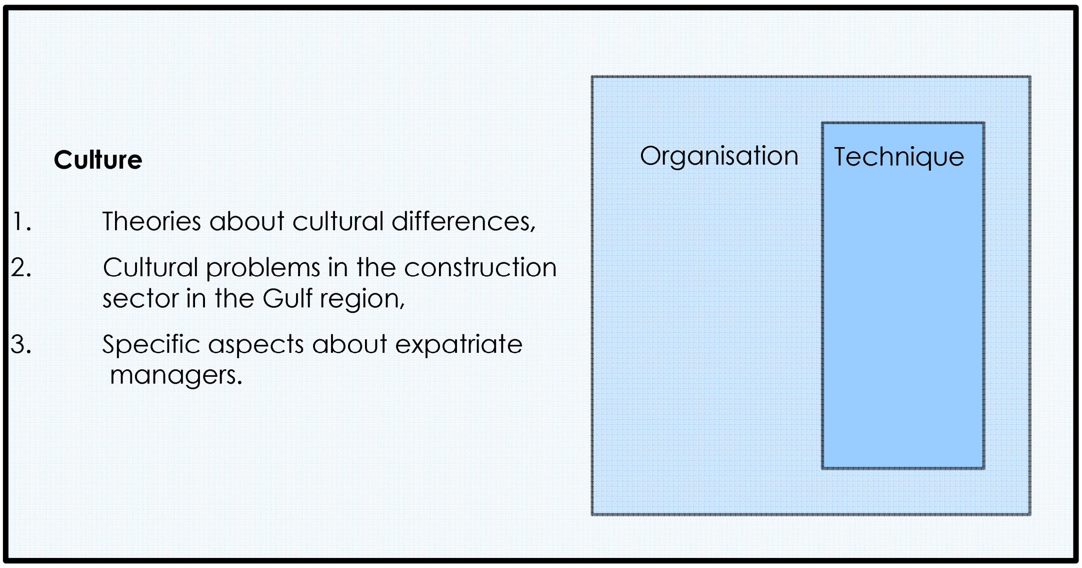

Figure 14, the applicable theoretical aspects for the "Culture" level of the "3-C" Framework

2.5 Summary

Analyzing construction projects can be complicated due to the typical aspects of this sector (Darshi de Saram et al, 2004);

- Informal processes,
- Low tangibility,
- High customer participation,
- Low degree of repetition.

If those construction projects are on an international level, those analyses become even more complex. Different cultures, environmental circumstances and project structures are only a few of the aspects that are introduced when construction projects take place on an international level. This thesis uses the "3-C" framework to allocate the aspects that are specific for analyzing construction projects on an international level (Tijhuis, 1996). The framework focuses on the elements "Contact", "Contract" and "Conflict", which are projected to the background levels of "Technique", "Organisation" and "Culture". Concerning this thesis, technical aspects are related to ready-mixed concrete, organizational aspects are related to international joint ventures and cultural aspects are related to cultural differences between the involved parties.

Technique → Ready-mixed concrete

Concrete is one of the most common materials used in the construction sector. It is cheap and allows great diversity in design. It also faces transport barriers because it has a low value-to-weight ratio and is highly perishable. Concrete is a custom specified material, the designers specify the needed strength and other relevant qualitative requirements. The contractor draws information from the contractual specifications and decides on the size of individual pours and the method of placement. This contractor identifies the concrete producer, who makes his schedule in coordination with the raw material providers.

There are two types of production:

1. Integration of batching and delivery,
2. Integration of delivery and placement.

The choice between these two types has a great effect on the responsibilities of the concrete producer. If the concrete producer is responsible for the transport to the construction site, he is fully responsible for the schedule and the on-time delivery of the concrete. If the contractor arranges the transport, he will still expect from the producer that he takes responsibility for the concrete, even if the goods are physically transferred from the producer to the contractor.

Quality control is an important part of the production of ready-mixed concrete because the nature of the raw materials and the large numbers of factors which affect the strength, make it a highly variable product (Newman and Choo, 2003b). Most batch plants use automatic control systems. This reduces the variability and makes control more easy and comfortable. The workability and compressive strength are two important aspects that provide information about the concrete. The workability provides information how easy the concrete can be transported and placed. The compressive strength is an important aspect in the final acceptance of the concrete. The designer prescribes a specific strength class and the producer has to make sure the concrete he produces meets this strength requirement.

Organisation → International Joint Ventures

Two restricting conditions determine the type of organization that has to be implemented by a ready-mixed concrete producer expanding to Qatar. First is the legislation in Qatar that states that foreign companies may invest in all sectors of the economy, provided that they have a Qatari partner whose share is not less than 51% of the capital. Second is the fact that the limited workability of concrete after production makes it necessary that a production facility is present in the proximity where the material is placed. Therefore, ready-mixed concrete producers expanding to Qatar must operate in an international joint venture (IJV) with availability of a local production facility.

International joint ventures are typically difficult to manage due to their complex structures. The parent organizations might have different or even competitive objectives and strategies and IJVs face greater challenges because they operate in uncertain environments. Aspects, which are allocated to the environment are in this case customers, suppliers, competitors, regulatory groups and technological conditions.

The selection of an appropriate partner and the trust between the parent organizations is important for stability in and control over an IJV. The partners need to understand the relevance of cultural differences, another aspect that might be of importance is that a suitable partner has access to local market knowledge. Trust between the partners is important to fulfil the expectations.

Culture → Cultural differences

The construction industry is a labour intensive sector. On top of this, the Gulf region is a melting pot of a workforce with numerous nationalities. These conditions make it evident that cultural aspects play a major role in everyday situations companies face that work in this region. Culture can be defined as the collective programming of the human mind that distinguishes the members of one human group from those of another. Culture is a system of collectively held values (Hofstede, 2003).

Hofstede identifies five major dimensions upon which the cultures in countries differ (Hofstede, 2003):

1. Power distance,
2. Uncertainty avoidance,
3. Individualism versus Collectivism,
4. Masculinity versus Femininity,
5. Long-term versus Short-term orientation.

In construction works there is a need for accurate understanding when interpreting technical terms. Inter-cultural communication is one of the greatest problems in the construction industry in the Gulf region. There seems to be a low level of sensitivity to Arabic values and to their concept of time (Loosemoore and Al Muslami, 1999). Furthermore, the effectiveness of site managers reduces when managing multicultural groups (Enhassi and Burgess, 1990). Site managers need special human skills and understanding to obtain a high level of productivity.

3 Case-study

This chapter describes the critical incidents of the case MCQ. First, the methodology is described. Next, the company MCQ and the project they are involved in are delineated. This is followed by the description of the critical incidents.

3.1 Methodology

This thesis intends to analyse problems related to the production of cooled ready-mixed concrete in an international setting. In order to perform such an analysis, in depth data is gathered from the field by personal experience. This is a suitable source because it provides accurate and true information about specific local circumstances that are difficult to obtain in any other way. These specific aspects and happenings that occur in praxis can be analysed consequently with the theoretical framework in mind. A disadvantage of this type of data gathering and analysing is that it is very time consuming.

There are different ways to obtain field information. Selecting the best technique increases the validity and credibility of the results from the analysis, i.e. the variation for a different interpretation is as small as possible. This fact is especially important when analysing human behaviour. Hence, this type of research is qualitative. A definition of qualitative research is (Denzin and Lincoln, 1994, p.2 in Buttterfield et al, 2005):

> "Qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials – case study, personal experience, introspective, life story, interview, observational, historical, interactional, and visual texts – that describe routine and problematic moments and meaning in individuals' lives".

There is one particular issue about this type of data gathering which the researcher has to take care of. The researcher has to stay constantly aware that his cooperation within the company he is observing, might give a coloured view of facts. This could lead to different analysis and a decline in credibility (Marelli, 2005). Therefore, all gathered information has to be checked if it represents the highest objectivity and the researcher has to analyse the data considering this aspect. Sanders also describe this as 'being a third culture man', in which the observer acts as sort of a third culture in analysing conflict situations (Sanders, 1995). The other two cultures, which are involved, are the conflicting parties that are analysed. In this research this item is addressed by reflecting the observed situation from different viewpoints. Regarding the organisational and contractual objectivity the observations are seen from the viewpoint of MCQ, the local sponsor and that from Mobil Baustoffe. Regarding the cultural aspects, the researcher was present in the field for 1,5 years and therefore gained a detailed impression of the cultural circumstances in Qatar. A thorough preparation on cultural differences gave the researcher an impression of the cultures of the involved nationalities.

The critical incident technique is a qualitative research method, introduced by Flanagan in 1954. It has become widely used and is recognized as an effective exploratory and investigative tool (Butterfield et al, 2005). The Critical Incident Technique is a flexible set of principles that have to be modified to meet specific situations (Flanagan, 1954). The technique has its roots in industrial and organisational psychology and was first used for selecting and classifying aircrews during World War II (Butterfield et al, 2005).

To be able to identify critical incidents a description of an "incident" and of "critical" has to be defined. An "incident" is described as: "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act". "Critical" means that the incident "must occur in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effects". (Twelker, 2003 p.1)

In this thesis, technical problems are analysed which occurred during the production of ready-mixed concrete in an international construction project. These technical problems are relatively easily noticeable because they happen as clear "incidents" with the effects of those incidents clearly faced in the overall construction process. The causes and background of these critical incidents are more complex to see and will derive from the analysis in this thesis. As already described in section 1.3 and 1.6, this method is an appropriate method in analysing construction processes. It gives the researcher the possibility to understand certain situations and the involved cultural aspects better (Tijhuis, 1996). Darshi de Saram and others describe this technique as appropriate to overcome the typical difficulties in analysing the construction sector, which are informal processes, low tangibility, high customer participation and low degree of repetition (Darshi de Saram et al, 2004). Hence, the critical incident technique provides the possibility to gather detailed information from all involved stakeholders when the researcher is present in the field. This information is then used as input for the 3-C model and provides a sound basis to allocate the information to each of the three aspects of the 3-C model.

3.2 The Company MCQ

The company MCQ is a 100% legal Qatari company, founded in the beginning of 2006. It is an international joint venture between Mobil Baustoffe GmbH (an Austrian company) and Gulf Beach Trading and Contracting (a company from Qatar). The latter one is the local sponsor of MCQ, which is a legal requirement in Qatar. This sponsor possesses 51% of the international joint venture.

The scope of Mobil Concrete Qatar is: "Design, Production and supply of ready mix concrete, concrete prefabricated products and in-situ concrete construction works" (MCQ - ISO: 9001, 2006).

MCQ has the objective to deliver ready-mixed concrete for large industrial projects in the industrial cities of Ras Laffan and Umm Said. The first batch plant was operational in Ras Laffan in October 2006, the combined second and third was operational in the summer of 2007 and a fourth is awaiting erection in Umm Said.

The official organisation structure of MCQ, as adopted in the ISO 9001 Quality management system manual, can be seen in figure 15. The general manager and production manager were previously employees of Mobil Baustoffe. The assistant of the general manager and the responsible person for public relations are employees from Gulf Beach. All other employees are recruited and selected by the local management of MCQ.

Furthermore, it is agreed that Mobil Baustoffe GmbH provides the batch plants to produce the ready-mixed concrete and Gulf Beach provides land and all local arrangements, which are needed to be able to produce concrete.

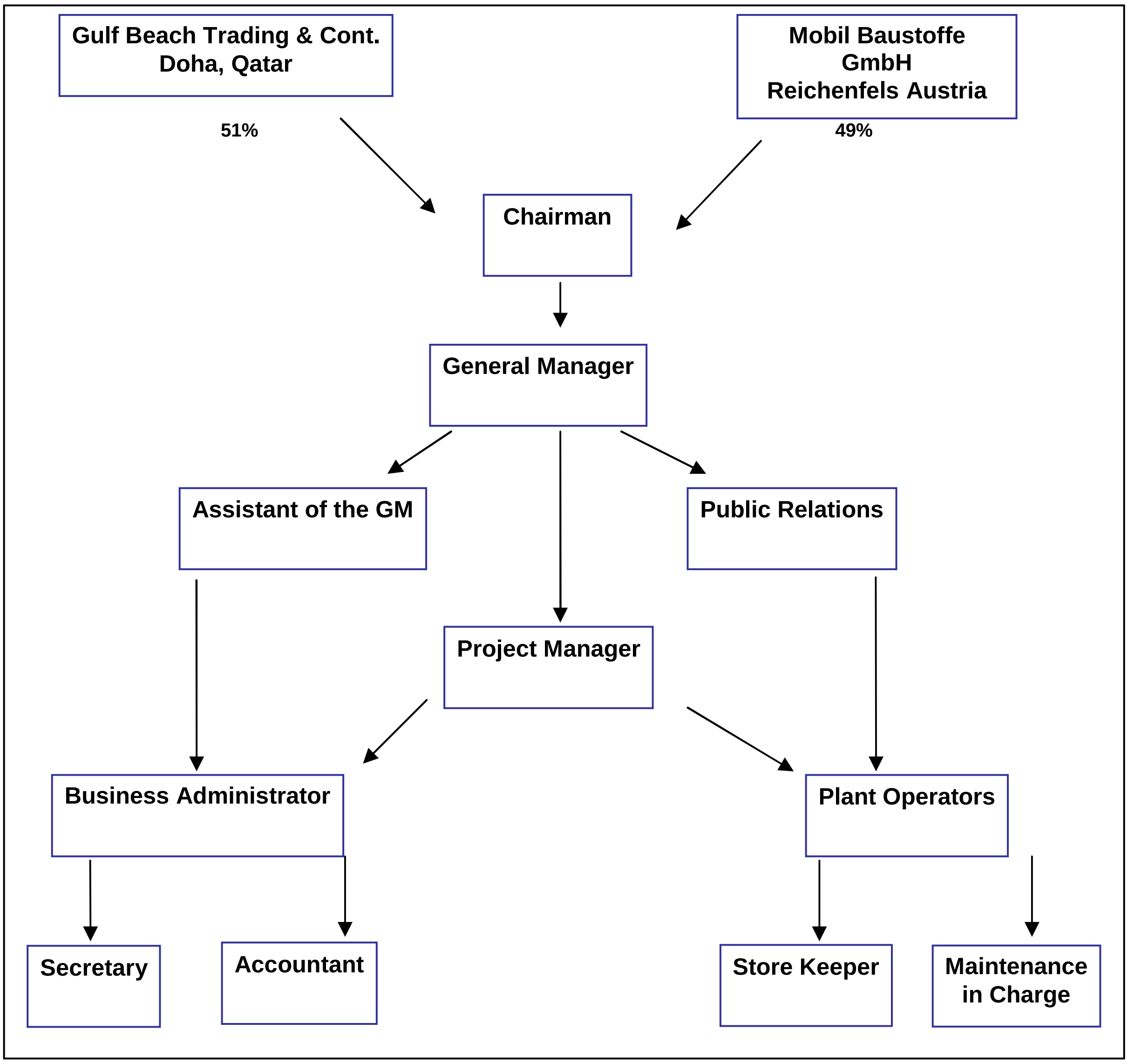

Figure 15, Organisation structure of MCQ (Source: MCQ-ISO: 9001, 2007)

3.3 Ras Laffan Port Expansion Project (RLPEP)

The RLPEP project is awarded by Qatar Petroleum (QP) to a main contractor. This is a joint venture between Boskalis and Jan de Nul, the Ras Laffan Joint Venture (RLJV). This phase of the project consist of dredging works, the construction of two breakwaters and the extension of the existing harbour by means of land reclamation and construction of some small breakwaters.

The two breakwaters (main- & south breakwater) enclose the harbour of Ras Laffan Industrial City. Both of those breakwaters have a length of 11 km. Two subcontractors from the RLJV execute the construction of the main- and south breakwater. The main breakwater (MBK) is executed by a joint venture named RLNBC between Boskalis and Van Oord ACZ and the south breakwater (SBK) is executed by CFE Qatar. The relationships between all the involved stakeholders are visually shown in figure 14.

The concrete works for this project consist of an in-situ concrete road on top of the previous mentioned breakwaters and prefabricated concrete blocks. The road functions as a dead weight on top of the breakwater and the prefabricated blocks protect the breakwater from wave impacts. The in-situ road has the same shape for both the breakwaters, only the dimensions vary slightly. The main breakwater has a width varying from 6.5 meters, a thickness from 1.8 meters and is divided into bays with a length of 15 meters. This gives each bay a volume of 175 m^3. The last 4 kilometres the width of the road is 8 meters wide, which increases the volume per bay to 215 m^3.

The first 7 km of the south breakwater have a thickness of 1.0 meter, a width of 8 meters and a bay length of 15 meters, which gives each bay a volume of 105 m^3. On the last 4 km the thickness is 1.5 meter, the width is 10,5 meter and the length stays 15 meters. This gives each bay a volume of 236 m^3.

On top of the road on the seaside, in-situ blocks are located. They are 1.5 m wide, 1.5 m long and 0.8 m high. On the main breakwater, the contractor altered the design and made a straight wall from km 1.5 onwards. The total quantity of the in-situ concrete for both breakwaters is 250,000 m^3.

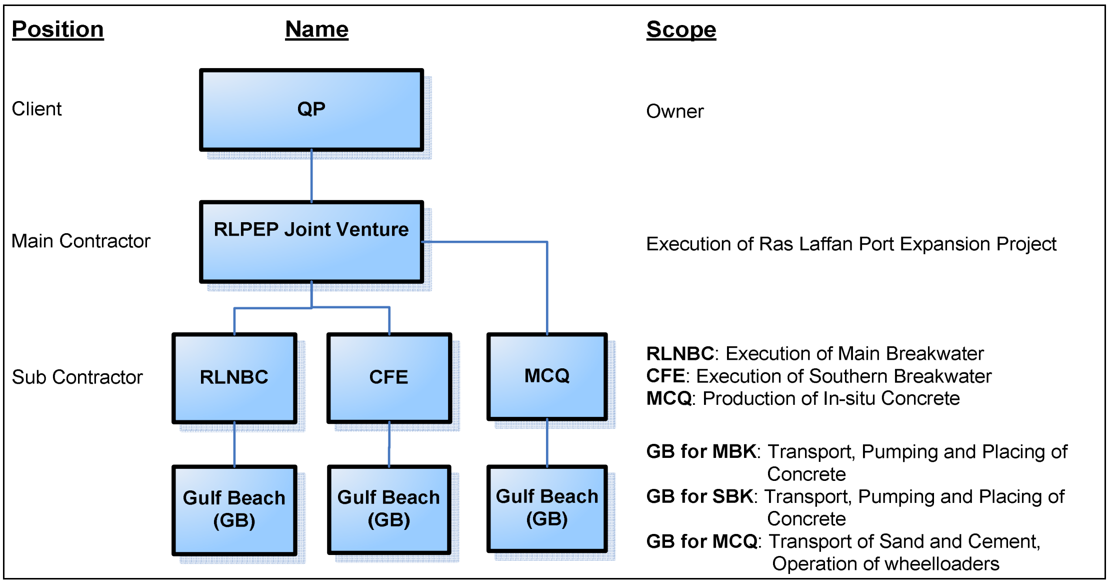

Figure 16, Relationships between the involved stakeholders of RLPEP

3.4 Critical Incidents

The following section describes the critical incidents, which were observed by the researcher. A comprehensive description of all field observations can be found in Appendix 1 "Field observations" and Appendix 2 "Timeline critical incidents". During the field study, many situations came about which led to unwanted situations for MCQ. However, not all of these situations can be identified as critical incidents. The ones that will be analysed in this section are those which obstructed MCQ most to reach their targets. In general, the main target of a ready mixed concrete producer is to produce the correct requested amount of concrete on time at the required quality level. If one or more of these main objectives are not fulfilled, the contractor will not be satisfied with the performance of the RMC producer and a critical situation arises.

In the case of MCQ, the following situations are identified as critical incidents:

1. Too high temperature of the concrete,
2. Delayed delivery of concrete on site,
3. Fluctuating quality of the concrete.

Each description of a critical incident is structured as followed:

1. Description of the critical incident,
2. Background information relevant to the particular critical incident,
3. Description of the effects of the critical incident.

Critical Incident 1: Too high temperature of the concrete

<u>Description of the critical Incident</u>

The temperature of concrete is an aspect that is important to control in an arid environment like in Qatar. If the concrete temperature during hardening rises too much, it affects the final quality adversely. The 28-day strength and the durability reduce and the risks of for instance salt attack increases. The maximum temperature during hardening is correlated with the fresh concrete temperature. A rule of thumb is that for every 100 kg of cement in the mix design, the maximum temperature rises 12 degrees Celsius (Newman and Seng Choo, 2003c). With the high ambient temperatures and solar radiation present in Qatar, the maximum temperature can easily rise far above 70 degrees Celsius if no precautions are implemented. The threshold value for maximum temperature is not widely agreed upon among international specifications. An international renowned engineering firm (COWI) investigated a case where DEF occurred in the harbour of Ras Laffan and therefore concluded that the maximum temperature during hardening should be restricted to 65 degrees Celsius (COWI, 2007). Other studies investigating problems with steam-cured prefabricated elements propose a limit of 70 to 75 degrees Celsius (Newman and Seng Choo, 2003c).

On most projects in Qatar, the client restricts the fresh concrete temperature and sometimes the maximum temperature as well in order to minimize the risk of the negative effects mentioned before. In the contractual agreement between MCQ and the main contractor, the fresh concrete temperature is limited to 32 degrees Celsius. This temperature has to be measured at time and location of placing the concrete. Another item mentioned in the contract is that the temperature of the hardening concrete has to be measured. Frequency, exact location and a temperature limit are not prescribed in the contract for this specific test.

The actual fresh concrete temperature exceeded 32 degrees Celsius on several occasions and often there was very little headroom for considering unforeseeable variabilities. Besides this, one of the first temperature monitoring from the in-situ concrete during the summer of 2007 showed a maximum temperature which reached 72 degrees Celsius and the temperature differential exceeded 25 degrees Celsius.

<u>Background</u>

The temperature development of RMC can be divided in two different aspects:

1. The fresh concrete temperature,
2. The maximum temperature during hardening of the concrete.

The fresh concrete temperature is influenced by the temperatures of the raw materials and pre-cooling arrangements. The maximum temperature during hardening is influenced by the mix design, the fresh concrete temperature, the structure design, the ambient temperature and post-cooling arrangements (if applicable) (ACI 207). The fresh concrete temperature is a typical responsibility of the RMC producer, whereas the responsibility allocation of the maximum temperature during hardening is more ambiguous because different stakeholders share influence.

<u>Effects</u>
The main contractor confronted MCQ on an ongoing basis with the concern that the temperature control, in their opinion, was not at an appropriate level. The responsibilities of the in-situ temperature development were first allocated to MCQ, but in a later stage withdrawn. The client was more or less only accepting or rejecting the fresh concrete and a rejected load did not cause them any problems. Of course, they have their opinion that the temperature control should have been more appropriate, but the main contractor put more pressure on MCQ regarding this matter.

Critical Incident 2: Delayed delivery of concrete at site

<u>Description of the critical Incident</u>
It is of the utmost importance that a RMC producer delivers the ordered concrete on time to the construction site. The contractor wants to pour the concrete as soon as possible after he is finished with the preparations. Most of the time, the following activities after pouring can only start when the concrete has gained sufficient strength. Thus, in order to make these idle times as short as possible, contractors are always in a hurry. Another important aspect related to the delivery of the concrete is the flow of the concrete during pouring. The supply has to be constantly matched to the demand of the construction site to prevent interruptions of the pour on the one hand and long waiting times for the truck mixers on the other hand.

In this project, the concrete was often not delivered on site at the time requested in the planning. This planning was submitted to MCQ on a weekly basis and mentioned the quantities and starting time of the concrete pours. From the start of the in-situ construction works in August 2007, the daily deliveries often started between 1 and 3 hours later than planned. Furthermore, the main contractor never submitted an overall planning to MCQ for the whole project and all concrete quantities. Due to the delay of the project, it was long uncertain what effect this would have on the production schedule of the ready-mixed concrete. MCQ could not make a reliable planning for raw material deliveries due to the lack of an overall planning.

Background

The production of ready-mixed concrete is a logistic puzzle. It requires for instance raw material deliveries, capacity and delivery planning and proper manpower scheduling. Only if all these items are controlled properly is it possible to fulfil the requirements from the clients regarding on time delivery.

A distinction can be made between overall planning and daily planning. The overall planning divides the total amount of concrete for the whole project in monthly quantities. This determines the amount and size of equipment and stockpile sizes that the RMC producer chooses in order to be able to produce the needed peak quantity of concrete. The daily planning deals with the daily quantities and times of delivery. This determines the daily raw material deliveries, transport arrangements and labour scheduling for the RMC producer.

Early communication between the main contractor and the RMC producer regarding scheduling assures that all involved stakeholders know when to produce which amount of concrete and where it has to be placed.

Effects

The fact that the deliveries of the fresh concrete were often not on time caused a lot of frustration for the subcontractors that executed the breakwaters. These contractors had a strict daily cycle and any delay before or during a concrete pour would affect the whole schedule. In the case of a pour being finished a few hours later, removal of the framework would also be delayed with the same amount of time due to the needed early strength. Subsequently, the preparations for the formwork for the next pour would also be finished later and this consecutive pour is likely to be delayed as well.

Critical Incident 3: Fluctuating quality of the concrete

<u>Description of the critical Incident</u>

The quality of concrete is an important aspect for the quality of a structure as a whole. Tests on the quality of concrete assure to the client that he gets the product that he asks for. If the quality is not at the required level, the whole structure fails and in the worst case has to be rebuilt completely. Some relatively simple tests can provide assurance about the quality of the fresh concrete, e.g. slump test, air content test, W/C-ratio. A common test for the assurance of the quality of the hardened concrete is the compressive strength of test cubes.

In this case, the contract prescribes in detail the concrete mix design specifications and the tests on raw materials, fresh and hardened concrete that have to be performed. These prescriptions are strict and for each test, the frequency, test method and acceptance criteria are mentioned. A distinction is made between testing of fresh- and testing of hardened concrete.

For acceptance of the fresh concrete, the slump has to be measured from every truck mixer. The criteria for acceptance are set by a laboratory and a field trial mix and cannot be changed afterwards. The mix design is fixed and every truck mixer has to be loaded with exactly the quantities from the mix design (with a maximum of 2% tolerance). This means that a variation in raw material specifications can have an effect on the slump that is not allowed to be corrected by changing the dosing of, for instance, plasticizer. The slump range of the fresh concrete was set at 75-115 mm. During the delivery of the ready-mixed concrete for the in-situ construction works, the slump was often fluctuating between 60 and 160 mm.

For acceptance of the hardened concrete, every 50 m^3 a set of test cubes have to be made. One set consists of four cubes, one is tested at 7 days age and three are tested at 28 days age. The average of the 28-day results is the value, which has to meet the requirements in the contract. The characteristic strength is 40 MPa and the results are unacceptable if (Contract MCQ-RLJV, Appendix F, section 409.4, 2007):

1. The average strength determined from any four consecutive test results does not exceed the specified characteristic strength by 0.5 times the current margin;
2. One or more results in any forty consecutive are less than 85% of the specified characteristic strength;

3. Three or more results in any forty consecutive are less than the specified characteristic strength.

About 99% of the 28-day results passed the requirements. As stated previously, the fluctuations in the results (standard deviation) were a bit higher than normal. The high cement content of 350 kg/m^3 resulted in strengths high enough to provide sufficient margin for acceptance in despite of the fluctuations. Some of the drilled cores from the in-situ concrete works were tested both at a laboratory in Qatar and Belgium. The results from the laboratory in Belgium showed significant higher results (about 20-30%).

Background

The quality of fresh concrete is an item that is widely spoken about in literature. It is also an item where a lot of myths and misunderstandings arise. Many countries have their own standards and methods to assure and control the quality of concrete. If a RMC producer decides to start production in another country, they have to be aware of the standards that are used in that specific country.

Effects

The fluctuation in the test results gave the main contractor and client a bad impression from the quality MCQ delivered. Not all of this could have been directly avoided by MCQ. First, the test procedure was strict and rigid; the deviations were quite often unavoidable and could not be influenced. Secondly, the performance of the independent third party was lacking.

3.5 summary

For the analysis in this thesis, in dept data is gathered by field observations performed by the researcher. This provides accurate information about specific local circumstances that is difficult to obtain in another way. The information is analysed using the critical incident technique. This technique is suitable to overcome the typical difficulties in analysing the construction sector, which are informal processes, low tangibility, high customer participation and low degree of repetition. The field observations and the critical incidents which derive from these are conducted at MCQ in Ras Laffan, Qatar. Technical problems are analysed which occurred during the production of read-mixed concrete. The causes and background of these problems become apparent after the analysis in this thesis.

The critical incidents are those which obstructed MCQ most to reach their targets. The target of a ready-mixed concrete producer is to produce the correct requested amount of concrete on time at the required quality level. In this case, the following situations are identified as critical incidents:

1. Too high temperature of the concrete,
2. Delayed delivery of concrete on site,
3. Fluctuating quality of the concrete.

4 Analysis

This chapter describes the analysis of the critical incidents. The objective of the analysis is to retrieve the causes that created the circumstances in which the critical incident occurred. In the beginning, each incident will be analysed individually. Hereafter, in a cross-analysis, patterns are pinpointed and for each field of the "3C-Framework" specific keywords are given.

4.1 Analysis of the critical incidents

The following critical incidents, described in chapter 3, will be analysed:

1. Too high temperature of the concrete,
2. Delayed delivery of concrete at site,
3. Fluctuating quality of the concrete.

The analysis all follow the same logic and are based on the "3C-Framework" (Tijhuis, 1996). This is a cyclic framework that consists of the elements Contact, Contract and Conflict (see section 2.1 and figure 17 below).

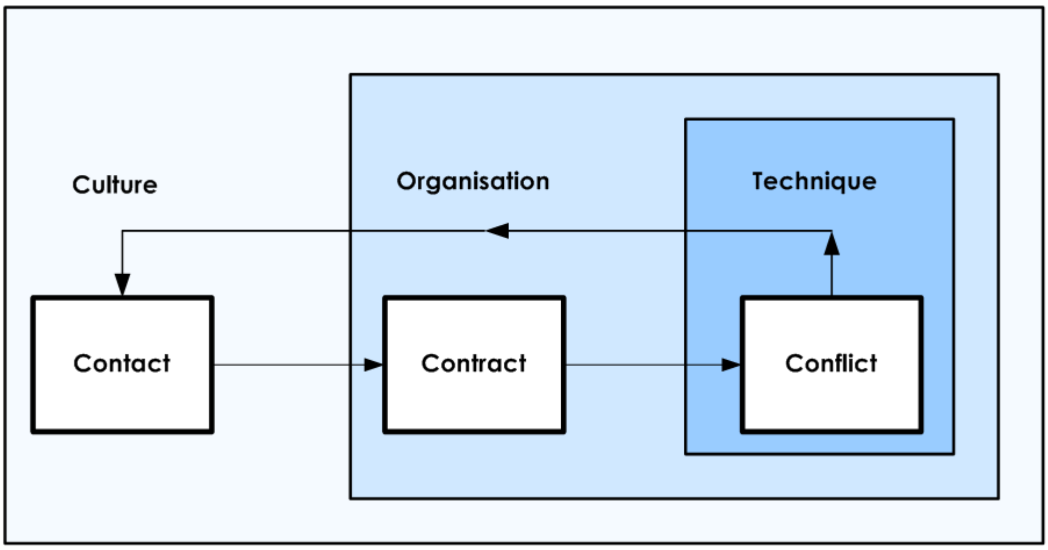

Figure 17, Overview of "3C"-framework (Tijhuis, 1996)

Each of these elements is projected against cultural, organisational and technical aspects, as is indicated by the arrows in the figure. This results in a matrix where every cell identifies the origin of the causes from the critical incident and allocates them in a specific field. This matrix is given in figure 18.

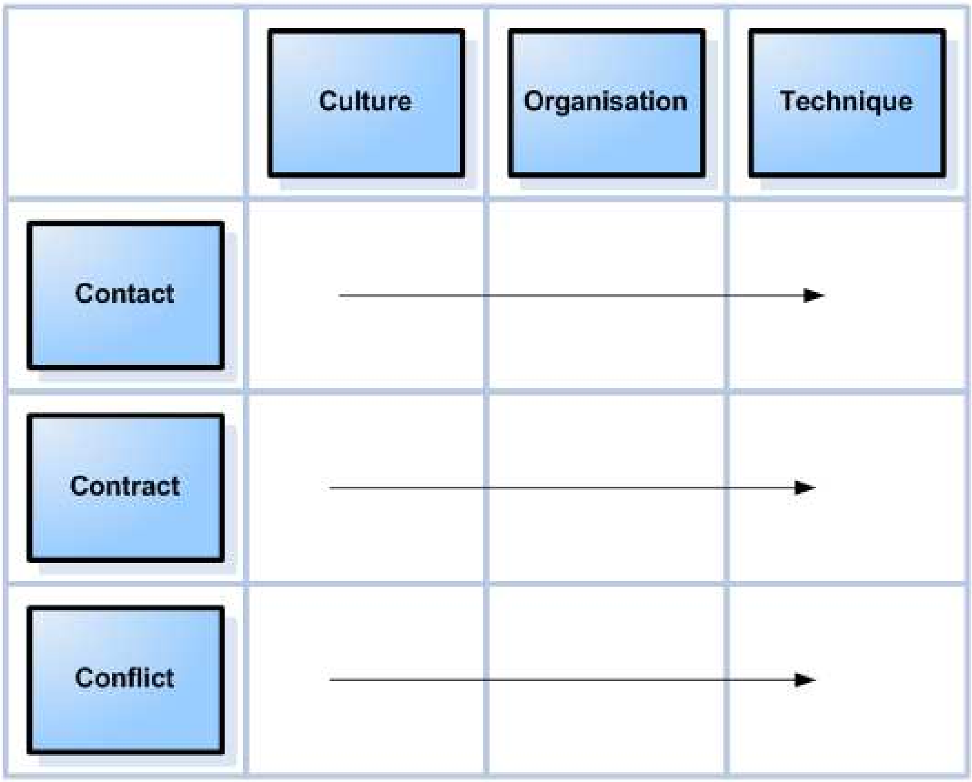

Figure 18, The cyclic character of the "3C"-framework results in a matrix

4.1.1 Analysis of critical Incident 1: Too high temperature of the concrete

Contact

Culture related to contact:

Every person involved in the supply chain of ready-mixed concrete production needs to be aware of important aspects that have to be controlled. Of course, one cannot expect specific concrete knowledge from a truck mixer driver, but as long as this driver is aware of the tasks (and at best the reasons behind them) he has to perform, this specific aspect of the supply chain of fresh concrete is controlled and the chances of problems occurring is reduced. This means that workers need to be instructed and (if needed) also educated. In this international project, instructions and education require more attention than in the domestic region of the mother company. One has to pay attention to cultural differences and the possible effects of them on the performance of their job. The most obvious difference is the language barrier. Often the communication language on international construction projects is

English. At MCQ, English is not the mother tongue of either the managers or the subordinates. Both parties understand basic English but do not speak it fluently, which leads to misunderstandings.

In addition, the content of the communication between managers and subordinates was insufficient. The needed knowledge on key-aspects one has to keep in mind in his job that influence the temperature of ready-mixed concrete, was not transferred. For instance, for mixer drivers this means that they have to cool their drum with cold water before they load the first batch of concrete. This item was not communicated clearly and repeatedly, and thus, it often happened that the mixer drivers were not prepared when concrete batching commenced. However, most relevant issues regarding temperature control have to be controlled by plant operators. They have to prepare thoroughly to ensure the temperature of the fresh ready-mixed concrete complies with the specifications. Cooling of the concrete is mainly achieved by adding cold water and flake ice, so the plant operators have to prepare the cooling systems and check the stockpile size before the start of batching. They need to have an overview if the cooled materials are sufficient for the planned quantity of concrete and if these materials are properly cooled to reach the temperature targets. The Filipino plant operators of MCQ were all unfamiliar with the sophisticated type of equipment and the speed of production that is needed in this project. Hence, they need solid education to be able to perform their job consistently. They only received basic instructions on the control system but did not learn the finesses of concrete production.
To conclude: The language barrier between managers and subordinates and insufficient instructions and education of workforce led to ongoing disruptions in the supply chain of production and delivery of the ready-mixed concrete. These disruptions eliminated the temperature margin and caused the fresh ready-mixed concrete temperature to rise to a critical level.

<u>Organisation related to contact:</u>
The main contractor's core business is dredging and in general, concrete structures only comprise a small amount of their projects; therefore, their knowledge of concrete works is limited. At the start of the project, they relied heavily on the opinion and expertise of MCQ regarding practical and organisational aspects of the production of ready-mixed concrete in hot weather. However, MCQ did not consult the main office of Mobil Baustoffe in Austria to support them with their knowledge and expertise. The general manager of MCQ blocked the contact between MCQ and Mobil Baustoffe completely and thus also the access to technical support. Before

shipment of the equipment to Qatar, Mobil Baustoffe investigated which equipment would be suitable for the production of concrete in Qatar. During the start-up, the concrete works were delayed and the original plan had to be changed. While the ambient temperatures rose steadily during the first hot weather season (2007), it became clear that the implemented methods to control the fresh concrete temperature were not sufficient to guarantee a steady production rate. The local management of MCQ waited too long before action was taken. If the changed circumstances were immediately communicated with Mobil Baustoffe, it is likely that a more suitable solution would have been found.

Next to the internal communication with the parent company, the communication between MCQ and the main contractor should have also been more pro-active from the side of MCQ. The level of trust from the main contractor towards MCQ quickly declined from the moment the production of ready-mixed concrete started and the first problems arose. Only if the main contractor came up with a negative observation or a problematic situation, MCQ would provide an explanation. What MCQ should have done from the beginning, is explain the critical aspects about the production of ready-mixed concrete in hot weather and communicate openly about problems they face. This could have helped to create understanding and possible support in finding solutions for these problems.
To conclude: The lack of communication between MCQ and Mobil Baustoffe caused the equipment to be installed incorrectly and the problems that were faced in praxis were not communicated effectively.
The passive way of communication between MCQ and the main contractor resulted in misunderstanding and lack of awareness and understanding of the situation that MCQ was facing.

<u>Technique related to contact:</u>
A batching plant to produce cooled ready-mixed concrete consists of sophisticated technical equipment. In a place like Qatar, especially in the summer months, a flake-ice producing and water cooling machine needs to lower the fresh concrete temperature. This machine requires a skilled mechanic for installing, operating and maintaining this equipment. MCQ employed one Austrian mechanic, who left the company before the equipment was installed. Some Syrian mechanics finished the installation, unfortunately though, communication with these mechanics was difficult because they did not speak English fluently. Furthermore, the installation instructions (manuals + drawings) were all in German, which obviously caused additional

problems. Due to all these problems, the cooling equipment did not function properly.
To conclude: MCQ did not employ technical skilled employees that were capable of installing and operating the equipment that was needed to lower the fresh concrete temperature.

Contract

Culture related to contract:
In the contract with the main contractor, it is mentioned that the temperature of fresh concrete is allowed to be 32 degrees Celsius maximum and a separate clause quotes that the "ACI 305: Recommendations for hot weather concreting" shall be complied with. These specifications are an exact copy of the contract between the main contractor and the client (this is actually a common method). However, a clause that a subcontractor has to comply with a document with recommendations (like ACI 305) is very vague and maybe should be avoided because these references are too general and do not result in concrete actions that can be implemented and controlled.

Controlling the temperature of large amounts of concrete requires strict planning and control of all processes involved. Concrete works with quantities of 1,000 m^3 require at least 10 hours of pouring. Placing these large quantities during the day in this region is not feasible because of the direct sun radiation and physical requirements of concrete works. If the work is performed at night, the hydration of cement paste starts during the hottest time of the day. Either way, the setting of the concrete is negatively influenced by the hot weather. The characteristics of hot weather conditions in Qatar are extremely hot and dry, with high solar radiation. A lot of standards and documents, which are referred to in construction contracts in Qatar, stem from the UK (BS) or the USA (ASTM). These documents are originally made for their domestic region, so the fact that there is no British Standard for hot weather concreting can be explained quite logically because extreme hot weather is not common in the UK. In the American standards there are some precautions for hot weather and there is a separate document for hot weather concreting, in the previously mentioned ACI 305. However, the conditions faced in Qatar are extreme in terms of the descriptions adopted in this ACI 305. On the other hand, there is a local standard, the Qatar Construction Standard (QCS), but this standard is very shallow and does not contain specific prescriptions for temperature control of concrete. An ideal solution would be a guide, with recommendations for concrete works for the specific hot weather conditions in the Gulf region.

To conclude: The absence of a Gulf region oriented document that addresses the specific hot weather issues regarding concrete works, makes the contracts vague and leaves important items unspecified in these contractual documents.

Organisation related to contract:

There are two aspects mentioned about temperature control in the contractual agreement:

1. The fresh concrete temperature is allowed to be 32 degrees Celsius maximum, measured at location of placement,
2. The maximum temperature differential between the centre and the face of an element shall not be more than 25 degrees Celsius,

The reasoning behind the first restriction is that the maximum concrete temperature during hardening is related to the fresh concrete temperature. The fresh concrete temperature can be influenced by the production method and this aspect can be easily controlled by measuring the temperature of the fresh concrete in a truck mixer. As mentioned in chapter 3, a too high temperature has negative effects on the strength and durability of the structure. The temperature differential between the centre and the face of a concrete element is related to the thermal stress in this element. If this stress gets too high, the concrete might crack, which exposes the internal structure directly to weather conditions.

The maximum temperature during hardening is not restricted in the contractual agreement. However, in several letters the client stated his concerns about the maximum in-situ concrete temperature, which reached a maximum of 72 degrees Celsius. The client stated that the maximum temperature should not exceed 65 degrees Celsius, although the contract did not comprise any restriction. A rule of thumb says that for every 100 kg of cement, the maximum temperature rises 9 to 20 Kelvin due to the hydration of cement (depending on the cement type) (Newman and Seng Choo, 2003c). With 350 kg of cement in this particular mix design, this means an increase in temperature of 42 degrees Celsius. With a maximum fresh temperature of 32 degrees, the overall maximum temperature could rise to 74 degrees Celsius. With ambient temperatures up to 48 degrees Celsius, this scenario seems quite realistic. Thus, the client prescribes precisely the mix design composition and maximum fresh concrete temperature, but does not incorporate a maximum temperature during hardening for the in-situ concrete. It seems then not logical that the client writes a letter where he states that the maximum temperature should not be higher than 65 degrees Celsius. So on the one hand, the client does not give the main contractor and concrete producer the ability to influence the maximum temperature, while on the other hand the client comes up with additional restrictions that are not even part of the contract.

Another item regarding contractual statements is that there are some vague formulations in the contractual agreement. There is a clause that mentions that the document "ACI 305: Recommendations for hot weather concreting" shall be complied with. In this document, it is mentioned that a contract should not refer to the ACI 305, but that "If items found in this document are desired by the Architect/Engineer…they shall be restated in mandatory language for incorporation" (ACI 305R-1, 2005). Thus, the document ACI 305 directly prohibits to incorporate vague formulations like those found in the contract from MCQ.
To conclude: the fact that some important information in the contract, regarding temperature control, is simply missing or vaguely formulated causes a lack of possibilities to control MCQ appropriate by the main contractor.

Technique related to contract:
Although the mother company of MCQ, Mobil Baustoffe, made a plan concerning the installations to produce cooled concrete in Qatar, these arrangements were not properly tested or further investigated before commencement of production in Qatar. It can always happen that project circumstances change or that assumed situations turn out to be otherwise. The delay of the project caused that the original intended cooling system could only be built 1.5 years later than planned. This meant that a less suitable cooling system, consisting of a flake-ice machine had to be used longer to produce the needed concrete. The manufacturer of this flake-ice machine checked it before shipment to Qatar, but this piece of equipment was of poor quality. Overall, MCQ neglected the necessity for a reliable and steady flake-ice machine until the hot weather already arrived. A better solution would have been if MCQ forced the manufacturer to install a reliable flake-ice machine on-site in Qatar.
To conclude: MCQ did not control the equipment sufficiently that is critical for temperature control.

Conflict

Culture related to conflict:
Basically, a batch plant is an installation like any other heavy industry component, i.e. rough steel work added with some specific items like valves, pneumatic systems and electronic sensors. For proper maintenance, about 90% of the work can be done with basic tools, equipment and spare parts. In Qatar, the industry sector is small and one

can only find a very small service sector for maintenance of this industrial equipment. Besides this, many of the locally available resources are of inferior quality and therefore not reliable.
To conclude: Little industry and thus no service industry of proper tools, equipment and spare parts complicate maintenance of the batch plant and all related installations.

Organisation related to conflict:
Most of the supervisors of the main contractor are Filipino and the personnel from the client are either Indian or Filipino. Communication with the workforce is quite easy if both parties have the same mother tongue. Filipino subordinates are not likely to protest against a decision from a person in a superior position, even if they know that person might be wrong and the result may affect the product or process adversely. These subordinates accept their position and follow all orders from superiors, which can lead to problems. For instance, once concrete is mixed and loaded into a truck, time is always a critical factor. The time available in the plastic phase is limited and the temperature starts increasing after a while. If the progress of the concrete works slows down and the temperature becomes critical, rejection of a full load of concrete is a serious threat. There were quite often congestions at the construction site due to problems with pumping equipment or due to problems with the acceptance of the concrete. In such cases, there is a person needed who takes responsibility and solves this issue in the best way even though the superior might have given different orders. This person needs authorisation from the management of the concrete producer and transport companies and has to be present at site.

The contractual duties consisted solely of the production of the concrete, the transport was to be arranged by the contractor themselves. Although it is not directly the responsibility of MCQ to arrange logistics on site, they can benefit a lot from a smooth placement on site. If the responsible stakeholder (Gulf Beach) is not performing at the required level, this leads directly to problems for MCQ due to the critical relation between production and placement. In almost all cases, Gulf Beach was responsible for the occurred problems. Due to the tangled and blurry relations, it seemed to the main contractor as if MCQ was not performing well. MCQ could have taken the initiative and allocated an employee for all logistic matters. If Gulf Beach is charged fully or partially could be discussed at a later stage, at least the main contractor would not be faced with the problems as often.
To conclude: There is no responsible person authorised by MCQ (or Gulf Beach) to deal with unexpected situations during concrete pours.

Technique related to conflict:

The temperature of fresh ready-mixed concrete can be passively influenced by intelligent use of raw materials. Aggregates, for instance, can be placed under a shaded roof to prevent them from direct solar radiation. The tanks where cold water is stored can also be protected from direct solar radiation by installing sunroofs. The cement is often delivered quite fresh and thus hot, therefore one could create a larger stockpile size to let the cement cool down a little. All these procedures have a limited influence on the fresh concrete temperature, but they are quite cheap and prevent running costs for extra energy consumption to actively reduce the temperature of fresh concrete. MCQ did not apply any of the techniques to passively reduce the temperature of the raw materials and thus spent extra (unnecessary) money on active cooling.

To conclude: MCQ did not use passive cooling of raw materials

Summary

The analysis of this critical incident results in the following figure with key sentences for each specific cell of the matrix.

	Culture	Organisation	Technique
Contact	Language barrier between managers and subordinates Insufficient instruction and education of workforce	Lack of communication between MCQ and mother company Passive way of communication with main contractor	No technical skilled employees for installing & maintenance of equipment
Contract	The absence of a local oriented document that addresses hot weather concreting issues, leaves important aspects unspecified	the fact that some important information in the contract, regarding temperature control, is simply missing or vaguely formulated causes a lack of possibilities to control MCQ	MCQ did not control the equipment sufficiently that is critical for temperature control
Conflict	Little industry and thus no service industry of proper tools, equipment and spare parts complicate maintenance of the batch plant and all related installations	There is no responsible person authorised by MCQ (or Gulf Beach) to deal with unexpected situations during concrete pours	MCQ did not use passive cooling of raw materials

Figure 19, Results of analysis of critical incident 1

4.1.2 Analysis of critical Incident 2: Delayed delivery of concrete at site

Contact

Culture related to contact

Two organisations, which are unknown to each other and join in an international joint venture, enter a process where they have to find ways of working together. In this case, the parent organisation that is the initiator of the joint venture has its origin in Europe and the other parent organisation comes from Qatar. The cultural differences that these companies have to overcome are large. Most of these differences have to be overcome by Mobil Baustoffe, because they are the one that intends to expand towards Qatar. However, the local organisation (Gulf Beach) also has to be aware of characteristic of the everyday business processes in European organisations.

According to Harris and Moran, Arabic persons have more trust in people than in positions or organisations (Harris and Moran, 1990). If these Arabs are in business, the person who is having contact is very important for the success of this business. In this case, the general manager of MCQ established the first contact between the organisations and was therefore seen by the local sponsor as the spokesperson and a trustworthy partner. The general manager used this trust in his personal favour and built a strong relation with this sponsor. This fact caused the circumstances in which complex relationships, both contractual and personal, were created. The interests of Gulf Beach were always more important than those of MCQ and no one ever told them clearly that they did not fulfil their contractual obligations.
To conclude: Due to their cultural background, Arabic entrepreneurs are more likely to trust people instead of the organisation for which they work.

Organisation related to contact

The General Manager of an IJV possesses a key position in the relation between the parent organisations. He has to acquire the trust of the local partner to convince him of the capabilities of the foreign and unknown partner and at the same time he has to maintain the commitment of the foreign parent organisation in despite of the physical distance to the activities. Besides this, he bears the overall responsibility of the performance of the organisation. There is always an amount of uncertainty how the combination of parent organisations and general manager fit together. The allegiance of the general manager of MCQ was very much biased to the local organisation, Gulf Beach (see section 2.3.4 for the theory on allegiance). He arranged business in cooperation with the local parent organisation (Gulf Beach) and without informing the other parent organisation (Mobil Baustoffe). This resulted in

favouring the interests of Gulf Beach and not consulting the knowledge of Mobil Baustoffe. Without the presence of MCQ in the project of this case, Gulf Beach would never have acquired the contracts for transporting, pumping and placement of the concrete themselves.
To conclude: The General Manager has a key position within MCQ (as in any international joint venture). This position gives him power and therefore his objectivity must be monitored.

Technique related to contact

Concrete pump operators are an important element in the supply chain of ready-mixed concrete. They transfer the batch and queue system in a continuous flow of concrete in the formwork. The operators need to know the capabilities and limitations of their equipment in order to establish this continuous flow. Although the responsibilities for MCQ regarding logistics end the moment the fresh concrete is dispatched from the batch plant, they directly notice any obstructions in the downstream supply chain. The batch plant has to adopt its production rate to the changed situation. Gulf Beach only employed one operator that had significant experience with a concrete pump. All other operators did not have any experience with concrete pumps and received their training ‘on the job’. When working on a two-shift 24-hour schedule with two concrete pumps, one needs at least four operators to be able to operate the equipment with minimum staff.
To conclude: Concrete pump operators are unqualified and cause a great deal of all delays regarding the delivery of concrete.

Contract

Culture related to contract

The structure of the business world in Qatar differs significantly from that in Europe. One needs personal access to local organisations in order to arrange reliable relations. These reliable relations are needed for a ready-mixed concrete producer to assure uninterrupted delivery of raw materials. With the daily quantities in this project, guaranteed deliveries around the clock are a necessity. The delivery of cement was quite unreliable and could not be estimated at all. This requires a personal relation between an employee from MCQ and the cement company. In addition, the delivery of coarse aggregates from U.A.E. requires more attention than one would give to an aggregate supplier in Europe. For instance, the queue for loading aggregates can vary greatly and the quality of the material fluctuates. All these aspects require a pro-active attitude and ongoing control from the ready-mixed concrete producer.

To conclude: Industry characteristics require in-person local connections.

Organisation related to contract

The legislation in Qatar determines that every foreign organisation has one or more Qatari partner whose share is not less than 51%. In praxis, this means that every organisation needs to find an appropriate partner before commencement of business in Qatar. It can be quite difficult to find a partner that has the same goals for starting a joint venture. Many Qatari sponsors only see it as a pure financial investment without being interested in the type of business from the organisation. The general manager of MCQ found, in his opinion, an appropriate sponsor in Gulf Beach. This sponsor is active in residential construction and seemed to be interested in the ready-mixed concrete industry. The exact criteria with which was decided that Gulf Beach would be suitable are unknown. It turned out that the interest of Gulf Beach was opportunistic and not in favour of MCQ (described as well in the close relation between the general manager and Gulf Beach). Around September 2008, Mobil Baustoffe decided that Gulf Beach would act as a silent sponsor and would no longer be involved in any daily business. This completely tangled situation shows that it is of the utmost importance to select an appropriate sponsor, one that has similar goals and objectives for the company to be established.
To conclude: the local parent organisation has a big influence on the performance of MCQ.

In this project, MCQ produces the ready-mixed concrete for the main contractor. This main contractor has two subcontractors, one that constructs the northern breakwater and one that constructs the southern breakwater. These subcontractors have to transport, pump and place the concrete themselves. Both of them contracted Gulf Beach for these activities, the company that is also the local sponsor of MCQ. The fact that Gulf Beach acquired these contracts was arranged by the general manager of MCQ. Towards all these stakeholders, the general manager acted as if MCQ and Gulf Beach were the same company. MCQ was used for its connection with the main contractor to provide Gulf Beach the contracts they desperately wanted. When it turned out that Gulf Beach did not fulfil their job appropriately, MCQ received all critics, obviously a win-win situation for Gulf Beach. It took until February 2008 before the main contractor got a grip on the situation and made a clear distinction between the contractual obligations from MCQ and those from Gulf Beach.

Theoretically, the responsibility from MCQ ends when the concrete is dispatched in the truck mixer. Of course, the quality of the product is still the responsibility of the producer until the concrete has hardened. A concrete producer is also interested in a fluent delivery and placement process, if only to prevent problems for the acceptance of the concrete on temperature restrictions. The transport company (Gulf Beach) should appoint responsible persons for transport and pumping of the concrete. However, no one was allocated and the managers from MCQ performed these activities next to their normal tasks.
To conclude: The separation between production (MCQ) and delivery (Gulf Beach) leads to ambiguous situations.

<u>Technique related to contract</u>
The overall planning for all concrete works in a project is an important instrument for a ready-mix concrete producer. This determines the type and size of equipment as well as the stockpile size and supplier contracts. In this project, the original production rate was 180 m^3/day, with a total duration of 24 months. In the end, it turned out that the concrete works started 10 months later and had a nominal production rate of approximately 500 m^3/day. This delay was caused by the fact that it took that long before the client approved the design of the breakwater from the main contractor. During this 10 month period, the main contractor never communicated clearly towards MCQ about the duration of this delay and the effect on the overall planning of the concrete works.

This significant increase in daily production has a big influence on organisation of the ready-mixed concrete production. In this case, there was already an excess production capacity planned by MCQ because the aggregate cooling system requires a separate batch plant. What had to be completely revised, were the stockpile sizes and material delivery agreements. After signing of the contract with the main contractor, MCQ arranged raw material deliveries with suppliers based on the quantities mentioned in this contract. If MCQ does not purchase any materials then for the next 10 months and suddenly requests triple the needed daily amount, one can imagine that this cannot be easily arranged on such short notice. Especially those materials where the transport forms a bottleneck and/or the available capacity from the producer is limited. In this case, these are the coarse aggregates that have to be transported by barge from U.A.E. and the cement from Qatar National Cement Company. Directly related aspects of this are other results of this analysis, e.g. the passive way of communication from MCQ and the need for in-person local connections.

To conclude: the overall planning from the main contractor is not properly communicated with MCQ, this results in problems with the supply of raw materials.

Conflict

<u>Culture related to conflict</u>

The supply of raw materials in Qatar is not as reliable as in Europe. In construction projects in Europe, one calculates the required stockpile size and delivery rate based on an overall planning. In some cases, the suppliers can even guarantee a lead-time of 6 hours if needed and the concrete producer can rely on his suppliers. However, in Qatar, the delivery is not that reliable and one has to find an optimum between the additional costs of a larger stockpile and the risk of running out of raw materials. The aspects that cause delay in the supply chain of raw materials are quite different than in Europe. For instance, hauling queues can vary greatly from day to day and maintenance of transport equipment is often poor.

Coarse aggregates and admixtures have to be transported by sea freight for this particular project. The coarse aggregates come from UAE, which is about 5 days shipping. The admixtures come from Austria, which is about 4 weeks shipping. The actual transport duration depends on weather conditions. Acquiring raw materials from abroad goes in hand with getting documents and paperwork from the Qatari customs department, causing another possibility for delay. Unfortunately, the procedures in Qatar are not as transparent as in Europe and can change on short notice. Cement can only be acquired locally at Qatar National Cement Company (QNCC), as stated in the contract between MCQ and the main contractor. In fact, one needs good personal relations with responsible persons at QNCC in order to guarantee deliveries of cement.
To conclude: the supply of raw materials requires a different strategy than in Europe.

<u>Organisation related to conflict</u>

The organisation of delivery and pumping of ready-mixed concrete is a logistic puzzle. Although it might seem at first sight just a matter of hauling, delivery and returning of truck mixers, it does need ongoing attention from a responsible person. Gulf Beach was responsible for transport and placing, but did not allocate supervision to organise these tasks. Because the strangled relation from the general manager between MCQ and Gulf Beach, all stakeholders were convinced that the managers from MCQ performed these activities, parallel to their original tasks. Gulf Beach was actually “invisible” and did not have any person present at site except the general manager from MCQ. This caused major irritations to the main contractor.

To conclude: Gulf Beach did not allocate responsible persons for managing transport & placement. Due to the blurry relations between MCQ and Gulf Beach, MCQ solely had to bear the consequences.

Technique related to conflict

The equipment used for pumping the concrete is not the optimum choice for the adherent local conditions. There were two concrete pumps available, but there were so many ongoing problems with hydraulic systems and pipelines that 90% of the time there was only one concrete pump operational. The quality of the Korean concrete pumps (Hanwoo) is a cheaper alternative to the major German brand Putzmeister or Schwing. The following aspects result in greater wear and tear of the equipment:

1. High daily placement rates of around 1000 m^3,
2. High ambient temperatures,
3. Crushed coarse aggregates.

Ad 1. Although the maximum capacity of the concrete pump is around 100 m^3/hour, the quality of the equipment is not capable of the ongoing operation of nearly 20 hours per day.

Ad 2. The high ambient temperatures during summer have a great influence on the wear of the hydraulic system of the concrete pump, especially if the operators do not use the equipment in an appropriate way.

Ad 3. Due to the crushed coarse aggregates, the pipeline of the concrete pump is subjected to greater wear than with round aggregates. There are special pipelines available, made out of hardened steel (Hardox), but Gulf Beach applied basic steel pipelines, which resulted in numerous explosions of concrete pipes.

The delivery capacity is usually greater than the batching capacity, simply because it would not be economical if the transport rate was lower than possible at the batch plant, e.g. the investment in batching equipment is far greater than that in transit mixers. When the production and delivery of ready-mixed concrete is separated, like in this case, the transport company has fewer revenues to return their investments. Second hand equipment is rarely available in Qatar, so all truck mixers had to be bought brand new. Gulf Beach tried to cut costs by minimising the amount of needed trucks and drivers. In theory, the delivery capacity was sufficient for this project, but every time a truck needed service or a driver was sick, the capacity was

insufficient and improvising in order to try to reach targets began. In addition, in times the delivery switched from the northern to the southern construction site, the amount of available truck mixers was insufficient to serve two sites at the same time.
To conclude: All uncontrolled aspects of an important item such as concrete pumping lead to the fact that MCQ becomes dependent on the performance of Gulf Beach. MCQ constantly has to improvise when problems occur.
Insufficient delivery capacity led to delays in the transport of concrete, which makes MCQ also in this case dependent on the performance of Gulf Beach.

Summary

The analysis of this critical incident results in the following figure with key sentences for each specific cell of the matrix.

	Culture	**Organisation**	**Technique**
Contact	Arabic entrepreneurs are more likely to trust people instead of the organisation for which they work.	The General Manager has a key position within MCQ. This position gives him power and therefore his objectivity must be monitored.	Concrete pump operators are unqualified and cause a great deal of all delays
Contract	Industry characteristics require in-person local connections	the local parent organisation has a big influence on the performance of MCQ The separation between production and delivery leads to ambiguous situations	the overall planning from the main contractor is not properly communicated with MCQ, this results in problems with the supply of raw materials
Conflict	the supply of raw materials requires a different strategy than in Europe	Gulf Beach did not allocate responsible persons for managing transport & placement. Due to the blurry relations between MCQ and Gulf Beach, MCQ solely had to bear the consequences	All uncontrolled aspects of an important item as concrete pumping lead to the fact that MCQ becomes dependent on the performance of Gulf Beach. MCQ constantly has to improvise when problems occur.

Figure 20, Results of analysis of critical incident 2

4.1.3 Analysis of critical Incident 3: Fluctuating quality of the concrete

Contact

Culture related to contact

Many employees in the construction industry in Qatar come from the Philippines. At the MCQ project in Ras Laffan, the entire workforce involved with quality of concrete was Filipino (including those of the independent third party and the main contractor). The employment procedure is as follows; these Filipinos register themselves with a labour agent for overseas jobs, then a contractor in need for labour contacts this labour supplier. In the case of MCQ, the Qatari CEO personally interviewed possible employees in the Philippines together with a Filipina translator. This method did not really result in the allocation of the right employees in the right positions. The people from MCQ that selected these employees do not possess the knowledge to judge the candidates on their assets. The people that worked in the laboratory of MCQ did not have any specific knowledge about concrete at all. On the one hand, education in the Philippines is at a different level, which is common in Europe. The construction industry is not as professional and organised as in Europe; therefore, the need for profound concrete specialists is much less. One could question whether these people should be employed in these positions, but it is simply not economically feasible to allocate European expatriates on every position that brings along certain responsibilities.

Another aspect concerns communication. The communication between the management from MCQ and the subordinates was difficult. The production manager from MCQ could not speak English fluently and neither could the Filipino subordinates. Instructions to plant operators or laboratory personnel were often incorrectly understood. This problem has even more impact due to the difficulty to understand non-verbal signals between people that stem from different cultures. Filipinos do not want to lose face (Harris and Moran, 1990) and therefore might not give recognisable signals as to whether they have understood a message or not.
To conclude: The communication between managers and subordinates is ineffective and the selection procedure of employees is inefficient.

Organisation related to contact

The relations with the relevant stakeholders are quite loose and unorganised. In this critical incident, the relevant stakeholders are the third party and the main contractor. The contractual obligation that all tests need to be performed by an

official independent third party was long neglected and the amount of tests that had to be performed at a nominal production was underestimated by MCQ. During the progress of the work, meetings were seldom arranged. Most of the contact between the management of the third party and MCQ only took place impromptu after a problem was faced. Besides this, almost all communication by MCQ was done verbally and not through written correspondence. The main contractor sent all remarks and observations by fax and the management of MCQ answered by phone or a small explanation by e-mail. This resulted in a weak position for MCQ during meetings because they could not defend themselves by presenting written statements and facts.
To conclude: Communication with main contractor and third party is not strict and not consistent enough.

<u>Technique related to contact</u>
The control system of a modern batch plant is able to produce fresh ready-mixed concrete at a consistent and reliable level. However, the results are still dependent on the skills of the plant operator. He has to monitor the progress and interfere if parameters are out of range. This requires thorough knowledge of how the complete control system works, hence training and learning on the job is the main adopted education method. At the start of the project in Qatar, there were plant operators from Mobil Baustoffe allocated. These experienced plant operators from Germany left after a year, just before the production for the in-situ construction works started. These plant operators had many problems adapting to the uncertain conditions in Qatar. From then on, the only plant operators present were the Filipino ones. The education of these plant operators was not sufficient to control the production process adequately. The control system is in English and there are a lot of technical terms and parameters. These need proper explanation and are not easy to understand with only basic English knowledge. Besides this, a manual was only available in German. These aspects resulted in larger fluctuations of the fresh concrete quality than expected.
To conclude: Education of plant operators is insufficient to fully control the production process.

Contract

<u>Culture related to contract</u>
The specifications for concrete structures and ready-mixed concrete producers in the Gulf region are mostly based on standards from the United Kingdom or from the United States of America. Although these standards are reliable and have evolved

during the last century together with knowledge in the concrete industry, it might not always be possible to implement these directly in other regions than they are originally designed for. The raw materials that are locally available and the difference in environmental conditions have a significant influence on concrete properties and therefore also on the needed standards and regulations. However, there is a local construction standard present, the Qatar Construction Standard (QCS). This standard is mainly based on British standards with a few extra additions. This local standard is not very thorough and basically can only be considered as a set of guidelines.

In the Gulf region, there is no concrete institute or quality scheme present to regulate legal, commercial and technical matters. In most Western countries, there are organisations that prescribe ready-mixed concrete producers specific rules they have to comply with in order to be allowed to produce ready-mixed concrete. Over the years, this resulted eventually in ready-mixed concrete that is delivered on-site with a quality certificate. The client can request a specific concrete strength class and any other specific requirements and can be sure that the delivered concrete complies with all the national requirements. Many clients of major projects in Europe do not accept any concrete that is produced without such a certificate. In Qatar, there are no such arrangements for the complete ready-mixed concrete sector.

In the contract from MCQ, concrete mix and test specifications are very detailed. This is a consequence of the two situations mentioned before, i.e. the abundance of local standards and sector wide organisations. Clients cannot take advantage of experiences in the Gulf region and standard designs and specifications, simply because this information is not collected somewhere central. The clients try to prevent the specific local disadvantages such as lack of workmanship and harsh environmental conditions by prescribing as much in detail as possible, whereas this only leads to inflexibility for the planning and execution of the concrete works.
To conclude: Shortage of local standards leaves too much space for different interpretations of quality level.
The absence of a local institute or quality scheme obstructs the ready-mixed concrete producers to obtain region wide advantages.

<u>Organisation related to contract</u>
The main contractor introduced a clause to the contract that MCQ needs to be ISO 9001:2000 certified. The reason behind this is that they wanted to comprise a safeguard to guarantee the reliability of the management of the subcontractor. However, this was not the case for MCQ. An ISO 9001 certification only works if the

management from the company that wants to be certified is dedicated to implement a properly working management system. This was obviously not the case at MCQ. The general manager saw the ISO 9001 certification as an unnecessary hurdle that was to be taken in order to comply with the contractual statements. This resulted in an ISO system with procedures, instructions and reports that existed parallel to the existing paperwork and with which no one worked. Another aspect regarding this matter is that the yearly audit by TÜV Middle East is also not comparable with an audit for an ISO certification in Europe. This audit only checks general items and is very shallow.

The contract with the third party to arrange all the needed tests was basic and only contained an agreement for one technician on site and an hourly rate. This resulted in delays with submittals of test reports and problems with manpower planning. A better solution would have been to attach the clauses from the contract between the main contractor and MCQ that contained prescriptions about tests and refer to these tests as obligatory for the third party to perform. Together with a nominal daily production rate and an expected maximum hourly demand, the third party could have planned the needed manpower and apparatus. MCQ could then have put pressure on them if any problems occurred and referred to the contract. In the present situation, MCQ was always the black sheep in between the main contractor and the third party. The main contractor blamed MCQ for insufficient testing procedures and level of quality. MCQ could not really blame the third party because appropriate descriptions of activities were missing in the contract.
To conclude: The ISO 9001 certification does not bring the intended result.
The contract with the third party is too general and reduces the possibility for MCQ to put pressure on the third party.

<u>Technique related to contract</u>
To reach and maintain a certain quality level, one has to measure the performance of the produced product. In the case of ready-mixed concrete, this means tests on the raw materials, and fresh and hardened concrete. A professional organisation requires this information to know what they are doing, if they contractually have to perform certain tests or not is not relevant. At MCQ, the attitude was only to perform the tests because it was contractually requested, not because of the information these tests could provide about the product they produce.
To conclude: All testing is only performed to fulfil contractual obligations, not to provide important information to control the quality of the concrete.

Conflict

Culture related to conflict

Resolving a conflict where people from different cultures are involved is more complex than in a situation where those people are in a conflict in their domestic region. The language of conversations might not be their mother tongue and interpretation of non-verbal communication is more difficult. In such circumstances, it is important to remain alert to these differences. The managers from MCQ relied too much on subordinates in critical situations. For example, in a situation where the slump is too high or too low, the lab technician and the third party technician should analyse the problem and find a good solution (if needed in coordination with the plant operator). Leaving such decisions to people whose responsibility does not include this, might result in escalating situations.
To conclude: Managers rely too much on subordinates in critical situations

Organisation related to conflict

The main contractors' core business is dredging and most of their managers do not possess specific concrete knowledge. Concrete works in hot environments are quite different from dredging works, both have their specific aspects but they are in a complete different field. This makes it difficult to convince them of the need for some specific solutions in case a critical situation occurs.
To conclude: The absence of a specialist for concrete works in the main contractor's organisation results in misunderstandings

Technique related to conflict

Contractual specifications are written to prescribe the characteristics the client wished towards the contractor. These specifications have a certain tolerance because concrete is made out of natural materials with coherent deviations. In this contract, the client prescribes a rigid mix design, which had to be tested for compliance before commencement of the concrete works. During the concrete works, only this rigid mix design was allowed to be produced. Any deviations for instance in coarse aggregate characteristics were not allowed to be compensated by changing and optimising the mix design. This resulted in an unnecessary fluctuation of the slump. Unfortunately, the slump was also one of the aspects on which the client accepted the fresh concrete.
To conclude: Rigid mix design and variances in materials result in fluctuations of fresh concrete

Summary

The analysis of this critical incident results in the following figure with key sentences for each specific cell of the matrix.

	Culture	Organisation	Technique
Contact	The selection procedure of employees is inefficient The communication between managers and subordinates is ineffective	Communication with main contractor and third party is not strict and consequent enough.	Education of plant operators is insufficient to fully control the production process.
Contract	Shortage of local standards leaves too much space for different interpretations of quality level. the absence of a local institute or quality scheme obstructs the ready-mixed concrete producers to obtain region wide advantages.	The ISO 9001 certification does not bring the intended result. The contract with the third party is too general and reduces the possibility for MCQ to put pressure on the third party.	All testing is only performed to fulfil contractual obligations, not to provide important information to control the quality of the concrete.
Conflict	Managers rely too much on subordinates in critical situations	The absence of a specialist for concrete works in the main contractor's organisation results in misunderstandings	Rigid mix design and variances in materials result in fluctuations of fresh concrete

Figure 21, results of analysis of critical incident 3

4.2 Cross-case analysis of the critical incidents

This section will deal with the cross-case analysis based on the findings of the critical incident analysis. All results of the three critical incidents are shown combined in figure 22. Whereas the analysis of the individual critical incidents retrieves the precise causes of these individual incidents, in the cross-case analysis these aforementioned results are the input for drawing findings from an overall perspective. In addition to this, MCQ and the parent organisation Mobil Baustoffe are taken into consideration from an organisational perspective. This results in key aspects for each of the elements "contact", "contract" and "conflict". In the last subsection these aspects are visualised in the overall "3-C"-model.

	Culture	Organisation	Technique
Contact	Language barrier between managers and subordinates Insufficient instruction and education of workforce Arabic entrepreneurs are more likely to trust people instead of the organisation for which they work. The selection procedure of employees is inefficient The communication between managers and subordinates is ineffective	Lack of communication between MCQ and mother company Passive way of communication with main contractor The General Manager has a key position within MCQ. This position gives him power and therefore his objectivity must be monitored Communication with main contractor and third party is not strict and consequent enough	No technical skilled employees for installing & maintenance of equipment Concrete pump operators are unqualified and cause a great deal of all delays Education of plant operators is insufficient to fully control the production process
Contract	The absence of a local oriented document that adresses hot weather concreting issues, leaves important aspects unspecified Industry characteristics require in-person local connections Shortage of local standards leaves too much space for different interpretations of quality level the absence of a local institute or quality scheme obstructs the ready-mixed concrete producers to obtain region wide advantages	the fact that some important information in the contract, regarding temperature control, is simply missing or vaguely formulated, causing a lack of possibilities to control MCQ the local parent organisation has a big influence on the performance of MCQ The separation between production and delivery leads to ambiguous situations The ISO 9001 certification does not bring the intended result The contract with the third party is too general and reduces the possibility for MCQ to put pressure on the third party	MCQ did not control the equipment sufficiently that is critical for temperature control the overall planning from the main contractor is not properly communicated with MCQ, this results in problems with the supply of raw materials All testing is only performed to fulfil contractual obligations, not to provide important information to control the quality of the concrete
Conflict	Little industry and thus no service industry of proper tools, equipment and spare parts complicate maintenance of the batch plant and all related installations the supply of raw materials requires a different strategy than in Europe Managers rely too much on subordinates in critical situations	There is no responsible person authorised by MCQ (or Gulf Beach) to deal with unexpected situations during concrete pours Gulf Beach did not allocate responsible persons for managing transport & placement. Due to the blurry relations between MCQ and Gulf Beach, MCQ solely had to bear the consequences The absence of a specialist for concrete works in the main contractor's organisation results in misunderstandings	MCQ did not use passive cooling of raw materials All uncontrolled aspects of an important item as concrete pumping lead to the fact that MCQ becomes dependent on the performance of Gulf Beach. MCQ constantly has to improvise when problems occur Rigid mix design and variances in materials result in fluctuations of fresh concrete

Figure 22, Combined overview of key-aspects from all incidents

4.2.1 Contact

The analysis of the incidents shows that many problems, related to the "contact" field occur in the areas of communication, selection & allocation of human resources and the relation between the parent organisations (see figure 22).

In an international joint venture of the size of MCQ, the person that has control over and responsibility of these key-aspects is the general manager. The person in this position has a very important and difficult task. He is the one who has to keep the mother companies informed and has a big influence on the trust between the partners. In Qatar, the general manager often stems from the organisation that decides to internationalise towards Qatar. On the one hand because they are familiar with the processes inside the parent organisation that internationalises (and is most often the company with in-depth knowledge) and on the other hand because Qatar does not possess a large pool of experienced managers. In praxis, this often means that communication between the parent organisations flows through the general manager as a messenger. He can, most often, communicate with the overseas parent organisation in his mother tongue and with the local partner in English. This central position shows the power which is affiliated to this position.

A suitable way to create more surety is to implement regulations in the contractual agreements between the partners before commencement of the local operations. A way to keep control over a general manager is to implement a clause that one parent can dismiss the general manager without approval of the other parent. This is a complicated matter because in the beginning the partners are not yet familiar with each other and there is not much trust built between them. A contractual clause which prevents a partner from leaving the contract could be seen by the other partner as a lack of trust or even as offending. Especially if the partners have a different cultural background. In this case it could be that the direct style of communication and negotiation cause conflicts with the more indirect style of Arab businessmen. It is therefore advised to discuss always all contractual issues in person before handing over any draft contractual agreement.

In the field of Contact related to Organisation of the '3C'-matrix, the aforementioned results in the key-aspects "communication" and "relation between parent organisations & position of general manager".

However, it is always difficult to predict how the general manager who expatriates will perform in the new environment and adapt to the local conditions. As described previously in the theory, the allegiance can be biased towards one of the two mother companies. A flawless record for the mother company in the domestic region does not mean that such a person can also perform accordingly in a different and new environment. Personal background from these employees on key-positions is becoming more important than solely the capability to execute their tasks on an appropriate level. These aspects are more relevant in international business than in local business. Verbal and non-verbal communication and the ability to understand people from a different background are just some aspects which play an important role in international business. Especially for the person with a management position which has a lot of power and many influences on all stakeholders this is the case.

From a general perspective, one can obtain a coarse idea about the cultural dimensions and the relations between the involved countries from Hofstede's research. The results from the analysis of the incidents, regarding the "contact" aspect, are directly and/or indirectly linked to cultural differences. To analyse the differences between the involved countries, the results of Hofstede's research (as described in chapter 2) concerning the involved countries will be used as a reference. These dimensions are shown in Table 1.

Country	Power Distance	Individualism	Masculinity	Uncertainty Avoidance
Austria	11	55	79	70
Germany	35	67	66	65
Arab Countries	80	38	53	68
Netherlands	38	80	14	53
Philippines	94	32	64	44
India	77	48	56	40

Table 1, Overview of the scores on Hofstede's dimensions for the involved countries

These dimensions provide a general impression on the differences between these countries. However, Hofstede's scores may not reflect a specific Middle East country's cultural value. The group that is describes as 'Arab' consists of great cultural diversity and consist of countries ranging from Egypt to Oman. This diversity has to be taken into consideration when analysing cultural differences based on the framework of Hofstede. Besides this, individual members of a culture might not represent the specific cultural values as they were found and ranked by Hofstede.
If a more detailed look is given at the dimension of power distance and compared within the involved countries, some clear differences occur. The differences in power

distance between the involved cultures are quite large. The German, Austrian and Dutch cultures have a lower power distance, whereas the Arab, Indian and Philippine cultures have a higher power distance. In this particular case study, this means that the managers (with a lower power distance) expect the employees, to take self-initiative and work independently on their tasks. However, many of the subordinates stem from a culture with high power distance. These people expect to receive clear and straight orders which they obey to and fulfil with discipline. In case circumstances alter and require adaption of the task which is executed, the manager might rely on the employee to take self-initiative and complete his task to his best decision, whereas the employee expects to receive new orders if needed. Obviously, this causes misunderstandings and requires awareness and attention from the managers while dealing with such employees. This also means that the right people need to be allocated in the right positions. Some positions, like plant operators or pump operators, require quite a degree of self-initiative and responsibility of the employees. Some people might be less suitable for these positions than others. Although one needs to have on mind that the individual members of a cultural can have a different personality than the general assumptions made by Hofstede, one should precautious plan the allocation and education of employees on certain positions.

In the field of Contact related to Culture of the ‘3C’-matrix, the aforementioned results in the key-aspects “personal background” and “cultural barriers”, for the field of Contact related to Technique this results in the key-aspect “allocation, education & instruction of employees”.

4.2.2 Contract

The analysis of the incidents shows that many problems, related to “contract” occur in the areas of contractual and official documents, organisational strategy and quality control & assurances, this last aspect mainly related to testing (see figure 22).

The contractual specifications determine the scope of the work that has to be performed. The designer/engineer from the client composes the structural requirements of a project. This person has certain criteria in mind which the structure has to comply with and transfers these to the contractor by means of contractual specifications. At best, the designer should be aware of the impact of the design on the construction process. With regard to for instance the concrete mix, it is important to achieve a balance between specified strength, durability, heat of hydration and the requirements for placing and compaction of the concrete. In particular the strength and minimum cement content should not be over specified (Newman and

Seng Choo, 2003a), a consideration that is often not adhered to. In this case, none of the aforementioned remarks is sufficiently taken into consideration. The concrete road on top of the breakwater is basically a dead weight without any constructive function. Prescribing a concrete mix with a design strength of 40 MPa and a minimum cement content of 350 kg/m^3 is obviously overcautious behaviour in these particular circumstances. The size of the structure (mass concrete) and the harsh ambient conditions result in more negative effects concerning the durability due to these restrictions than the benefits the designer had in mind they bring to the strength of the structure.
A second consideration regarding contractual specification is the lack of local official documents that can be applied to the construction industry in general and the ready-mix production in particular. The available documents are based on standards from the United Kingdom or USA and there is not much information about experiences in the construction industry and local practises. This makes it more complicated to benefit from previous experiences in this region. Official documents like standards or guidelines are constantly updated with new insights and experiences out of the field where they are applicable.

In the field of Contract related to Culture of the '3C'-matrix, the aforementioned results in the key-aspect "local standards and regulations", for the field of Contract related to Organisation this results in the key-aspect "contractual specifications".

Another aspect that plays a significant role is the delay of the project; this had a big influence on the organisation of MCQ. At the start of the project, the plan was to use the first batch plant for production of ready-mixed concrete from around October 2006 until end of spring 2007. This would provide revenues to finance the erection of the second batch plant and connect it to the aggregate cooling system. This batch plant would then be operational on time for the hot weather season of 2007. In praxis, the production of the in-situ concrete only started in August 2007. Until then there was only a small amount of production which was not enough to be profitable, let alone provide financing for building another batch plant. At this time (August 2007), the relation between Mobil Baustoffe and Gulf Beach was in such a bad state, that neither of them wanted to invest capital for erection of the second batch plant. MCQ tried to obtain a loan, but because the batch plant was second hand, no institute would provide a bank guarantee on this equipment. In Qatar, the perception of the quality and durability of equipment is different than in Europe, which means that only brand new facilities can get local financing. All in all, the second batch plant was not operational until the summer of 2008.

In the field of Contract related to Culture of the '3C'-matrix, the aforementioned results in the key-aspect "local industry characteristics".

In this contract, production and delivery are awarded separately. MCQ produces the RMC for the main contractor. This main contractor provides it at disposal for its own subcontractors (the contractors that execute MBK and SBK). These subcontractors both have to arrange transport, pumping and placing of the RMC themselves. These relations can be seen in figure 23. Both of these subcontractors decided to let all these activities be performed by Gulf Beach (also the sponsor of MCQ). At the time these contracts were awarded, the relation between MCQ and Gulf Beach was quite blurry and not transparent to all stakeholders involved in the project. It seemed an appropriate decision to let these activities be performed by Gulf Beach because of their close relation with MCQ. This should have reduced the possibility of conflicts and eased communication. Besides this, the availability of truck mixers in Qatar is scarce and there are no companies inside Ras Laffan, who have the equipment available to transport 230,000 m^3 in 18 months. One could say that this strategic game is played well by the general manager of MCQ and the Qatari sponsor himself despite the negative consequences this had for Mobil Baustoffe.

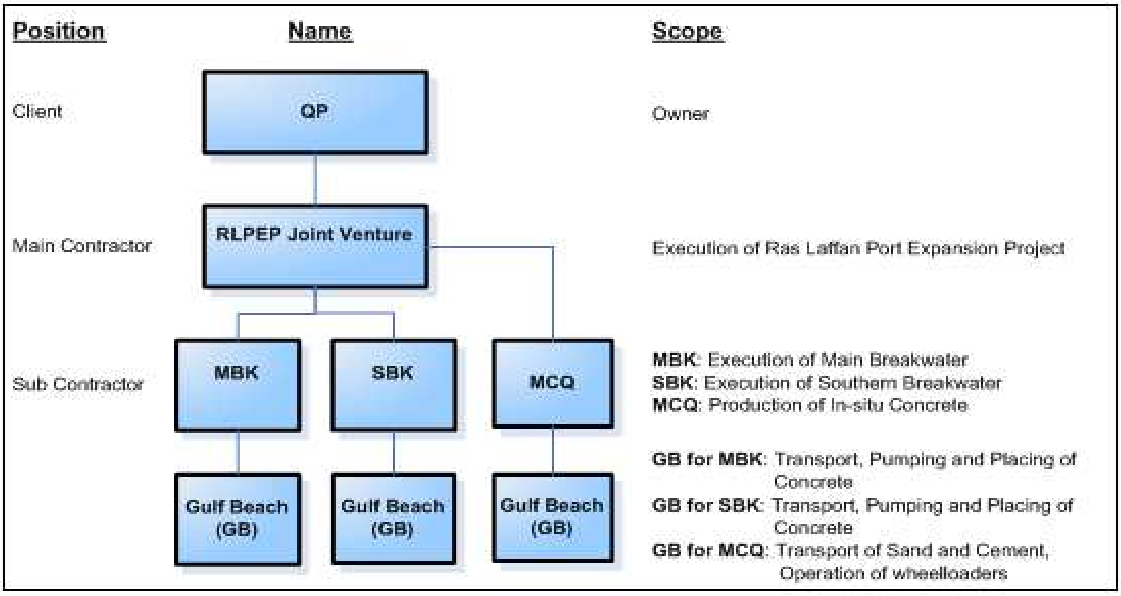

Figure 23, overview of the relations between the stakeholders in the project

From the viewpoint of the main contractor, the chosen contract relations for the concrete works did not seem to be the optimal choice. Of course, what has to be borne on mind is the overall picture that the production of RMC is about 1-2% of the total contract sum from the main contractor which could put it lower on the priority list. However, the concrete works are on the critical path for completion of the project. It would probably have been better for the main contractor if the contract to produce the RMC would include delivery on site and pumping of the concrete into the formwork. In this case, all responsibilities and risks would have been allocated to one stakeholder instead of dividing them over different subcontractors. There would have been one partner to communicate with and everyone's tasks would be clear with less ambiguity. In the present situation, there were officially no relations between the concrete producer and the transport company according to the contractual conditions. Of course, no one could have predicted that the relations would be tangled in such a complex way. In praxis a lot of information and communication was transferred between Gulf Beach and MCQ directly without interference of the main contractor or MBK-/SBK contractor. There were no responsible persons allocated for the transport and pumping of the RMC. The employees of MCQ tried to arrange these activities in addition to their normal work. As would become clear in a later stage, these were all arrangements between the general manager of MCQ and the local sponsor of Gulf Beach himself. After the dismissal of the general manager, he started working for the company of the local sponsor, Gulf Beach. This was clearly a sign, which confirmed the assumptions about the close relation between these two persons.

Another angle to look at this issue is from the European mother company Mobil Baustoffe. The strategy of Mobil Baustoffe in Europe is to have a lean and agile company strategy and focus on their core activities, i.e. production of ready-mixed concrete. Subcontractors perform all other activities e.g. transport of fresh concrete, delivery of raw materials and operating of wheel loaders. This decreases the fixed costs and gives Mobil Baustoffe the possibility to react quickly to opportunities in the market. In Qatar, they implemented the same strategy. After analysis of critical incidents derived from the start up period, it can be questioned if this strategy is appropriate in Qatar. The environment around an organisation in Qatar is more uncertain when compared to the domestic situation in Europe. It is widely described in literature that a suitable method of reducing uncertainty is vertical integration in the supply chain. In this way, an organisation attracts more activities within its own boundaries and thus can control them in a way that suits them best. In the concrete producing sector, this principal can be applied both up- and downstream of the core activity. In Europe, this is also an obvious trend in the ready-mixed concrete industry. Large raw material suppliers like Heidelberg, Holcim and Cemex acquired existing ready-mixed concrete producers and integrated them into their corporate strategy. It has to be mentioned here that MBS operates in a field, which is a bit different. In their

domestic region, they focus on civil projects with large quantities, which cannot be easily met by local ready-mixed concrete suppliers. In Qatar, however, the production and demand is clustered in a handful of different locations which can serve all projects. The need to be agile and quickly operational at different locations is therefore not present. Therefore, it could be an advantage to integrate some activities inside the boundaries of MCQ. Downstream integration can be transport and pumping of concrete and upstream integration can be transport of raw materials. It is not very likely that further upstream integration with raw material suppliers (like in Europe) is a reasonable option in Qatar, because all suppliers are independent and 100% local.
Also, it does not seem feasible to integrate further downstream activities, i.e. placing of the concrete, into the activities of MCQ. These activities are too far from the core business of a ready-mixed concrete producer and require completely different skills. However, downstream integration of transport of fresh RMC to the activities of MCQ can be a feasible option to reduce dependencies and uncertainty and increase reliability of production and delivery. The economical feasibility of this vertical integration possibilities are not part of the scope of this thesis and therefore it would require further investigation to recommend this as a solution.

With 51% ownership of MCQ, local presence in the country where the production and both upstream- and downstream subcontractor activities take place, the influence of Gulf Beach cannot be emphasized enough on the overall performance of MCQ.

In the field of Contract related to Organisation of the '3C'-matrix, the aforementioned results in the key-aspect "strategy fit".

Another item which derived from the analysis of the incidents regarding contractual aspects is quality control and assurances. To produce ready-mixed concrete in a country where the organisation has no experience before requires thorough investigation of the possibilities and limitations of the production. A first study should recognise the production possibilities with the available raw materials. A second issue is awareness of the local standards and regulations with which the produced ready-mixed concrete has to comply. Another item is the assurance of the quality towards the client. If the produced product is (almost) flawless but the client is not convinced by this for whatever reason, this can result in a situation where the perception of the characteristics of the product is lower than the actual level, i.e. a theoretical bias exists where there is none in praxis. A good quality control and assurance system can prevent such situations. This might be even more important for a company that starts

production in a foreign environment because a good quality system can convince a client in a situation where cultural differences are apparent. These cultural differences make it more difficult to acquire the needed level of trust through means of communication.
The coordination of the third party, which was contracted to perform all required tests of the ready-mixed concrete, was insufficient. The management of MCQ underestimated the amount of tests required for a daily production of 600 to 1000 m^3. Some basic equipment was brought along with the batch plant from Europe but this was by far not sufficient to perform all needed tests mentioned in the contract. Intentionally, MCQ even wanted to perform these tests with their own personnel. First when the client notified MCQ that test results are only acceptable when they are performed by an independent third party, MCQ contracted such a third party.

In this case, MCQ did not emphasize enough on the quality control & assurance of the product they produce. The independent third party was not managed properly and the awareness for the need of a reliable and thorough quality system was not present in the organisation.

In the field of Contract related to Technique of the ‘3C’-matrix, the aforementioned results in the key-aspect “Testing procedures” and “Suitable equipment”.

4.2.3 Conflict

The analysis of the incidents shows that many problems, related to “conflict” occur in the areas of awareness and control of country-specific conditions, the position and behaviour of the general manager, the absence of persons on key positions and the available equipment and production facilities.

The aspect “conflict” describes these issues that are encountered most of all the three aspects as direct problems or unwanted situations. The aspects “contact” and “contract” are more on the background level and indirectly noticeable, whereas the aspects related to “conflict” are directly noticeable on the surface as the first direct retrievable cause of an incident.

A company that starts production in an unknown region and especially if the company is active in a sector where local production is a necessity, thorough investigation of the local conditions needs to be performed. Building a production facility brings along for instance the supply of raw materials, wear &tear and operation of equipment. All these aspects might be different than in the domestic region. In Qatar these differences are in some fields quite large. For instance, the construction industry is booming, nonetheless the related sectors like maintenance and tools & equipment are lacking behind. This can cause problems to maintain a certain level of productivity. Another field where the differences are obvious is the supply of the raw materials. This is an important aspect for every ready-mixed concrete producer because it determines the quality and price of the product for a great measure. Different modalities of transport and different relations with suppliers require a different focus on raw material supply in Qatar than in Europe. A last aspect which derived from the incidents is the relation between managers and subordinates. In critical situations, the managers relied too much on subordinates. In Qatar, the subordinate employees are often from Asian background which automatically introduces cultural differences. The available pool of employees in Qatar makes the employment of employees from this region almost unavoidable. All these aspects can be analysed before commencement of expanding to a foreign country. In this case, MCQ did not sufficiently study the specific conditions in Qatar under which it had to produce ready-mixed concrete.

In the field of Conflict related to Culture of the '3C'-matrix, the aforementioned results in the key-aspect "Awareness and control of country-specific conditions".

Another item that became apparent through the analysis of all three incidents is the arrangement of human resources in management positions and the boundaries of their authorities and responsibilities. The lack of a transparent management system had an influence on the critical situations as analysed in this thesis. Temperature control, on-time delivery and quality control are three of the core-aspects on which a ready-mixed concrete producer has to focus. This requires clear and obvious tasks which introduces the need for clarification of authorisation and responsibility. Especially in cases where the responsibility of a task is shared between different stakeholders, it is important to assure your own part sufficiently. In this case, the production and transport & pumping are separated, which means also the responsibility for this should be with the correct stakeholder. The same applies to temperature and quality control. A ready-mixed concrete producer cannot bear the risk that is influenced by other stakeholders. Seen with a practical example, a delay or obstruction in delivery or pumping might lead to an unacceptable rise in temperature. This leads to rejection of the concrete, the consequences of this should be transferred to the company that is responsible for the transport and pumping. Another example could be incorrect curing of the concrete which might lead to doubts on the in-situ structure and additional testing. The root causes of these problems need to be thoroughly analysed and allocated to the correct stakeholder. The latter example it is more difficult to derive the clear distinction of the responsibility. However, thorough preparation of the item mentioned in this section will for sure make this easier to achieve.

In the field of Conflict related to Contract of the '3C'-matrix, the aforementioned results in the key-aspect "Allocation of authorisation and responsibilities".

Last aspects that can be addressed from the critical incidents analysis are technical production issues. These technical aspects are most often the first indicators when critical situations arise. In this case for instance, the temperature of the ready-mixed concrete might be insufficient controlled through a lack of capacity in cooling equipment or incorrect control of the equipment. The underlying causes that might have led to the incident, like the aforementioned 'strategy fit' or 'cultural barriers' only show up after thorough analysis of the incident.

The equipment used for the production of ready-mixed concrete is in principal perfectly suitable for production high quality ready-mixed concrete in large quantities. The control system is modern and has quite an easy user interface. The problem lies in the area where the equipment has to be adapted to the local environment and the boundary activities, e.g. raw material supply and storage concept. Seen from a practical perspective, the delivery of raw materials in Qatar is not as reliable as in most areas in Europe. Partially this is caused by to longer hauling times and partially by different market conditions. The storage capacity needs to be adapted to these circumstances in order to be able to guarantee the contractual production rate. Another issue is the adaption to the local circumstances. The storage of aggregates can be optimised if roofing is installed so shaded areas are created. The reduction in solar radiation on the aggregates lowers the temperature and hence saves energy when achieving the required fresh concrete temperature.

It should be analysed whether the common production techniques are feasible in the applicable region and if special precautions (like temperature control) are feasible enough to implement under the local circumstances, this applies to the technical fit as well to the type of control that is foreseen.

In the field of Conflict related to Technique of the '3C'-matrix, the aforementioned results in the key-aspect "Practical production techniques".

4.2.4 Visualisation of key aspects

The cross-case analysis resulted in key aspects for each of the fields “contact”, “contract” and “conflict”. In figure 24, all these aspects are visualised in the “3-C”-model. The cyclic character of the model implies that these factors are correlated and influence each other, i.e. the factors should not be addressed individually but as a set of aspects.

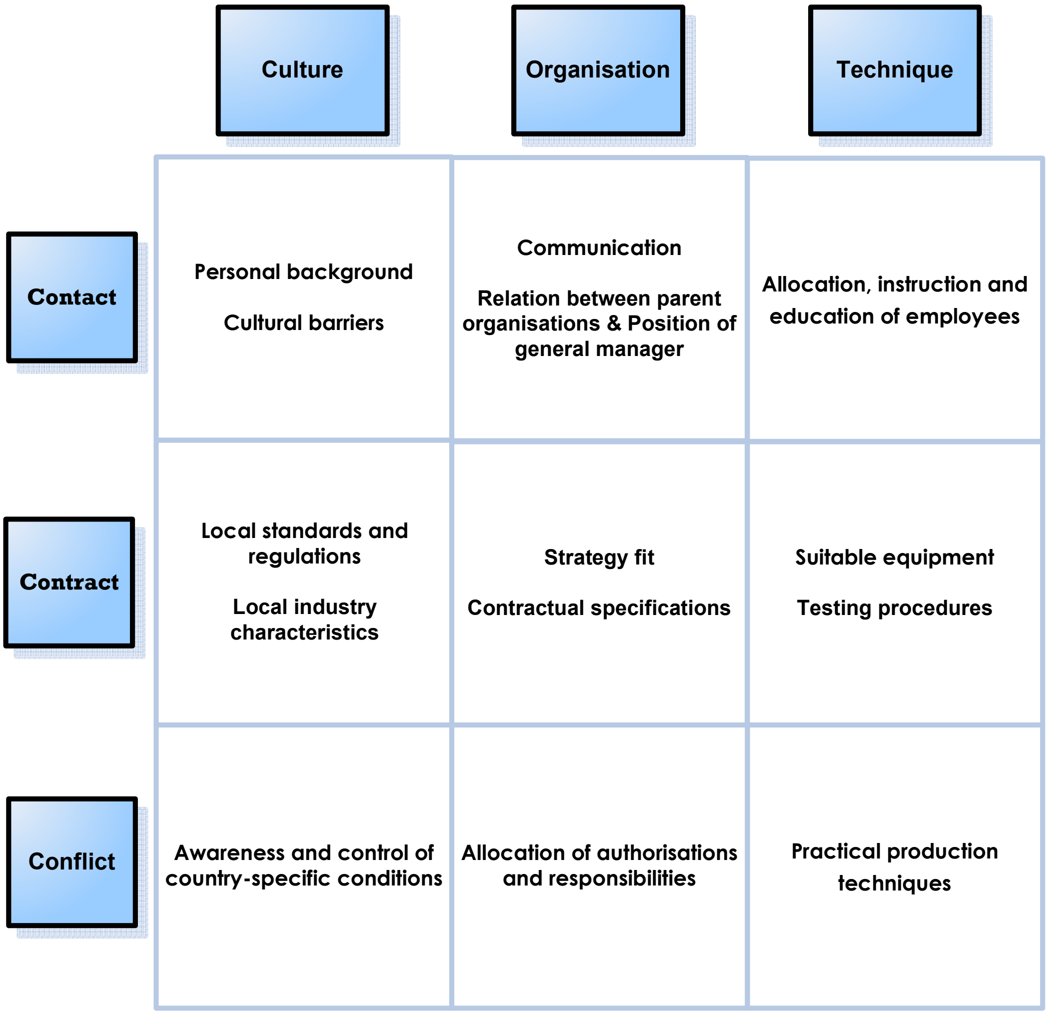

Figure 24, key-aspects for every field of the "3-C" model

These set of key-aspects derived from analysis of critical incidents concerning a ready-mixed concrete producing company which expanded from their domestic region in Austria towards Qatar. The critical incidents derive from field observations performed by the researcher in the first period of the expansion. The aforementioned key-aspects are not unconditionally transferable to companies in other sectors expanding towards Qatar or to ready-mixed concrete producers expanding to another country. However, some aspects might be applicable to a more or less extent.

4.3 Summary

This chapter analysed the critical incidents as encountered at MCQ. These critical incidents derived from field observations conducted by the researcher. The analyses of the incidents are based on the "3C-Framework" from Tijhuis (Tijhuis, 1996). This is a cyclic framework that consists of the elements Contact, Contract and Conflict. These three elements are projected against each other which results in root causes of the critical incidents.

The three critical incidents are compared and projected against each other to retrieve findings from an overall perspective. This results in key-aspects for each of the elements of the "3C-Framework". The key-aspects found are:

1. Personal background,
2. Cultural barriers,
3. Communication,
4. Relation between parent organisations & Position of general manager,
5. Allocation, instruction and education of employees,
6. Local standards and regulations,
7. Local industry characteristics,
8. Strategy fit,
9. Contractual specifications,
10. Suitable equipment,
11. Testing procedures,
12. Awareness and control of country-specific conditions,
13. Allocation of authorisations and responsibilities,
14. Practical production techniques.

5 Findings of Expert Panel

The results of the analyses were presented to the management of Mobil Baustoffe GmbH in Austria and an independent consultant from Abu Dhabi which advises MCQ in Qatar. These persons validated the findings of the analyses as being correct.

The management of Mobil Baustoffe GmbH added some additional information which was not gathered by the researcher through field observations but which contributes to the correct understanding of the analysis. This information is presented in the following section.

At the stage where the intentional agreement was signed, the local partner guaranteed to arrange local financing. The local partner could not arrange this, except for the needed surety bonds. Furthermore, the European partner expected that the contribution of the batching equipment and the technical knowledge of the employees would be sufficient contribution of resources to MCQ. After 2,5 Million Euro was additionally provided by Mobil Baustoffe GmbH, they stopped any other payments, especially because the revenues were lacking and progress of the project was slower than expected. The local general manager from MCQ and the local partner did not incorporate the management of Mobil Baustoffe GmbH in the daily business, which obviously affected the relation detrimentally. The investments for the facilities in Ras Laffan were financed by the main contractor and deducted in rates from the invoices for the delivered concrete. This caused a continuous negative cash-flow.

Small and medium sized enterprises (SME's) should be warned for an investment in the Arabian Gulf, because of different reasons. First, they are not able or willing to invest 100% of the needed resources with only 49% portion of the joint-venture (and the local partner additionally takes a revenue- and profit fee) and secondly they often do not have the possibilities to finance the needed investments over a long period, which is often needed due to the difficult local conditions.

6 Conclusion and Recommendations

6.1 Conclusions

The research objective of this thesis was:
"To analyse the production of controlled delivery of cooled ready-mixed concrete production in Qatar, in order to identify factors affecting this production."

These factors are identified by analysing critical incidents, which are derived based on field observations conducted by the researcher. Through a cross-case analysis of these critical incidents, one can draw inferences which will be discussed in this chapter. The research was framed by the 3C-Framework (Tijhuis, 1996). This provides a suitable framework which allocates specific aspects of construction projects in an international setting. This framework consists of three dimensions which are projected against each other. This results in a matrix with nine cells in which each cell represents specific aspects in its corresponding dimension. The three dimensions of the 3C-framework are "Contact", "Contract" and "Conflict" (Tijhuis, 1996).

The critical incidents are derived from the field observations, three incidents which caused the most obstructions for MCQ to reach their targets are analysed by the 3C-framework. The target of a ready mixed concrete producer is to produce the correct requested amount of concrete on time at the required quality level.
The following situations are identified as critical incidents:

1. Too high temperature of the concrete,
2. Delayed delivery of concrete on site,
3. Fluctuating quality of the concrete.

The analysis of the critical incidents show that there are quite some indirect factors affecting the international production of ready-mixed concrete. Indirect means in this context that the factors are not part of the actual production process itself and can mainly be derived by thorough analysis. These are precisely the aspects that are found to be the root causes of the critical incidents. Having extracted those root causes, patterns of similar factors are sought through a cross-case analysis to identify common fields and retrieve general key aspects which affects the production of controlled delivery of cooled ready-mixed concrete in Qatar.

The conclusions of this research are:

First, the personal background of employees in key-positions (e.g. general manager) is very important in an international joint venture.
Employees in key-positions are the people who have a lot of authorities, are in contact with both of the parent organisations and lead the international joint venture, therefore their influence is huge. For international ventures, the personal background of these employees influences the success of the venture in the new country.

Second, the relation between the parent organisations is crucial for the success of international joint venture and this relation is highly influenced by cultural barriers and communication.
An international joint venture consists of two organisations which stem from different countries. Co-operation between these two organisations is important for a successful venture. The organisations have to be aware of cultural barriers and need to communicate openly.

Third, the country-specific conditions, local industry characteristics and local standards need to be investigated prior to commencement of local production.
Production of ready-mixed concrete involves connection with the local industry due to the supply of raw materials. The local conditions and standards have a big influence on the possibilities to acquire the needed quantity and quality of raw materials.

Fourth, the most suitable employees need to be selected for the given job.
In an international venture, one does not have the same level of knowledge about the available pool of human resources as in the domestic region. Besides this, the available skilled human resources might be limited and/or from a different cultural background. These factors make it of the utmost importance that the selection of human resources is given all the attention it requires.

Fifth, the appropriate equipment needs to be selected for the local production.
Production of ready-mixed concrete in an international setting is influenced by the local conditions. The equipment needs to be selected in such a way that the quality of the product can be guaranteed, especially if these local conditions have a detrimental effect on the product.

This research analysed critical incidents concerning a ready-mixed concrete producing company which expanded from their domestic region in Austria towards Qatar. Hence, the results of this analysis are not unconditionally transferable to companies in other sectors expanding towards Qatar or to ready-mixed concrete producers expanding to other regions. However, some aspects might be applicable to a more or less extent and the results provide at least an indication of the 14 key-aspects that should be given attention to before expanding is commenced.

This research did not focus on the economical side of international production of ready-mixed concrete but addressed the factors affecting the production and the position of ready-mixed concrete production in a construction project. The "3C-Framework" (Tijhuis, 1996) provided the framework to conduct this research. A further research possibility would be to incorporate economical aspects. This could be done on a project level as well as an industry- or region level. One possibility would be to integrate economic- and industry oriented frameworks, like Porter's five forces. This would give a more comprehensive view of international production and could contribute to find more economic oriented key-aspects.

6.2 Recommendations

The following recommendations are given for small and medium sized companies that are involved in international production of ready-mixed concrete.

First, companies should invest in finding a suitable partner.

The selection of an appropriate partner is of the utmost importance for a successful relationship in an international joint venture. Especially when cultural differences are larger, the likelihood for misinterpretations is larger and it is then important to have a partner that understands the objective of the other partner organisation.

Second, contracts with partners should contain clauses which gives the parent organisation ongoing influence (so called safeguards).

This is a very delicate matter, because in the initial phase, the trust still has to be built between the partners and this can easily be destroyed if certain contractual phrases are interpreted incorrectly (therefore in-person communication and clarification concerning such delicate issues is preferred). However, these clauses need to be implemented to maintain control.

Third, if expatriate employees are sent to the international joint venture from within the mother company in their domestic region, these employees should be assessed on their suitability.
A flawless record in the domestic region does not mean that these employees are also the right choice for overseas activities. Working in a foreign country with a different culture in a multicultural team requires different competences than in the domestic region.

Fourth, preparation of the works is even more important in international production than with production in the domestic region of a company.
Production in a foreign country brings along extra uncertainties and introduces different aspects which need control. In order to diminish the detrimental effect of these additional items, work preparation is very important.

Fifth, the production of ready-mixed concrete in hot weather regions requires careful planning of the applied cooling techniques and the present conditions of the country where the company wants to expand to.
The appropriate cooling of ready-mixed concrete is a complicated and sensitive matter. It is influenced by the applied technique, the employees and the environmental conditions. All these factors need to be considered before the international venture is commenced so that the most suitable equipment can be acquired.

Sixth, the local supply sector for delivery of raw materials should be analysed thoroughly before signing any contracts, preventing organisations to be trapped in contracts which they can not fulfil.
The production of ready-mixed concrete is for a large part dependent on the raw materials. The availability and quality can vary greatly among different locations and should therefore be thoroughly investigated.

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Appendices

1 Field Observations

This appendix describes the field observations as they were experienced by the researcher. Field observations contain in-depth descriptive details of people, places, things and events (Given, 2008). The observations were gathered by the researcher during his presence in Qatar from November 2006 until March 2008. They are based on own experiences, analyses of documents, conversations with employees of MCQ and other involved stakeholders.

The field observations in this appendix contain a lot of detail. The reason for this extensive description is to introduce and explain the exact occurrence of events and create understanding and possibly even an imagination for the reader of the circumstances which lead to the critical incidents analysed in this thesis. A second reason for the extensive description is the fact that circumstances in Qatar differ quite a lot from European conditions, a thorough description of the observations provides insights to these differences.

First, general information about Qatar and its specific circumstances will be given. Next, the project in which MCQ is involved will be explained and at last the observations about the company MCQ will be described.

1.1 Qatar

The state of Qatar is a small peninsula in the Persian Gulf and borders in the south with Saudi Arabia. The country measures approximately 180 km north-south and 80 km east-west. Qatar has an arid climate with high peak temperatures in summer and high fluctuations in humidity.

Qatar became independent from the U.K. in September 1971. The current emir, Sheikh Hamad bin Khalifa Al Thani, replaced his father in a bloddless coup in 1995. He has shifted towards a course of economic diversification and educational opportunities. As a part of the liberalisation, the emir founded Al Jazeera in 1995. In April 2003, a referendum was held which granted women the right to vote. Elections are planned for a national Advisory Council, but no firm date has been set. These occurrences are signs that Qatar is slowly developing its own course towards an independent and sophisticated state. All this is only possible due to the natural resources that Qatar possesses.

Qatar holds the third-largest proven natural gas reserves in the world, behind Russia and Iran. The small population enjoys the highest per capita income in the world. The country's fiscal position is strong in spite of the retreat of the oil prices since the 2008 high. The economy has experienced an annual growth rate of 11.6% from 2005 through 2009 (IMF, 2010). Qatar has expanded its yearly LNG output from 4.5 million tons in 2002 to 43 million tons in 2009 and is therewith the largest exporter of LNG in the world. The large production and shipping facilities at Ras Laffan in northern Qatar serve as the main site for the country's gas development projects. The expansion of these production facilities and correlated construction projects attracts many foreign companies towards Qatar.

Establishing a company in Qatar differs from establishing one in Europe. It is a legal requirement that every company needs a local Qatari partner owning 51% of the company which will be established. Finding an appropriate partner is not easy. The choice of the local partner has a large influence on the performance of the company because this partner is inevitable in acquiring local licenses, permits and certificates, importing goods and making arrangements with local authorities and business connections.

The workforce in Qatar is quite remarkable. Almost all people who are involved in construction projects, from unskilled labourers to project directors, are expatriate workers. A huge variety of nationalities are involved in the construction projects in Qatar. The management positions are often occupied by managers from Western countries, whereas the workforce consists mainly of unskilled labour from surrounding Arabic countries and the Asian subcontinent. A lot of the unskilled labourers do not speak sufficient English, which is the main applied language in verbal and written communication in the construction projects. In such a situation the translation would be performed by a member of the team who understands basic English. This might cause problems concerning the acceptance of the message because these persons are often the younger ones of a troop of workers and they don't have any authority among the members of the group. In some Asian cultures instructions are only accepted if they are communicated by one of the oldest persons in the group.

To be allowed to work in Qatar, an employee needs a work permit. This work permit is valid for one year and can be renewed if needed. To obtain a work permit the employee needs to fulfil strict medical requirements. Applicants are tested for AIDS, TBC and some other medical tests are performed. Fingerprints are taken from all applicants. Once the medical tests are performed, the employee has to wait until this work permit is processed and he or she cannot leave the country within this period. It will take between two to six weeks until all the needed documents are ready. If in case of an emergency the employee has to leave the country in this period, the whole procedure has to start all over again.

Once a work permit is granted, the employee can only leave the country with approval of the local sponsor. A so called 'exit permit' has to be handed in at the customs desk before one can enter the terminal at the airport. It happened quite a few times that the researcher was not able to catch the booked flight due to the fact that the sponsor didn't organise an exit permit. The only thing you can do in such a case is to wait until the exit permit is ready (and leave later). One could feel quite limited in his movement with these restrictions, especially if the relationship with the sponsor is not optimal and one does not know whether he/she can freely move if this is urgently required. This system is known as the 'khefala' system and is subject to many critics. The U.S. State Department Country Report on Human Rights for 2008 states that Qatar's government *'placed varying restrictions on civil liberties, including freedom of speech, press (including internet), assembly, association and religion'* (cp. U.S. department of State, 2008 Country report on Human Rights Practices in Qatar, http://state.gov/g/drl/rls/hrrpt/2008/nea/119125.htm.

The regulations and circumstances for unskilled labourers are quite bad. According to their contract, most of them work 6 days a week for 8 hours a day. In reality, 12 to 14 hour working days are more likely on the majority of the construction projects. The circumstances in which they have to live vary greatly from company to company. Some are offered quite decent circumstances with air-conditioned rooms, proper sanitary facilities and sometimes even laundry service and food supply. Others have to live with six persons in a 12 m2 room with only basic facilities. A contractor can influence his subcontractor in issues regarding his employees but he has no influence on the subcontractors of the subcontractor. Qatar received critics from the international labour organisation (ILO), an article on the website gulfnews.com from the 12th June 2007 quotes: *"There are over 15 million migrants living in the six Gulf Cooperation Council countries, according to an estimate of the Bahrain Human Rights Society. Regardless of their nationality, they are subjected to local sponsors, who have the power to limit migrants' movement and job change.*
However, in the cases of low-income uneducated workers, they are exposed to other kinds of abuses also such as physical and verbal harassment, denial of access to consular services and contacts with families, participants in the conference said." (cp. Website www.gulfnews.com, accessed on 20th July 2007). The aforementioned country report on human rights from 2008 also states *'visits to labor camps revealed.. the majority of unskilled foreign labourers living in cramped, dirty, and hazardous conditions, often without running water, electricity or adequate food'*.

1.2 MCQ

The company Mobil Concrete Qatar was founded in early 2006 as an international joint venture between Mobil Baustoffe GmbH, an Austrian company, and Gulf Beach Trading & Contracting, a Qatari company. Mobil Baustoffe owns 49% of MCQ and Gulf Beach 51%.

Mobil Baustoffe was a private owned company until September 2008, when they were acquired by STRABAG SE, a large international contractor from Austrian origin.

Around 2005, Mobil Baustoffe had some projects in their portfolio which were reaching completion and new projects were not widely available. They were attracted by the promising news about the construction projects in the Gulf region and decided to try to acquire projects. After a quick shallow survey, the would-be general manger concluded that Qatar provides the best circumstances for Mobil Baustoffe. A sponsor was found in Gulf Beach and a simple and basic contractual agreement was made, which meant that MCQ was a fact.

The scope of MCQ according to their quality system is "Design, production and supply of ready-mixed concrete, concrete prefabricated products and in-situ concrete construction works". The first project they acquired dated from July 2006 and was located in Ras Laffan Industrial City and consisted of the production of all the ready-mixed concrete for the in-situ concrete works on the port expansion project.

The organisation of MCQ is quite small. The general manager and the production manager derive from Mobil Baustoffe and used to work in Europe and Austria before. The assistant of the general manager, the public relations officer, the secretary and accountant come from Gulf Beach and were active for both companies parallel. The first plant operators also came from Mobil Baustoffe but quite soon after commencement of the production they left MCQ because of irresolvable disputes and were replaced by Filipino plant operators.

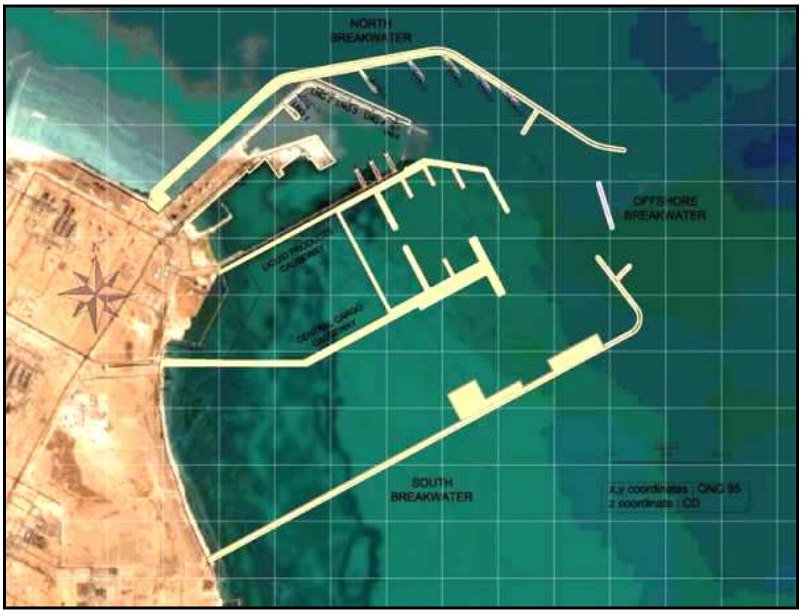
1.3 Ras Laffan Port Expansion Project (RLPEP)

In the northeast of Qatar, Ras Laffan Industrial City (RLIC) is located. It is a remote location with a size of 160 km^2 which will grow to 250 km^2 by 2015. This area is where the largest part of the natural gas is extracted and turned into liquefied natural gas (LNG). This industrial city consists of petrochemical installations and a lot of construction projects are ongoing to increase the capacity of the LNG production.

To enter RLIC, one needs a gate pass. The whole area around RLIC is surrounded with a fence and there are only a few guarded gates which provide access to RLIC. A gate pass can only be requested by a company which is working inside RLIC and they are provided by the Ras Laffan Security Centre. During the presence of the researcher in the field, the procedures for obtaining a gate pass changed a few times. Every change made it more complex and time-consuming to acquire a gate pass. For example, all trucks which supply anything from outside RLIC need a temporary gate pass to be able to deliver the goods to site. Most of the deliveries in praxis were arranged with short notice and then the only option to obtain a gate pass was to get a temporary one. If this truck needs to deliver anything else a week later, the driver needs a new gate pass. This whole procedure includes a lot of administration and paper work and it costs a lot of time to acquire all the needed documents from subcontractors.

RLIC is expanding greatly in order to be able to transport more LNG to their clients all over the world. The production and storage facilities are expanding and also the berthing facilities in the harbour require expansion. One of the major construction projects is the Ras Laffan Port Expansion Project, in which MCQ is involved. When completely finished it will provide the harbour with an additional five LNG berths (next to the existing four), a large dry-dock and some cargo facilities.

The RLPEP project was awarded by Qatar Petroleum (QP) to a Joint-Venture between Boskalis and Jan de Nul (Ras Laffan JV). This phase of the project consist of dredging works, the construction of two breakwaters and the extension of the existing harbour by means of land reclamation.



The two breakwaters (Main- & South Breakwater) enclose the harbour of Ras Laffan Industrial City. Both of those breakwaters have a length of 11 km. The construction of the Main- and South breakwater is executed by two subcontractors from the main JV. The Main breakwater (MBK) is executed by a Joint-Venture named RLNBC between Boskalis and Van Oord ACZ and the South breakwater (SBK) is executed by CFE Qatar.

The concrete works for this project consist of an in-situ concrete road on top of the previous mentioned breakwaters and prefabricated concrete blocks. The road functions as a dead weight on top of the breakwater and the prefabricated blocks protect the breakwater on the outside from wave impacts. The in-situ road has the same shape for both the breakwaters, only the dimensions vary slightly. The main breakwater has a width varying from 6,5 meters, a thickness from 1,8 meters and is divided into bays with a length of 15 meters. This gives each bay a volume of 175 m^3. The last 4 kilometres of the road has a width of 8 meters, which increases the volume per bay to 215 m^3.
The first 7 km of the south breakwater has a thickness of 1.0 meter, a width of 8 meters and a bay length of 15 meters, which gives each bay a volume of 105 m^3. The last 4 km, the thickness is 1.5 meter, the width is 10.5 meter and the length stays at 15 meters. This gives each bay a volume of 236 m^3. Both roads on top of the breakwater have the same total length as the breakwater, approximately 11 kilometres.
Located on top of the road on the seaside is a so called "crown wall", this consists of concrete blocks. They are 1.5 m wide, 1.5 m long and 0.8 m high. The total quantity of the in-situ concrete for both breakwaters is 250,000 m^3 with a design strength of 40MPa, there is no reinforcement applied in the whole road construction.

Figure 25, Overview of in-situ concrete road

1.3.1 Contracts

MCQ got awarded two separate contracts by the main contractor (Ras Laffan JV), one for the production of all the in-situ concrete (250,000 m^3) and one for the production of 11,000 prefabricated concrete blocks of 1.5 m^3 each. The contract for the prefabricated concrete blocks comprises about 5% of the total needed prefabricated blocks, the rest is awarded to another company.

The prefabricated blocks (named Antifers) were produced in the period from December 2006 until Augustus 2007. This contract was partially meant to overcome the delay from the in-situ concrete works, which will be described hereafter. For these Antifers a precast yard was installed directly next to the batch plant. The actual production of those Antifers was done by Gulf Beach as a subcontractor of MCQ, MCQ produced the ready-mixed concrete. A lot of everyday issues had to be dealt with by staff from MCQ, because Gulf Beach was lacking human resources and above all, qualified and experienced manpower. Towards the main contractor, Ras Laffan JV, it was never really clear that Gulf Beach made these Antifers and not MCQ. This situation was one of the first causes for a lot of misinterpretation between MCQ and the Ras Laffan JV and where the relations started to decline.

Figure 26, Pre-cast yard for the production of Antifers

The original planning for the main contract, the production of the in-situ concrete, had a time span of 24 months and a daily production rate of 350 m^3. The concrete works were supposed to start within three months of the signature date of the contract, which was July 2006. In order to be ready to fulfil the obligations of the main contractor, the batch plant was operational and calibrated in October 2006. Due to difficulties between the main contractor and the client concerning the design of the breakwater itself and the design of the in-situ road, the in-situ concrete works on the breakwaters only started in July 2007. In the period from November 2006 until July 2007 a lot of unclearness and friction arose between MCQ and the Ras Laffan JV. It was never clearly stated how long the delay would be and what the effect would be on the time schedule and daily production rates. On some occasions in this period the civil works department from the Ras Laffan JV asked MCQ for a delivery schedule of the ready-mixed concrete. In that case MCQ would have had to decide about the construction sequence, a task which is obviously the responsibility of the main contractor.

The contract contains two clauses which are worth mentioning here, these determined the management of the works.
The first clause mentions temperature restrictions for the ready-mixed concrete. The temperature of the fresh ready-mixed concrete is allowed to be 32 degrees Celsius, measured at time of placement. If a trip to the end of the breakwater is considered to take maximum 45 minutes, the temperature at the batch plant should be some degrees under this maximum. A safety margin should also be incorporated to be able to absorb unforeseen conditions. There is no restriction on the maximum temperature during hardening mentioned in the contract.
The second clause mentions that all testing has to be performed by an independent third party. Most of the testing requirements are based on British Standards and the contract contains quite a lot of different tests at a high test frequency.

1.3.2 Work method for the in-situ concrete roads

The work method for the construction of the in-situ roads is straightforward. A thin strip of blinding is poured on the locations where the formwork has to be placed. Then the formwork is erected and the bay can be poured. There is no reinforcement and there are only some small embedded items like PVC pipes for cables. MBK started production with pouring one bay per day in the evening times to limit the effects of the hot weather on the pouring activities and the fresh concrete. After a period of learning and optimising the process, the production increased to two or three bays per day. In ready-mixed concrete amounts this means about 540 m^3.

In December 2007 SBK started with the construction of the in-situ road. From this period on, MCQ had to produce concrete for both MBK and SBK. As already mentioned before, Gulf Beach was responsible for the transport, pumping and placing of the concrete. In this period there were ongoing problems with the concrete pumps, which caused severe delays and a lot of frustration to the Ras Laffan JV. There were two concrete pumps available, one with a 43 meter boom and one with a 32 meter boom. Around January 2008 a third, 36 meter concrete pump was bought. A big part of the concrete pours could not be performed with the 32 meter pump, because the boom was too short.

A typical production day would consist of the pouring of two to three bays at MBK from 15:00 pm until 03:00 AM and then the pouring of two bays at SBK from 06:00 AM until 13:00 PM, which sums up to a total daily production of around 900 m^3. This timeframe never worked and every day would face problems in achieving the planning. Most of the problems in this period relate to the pumping of the concrete. There were three Filipinos operating those concrete pumps, but there was only one experienced pump operator among them. Inferior quality of pump lines and fluctuations in consistency of the ready-mixed concrete led to a lot of bursts in the pump lines and complete blockages of the concrete pumps. During a period of about two weeks this happened every day. What would happen afterwards is that the pour would be finished with another concrete pump and the whole pour would be delayed. This would mean that the concrete pump would not be on time at the other site. Because MBK and SBK were two independent contractors, they would insist that their planning would be respected, in despite of the planning of the other contractor. Gulf Beach had no manager or spokesperson for the pumping and transport so all the problems would be directed to MCQ.

1.4 Production characteristics

This part will describe the production characteristics. In the first section the raw materials are described, followed by hot weather arrangements. At last, the production of ready-mixed concrete is described.

1.4.1 Raw materials

The raw materials used for producing the ready-mixed concrete are standard materials which are applied all over the world. These materials are:

- Sulphate resistant cement
- Fine aggregates (sand 0-5 mm)
- Coarse aggregates (5-40 mm)
- Fresh water
- Admixtures

The fact that there is only one mix design for the whole contractual amount of ready-mixed concrete annihilates the need for different types of raw materials, e.g. other cements, different types of fine- and coarse aggregates. This eases the raw material logistics and reduces the chances to a faulty concrete mix delivery.

The origin, travel distance, means of transport and lead time of the raw materials vary greatly per type of material. In table 2, the most significant logistic characteristics are shown. The first column shows the type of material, the second the company where the raw materials are procured from. Then it shows from which country they come, the travel distance, the means of transport and the lead time between order and delivery.

Material	Supplier	Origin	Distance [km]	Means	Lead time
Water	RLIC	Qatar	10	axis	12 hours
Fine aggregates	QSTP	Qatar	120	axis	24 hours
Cement	QNCC	Qatar	80	axis	2 days + prior payments
Coarse aggregates	Stevin Rock	U.A.E.	650	Barge	1 week + customs clearance
Admixtures	Betontechnik	Austria	4000	Sea freight / Container	6 weeks + customs clearance

Table 2, Overview of logistics characteristics

The materials which come from outside Qatar need to be cleared by the customs department in the port of arrival. These clearings can take from a few hours up to a week, Especially around Islamic holidays (Ramadan) one should take extra possible delays into account.

Due to the monopoly of the local cement manufacturer, QNCC (Qatar National Cement Company), the required amounts of cement have to be paid before any delivery is made to the customer. Import of cement by barge from any other country is not legally forbidden, but there is no registration of a successful attempt in history. On one occasion, the transport of cement was interrupted by QNCC. The official statement was that their drivers were on strike. The following day all customers of QNCC received a fax which showed that transport prices had risen 200%. To receive cement again, the only option was to agree. The following day the same drivers and trucks showed up as if nothing had happened and it is not very likely that those drivers received any increase in their salary. This event shows the volatility of the local industry and the unforeseen conditions that can occur in Qatar.

Concerning the other materials; the water comes from within Ras Laffan Industrial City (RLIC). This is because no water trucks are allowed to enter the Ras laffan area from outside, based on a regulation of RLIC. The fine aggregates come from Umm Babb, a quarry in the south of Qatar. They are transported by a subcontractor to RLIC by axis. QSTP (Qatar Sand Treatment Plant) supplies washed sand with such a high water content that customers pay for expensive water instead of sand! The coarse aggregates are Gabbro igneous rock and come from Ras-Al-Kaimh in the United Arab Emirates by barge.

Table 3 shows the characteristics of the stockpile. The first column shows the material type, the second how the material is stored, the third the capacity of the stock and the last column gives the equivalent of how many cubic meters can be produced with a full stockpile of each material.

Type	Storage type	Capacity	Equivalent of fresh concrete [M3]
Water	Tanks	100 m^3	680
Flake Ice	Air-conditioned container	60 metric ton	600 - 1500
Fine aggregates	Open stockpile	40.000 metric tons	55.000
Cement	Silo's	900 metric ton	2.500
Coarse aggregates	Open stockpile	15.000 metric ton / type	28.000
Admixtures	1 ton Containers	60 containers	15.000

Table 3, Stockpile characteristics

During the whole period the researcher was present in the field there was no planning present for the raw materials. The stockpile was monitored on a day to day basis and there was nothing that would warn for a shortage of materials. The deliveries were recorded in the control system of the batch plant, but this only tracks actual deliveries and has no planning purpose. The researcher tried to implement a simple sheet on the computer which calculates the lead time with forecasted production and automatically warns if a specific material would run out of stock but this system was ignored. It happened two times that the admixture was out of stock. The first time was in May 2006, during the production of the Antifers and the second time was in December 2007, on these occasions an admixture from a different source was used.

The coarse aggregates were delivered by one barge which sailed between the port in U.A.E and the port in Ras Laffan. In September 2006 there was a full stockpile of all coarse aggregate sizes. Because of the delay of the in-situ road, the available quantity would be sufficient until September / October 2007. Hereafter it would happen a few times that a particular size of the raw materials would be out of stock. Once there were aggregates arranged from another batch plant in Ras Laffan and sometimes the different sizes of aggregates would be mixed in the hoppers until a new shipment arrived.

The cement was delivered on a daily base except for Friday's; this is a free day in Islamic countries. When the production increased significantly from November 2007 on, Gulf Beach transported a part of the cement parallel to the deliveries from QNCC themselves. The available stock of cement was often below 100 tons. This would be sufficient for a production of around 300 m^3. With a production rate between 600 to 900 m^3 a day, the cement was often consumed straight after delivery (and thus being very hot).

The sand was transported by Gulf Beach. It depended on the amount of waiting trucks how long the delivery would take. Sometimes the trucks would have to wait 30 hours to get loaded. If they left a gap to the truck in front of them, they would be overtaken by other drivers from further down the queue meaning the drivers didn't get a rest during waiting. In October / November 2007 the stockpile was so low, that the sand which was delivered was almost directly used for the production. As earlier mentioned, the sand was extremely wet when delivered. This would result in problems with the dosing of the sand which would result in incorrect batch tickets.

The water was delivered from a central water supply point inside Ras Laffan. A lot of times the supply of water would be in the afternoon, just before the supply of ready-mixed concrete was planned to start. This would not give enough time to cool the water to the needed temperature. On one occasion the supply was interrupted for 1.5 day because of a broken pump at the supply station. This meant that production would be cancelled for the duration of this breakdown.

The fact that the in-situ concrete did not start before August 2007 had quite an influence on the deliveries of raw materials. Until October 2006 it was presumed that the production would start within a few months as mentioned in the contract. From December 2006 until August 2007 only a small amount of raw materials were needed for the production of the Antifers. When the production for the in-situ road started, MCQ had to arrange renewed delivery schedules with all their suppliers.

1.4.2 Hot weather arrangements

In a hot climate like in Qatar, precautions have to be made to produce ready-mixed concrete which meets the contractual requirements. The main issue which has to be controlled is the temperature of the fresh concrete. In order to achieve the required temperature, a water chiller and a flake ice plant were installed at the batch plant. The water chiller cools down the temperature of the water to approximately 4 degrees Celsius. The water is stored in white water tanks to reduce the effect of heating through solar radiation. The flake ice plant uses the water from the water tanks to produce flaked ice. This ice is stored in an air-conditioned container and transported to the batch plant with a screw. The ice, which is added in the concrete, replaces a part of the free water.

As mentioned before, the fine- and coarse aggregates are stored in an open stockpile. A separate small so-called ‘daily stockpile’ is located besides these stockpiles and is shaded to prevent heating through solar radiation. The shape of this shaded area does not provide enough shadow for the daily sunshine between 7 AM and 4 PM; hence, the temperature of the aggregates on the daily stockpile does not differ significantly from the temperature of the aggregates on the general stockpile.

During the hot weather period in the summer of 2007 a sprinkler system was installed on the aggregate hoppers at the batch plant. The purpose of this system was to cool the aggregates with chilled water. This method had quite a good effect on the temperature of the aggregates, but it’s forbidden by local and international standards as the QCS and the ACI. The sprinklers influence the moisture of the aggregates in an uncontrolled way. If the aforementioned daily stockpile was designed to have more effect on the temperature of the raw materials, there would probably be no need for arrangements like this sprinkler system.

For the cement and the admixtures no special arrangements regarding temperature control are implemented. The admixture has a dosing of about 3.4 to 6 kg/m^3 so the influence on the temperature of the fresh ready-mixed concrete is very small. The cement in contrary can get very hot inside the silos when the sun is shining for 10 hours in a row on the steel. Most of the cement which is delivered is fresh from the mill with a temperature around 60 degrees Celsius. Cement which is stored in silos cools down very slowly. This results in a significant influence of the cement temperature to the temperature of the fresh ready-mixed concrete.

The flake ice plant which was present at the batch plant was not operational for all of 2007. An ice plant is a complex piece of machinery and requires a skilled and experienced technician to install, operate and maintain it. The electro-technical installation of the ice machine was done together with the installation of the batch plant, in September 2006. An Austrian mechanic and two Egyptian mechanics did small mechanical installation work in the period of February 2007 until June 2007. When the ice plant was needed in June 2007, it was not operational. A Syrian service technician was able to start the ice plant, but the production of ice was small and often interrupted by malfunction alerts.

Due to the fact that an ice plant consumes a lot of electricity, there was an arrangement with the Ras Laffan JV that they would supply the electricity from their generators. When MCQ wanted to start up the ice plant they did not have enough capacity to deliver the needed electrical power. After some discussion, it was agreed that MCQ would buy a generator and that the Ras Laffan JV would bare a part of the costs because they could not hold up their end of the deal. There is no such thing as an electricity grid in Ras Laffan so everyone needs to arrange its own electricity supply. A suitable generator was ordered and had a delivery time of about six weeks. The generator was then delivered without a fuel tank. For a month the fuel came directly out of a fuel drum, which would last 1.5 hours when the ice machine was at full production rate. Besides that, no one ever thought of the idea that a generator also requires maintenance.

The production of ice was never sufficient to keep up with the production rate of the batch plant. To achieve the needed fresh concrete temperature during the hot weather season of 2007, ice was bought at an ice factory 20 kilometres outside Ras Laffan. First, the ice was simply added and the approximate amount of water would be deducted from the mix design. This is of course not a desired situation, so the ice had to be discharged through the ice plant over the weighing scale. Because the ice factory had no transport available to deliver the ice, it had to be collected by a driver from MCQ. Some period later, the ice factory would deliver the ice, but then there was always a problem with getting a gate pass for the driver (as described by the complicated procedures at the beginning of this appendix).

From the very beginning it was the intention to install an alternative system for decreasing the temperature of the fresh concrete. The two largest sizes of the coarse aggregates would be cooled in insulated storage silos through immersion in cold water. This was also one of the main reasons that MCQ acquired the contract to deliver the in-situ concrete to this project; they convinced the main contractor of their alternative cooling system and the advantages. This aggregate cooling system would be connected to two batch plants with each a production capacity of 150 m^3 / hour. The work on these batch plants started around August 2007, but progressed very slowly. The main contractor organised several meetings and demanded a planning of the activities, but the process did not speed up at all. The main contractor was of course eager to have this batch plant finished before the hot weather would arrive. At the beginning of January 2008, the main contractor allocated two people who had to closely monitor and if needed even take over control of activities to erect the second batch plant with the cooling system as soon as possible. In the end, the system was operational for the hot weather season of 2008 and delivered acceptable concrete temperatures.

1.4.3 The production process of ready-mixed concrete

The batch plant as used in Ras Laffan is an automatic controlled batch plant. This means that the production process can be completely autonomous, without the need from operators to interfere. The operating system from the batch plant uses an advanced GUI (graphical User Interface) which gives the plant operators a real-time insight on the processes and the ability to interfere easily if needed. For more understanding, one could compare the GUI from the operating system at the batch plant with a windows-style GUI which also allows its users to give commands with mouse clicks without the need to give instructions with difficult commands.

In case of a malfunction or a system failure, the plant operator should be able to solve the problem himself. In case of a shutdown of the mixer during the mixing of concrete, it is an urgent matter to prevent the concrete from stiffening inside the mixer. This requires sufficient understanding of the control system and the correlation with the physical mechanical installations that are connected to it. The German plant operators who were first present possessed this knowledge and maintained the batch plant properly. They instructed the Filipino plant operators who arrived around November 2006 and February 2007. These new plant operators where unfamiliar with sophisticated machinery like in Ras Laffan. Their previous experience was mainly with old analogue equipment on projects where the requirements for high quality concrete were not that strict. They had quite some difficulties to solve problems on the batch plant and to maintain the equipment in a good manner.

1.5 Quality

The quality of the ready-mixed concrete had to be controlled and assured by tests on fresh and hardened concrete. The amount of tests as prescribed in the contract is quite much and all these tests have to be performed by an independent third party laboratory. In the very beginning of the expansion to Qatar it was the intention that these tests were to be performed by Betontechnik, the supplier of the admixtures and a long-term partner in testing for Mobil Baustoffe in Austria. Because Betontechnik was not able to find a suitable local partner to establish a company, MCQ had to find another third party to perform all the needed tests for them. There are a few companies present in Qatar, which have the equipment to perform all the needed tests. However, all those companies have one thing in common: a lack of qualified manpower. Bodycote is the only laboratory in Qatar with an ISO 17025 certification. This certification is based on ISO 9000 series and is specially designed for laboratories. It is mainly due to the background of the British mother company that they have this certification. MCQ decided to appoint Bodycote as their independent partner for all concrete tests. However, MCQ did not study the appendices to the contract in an appropriate manner so they did not had a good overview of the amount of test and the needed equipment that was needed for a daily production rate of 900 m^3.

Soon after the start of the production of the Antifers started (December 2006), it appeared that Bodycote could not provide a permanent employee on site before February 2007. Officially, this would mean that all tests performed in this period would be invalid. The employee which Bodycote staffed at MCQ from February 2007 on arrived one week earlier fresh from the Philippines. This employee had a little bit of experience from a laboratory in the Philippines but had never worked independently and was not aware of any quality standards and work methods. To cut a long story short, the technicians from Bodycote only knew how to perform the requested test and nothing more. They could not give an interpretation of the result, nor did they knew the need for the test. This issue cannot be solely allocated to the responsibility of Bodycote because MCQ was not clear at the start about their requirements on Bodycote. However, Bodycote received a copy of the complete appendices of the contract regarding testing so one could expect from a professional company that they try to serve their clients adequately and inform them if they observe any variations between what the client requests and what should be performed according to the contractual documents.

For the approval of the concrete mix a laboratory trial mix and a full-scale trial mix had to be performed. This laboratory trial mix had to be cancelled three times while it was halfway in action. The first time there was no qualified concrete technician present, the second time the samples for the tests were not properly prepared and the third time the equipment for the tests were not available. Every time there were at least two persons present from both the client and the main contractor, all of them where frustrated about the unprofessional performance.

As is stated in the contract, a slump test had to be made from every truck. The requirements for this test are to be set in the mix design, so it's up to the production manager and the mix designer to find a range for the slump which results in a good workable concrete that complies with all requirements. For a long time it was not clear for all parties what the range of the slump could be. It was either 75 - 120 mm or 90 +/- 20 mm. The client was confused what they had to accept and again frustration arose. Normally, any variation to the mix design is done with the dosing of the plasticizer. The amount can be in- or decreased to adopt the workability of the concrete mix. This was not allowed by the client in this case and resulted in fluctuations of the workability which led to unneeded rejections of concrete trucks loaded with fresh concrete. The workability fluctuates if the properties of he raw materials change, in this case especially the coarse aggregates and cement quality was fluctuating.

All these described issues with Bodycote had a significant influence on the relationship with the main contractor and the client.

1.6 Communication

The communication with the main contractor mainly took place with its civil works department and the QA/QC department. The civil works department has the supervision of all the concrete works involved in the project. The concrete works division consisted of one European department head, two European managers and two Filipino assistants. The Europeans had a leave schedule of 8 weeks on and 4 weeks off, which often made it quite often difficult to get things arranged because agreements were not always communicated among the replacement managers.

All the written communication with the client officially takes place through the main contractor. In praxis this means that all letters and faxes are forwarded from the client to the main contractor and then to MCQ and vice-versa, whereby MCQ did not often write letters.

During the project a lot of complains from the client arose regarding concrete issues. These were mainly related to the following subjects:

1. Delayed submittal of test reports,
2. Concrete works in hot weather,
3. Health, Safety & Housekeeping.

Ad 1. The test reports from all contractual obliged tests have to be submitted to the client within a reasonable timeframe after completion of the actual test. These tests and the reports have to be made by an independent third party and they are also responsible for timely submittal of the reports. From the start of the project it nearly took a year until Bodycote established a proper rhythm regarding submittal of test reports. The client often complained about this issue and organised meetings with all parties to solve this.

Ad 2. The hot weather requirements on the concrete quality were a maximum fresh concrete temperature at time of placing of 32 degrees Celsius and a maximum temperature difference of 25 degrees Celsius between the surface and the centre of an element. Soon after the start of the in-situ concrete works, some temperature measurements started. These showed a temperature differential of more than 25 degrees between the surface and the centre. This could detrimentally affect the quality of the structure whereby the biggest risk is the occurrence of thermal cracks.

Another item that raised concerns at the client was evaporation rates of fresh concrete. A combination of high solar radiation, high wind speeds and low humidity leads to a high evaporation rate of fresh concrete. This leads to shrinkage and cracks and influences the quality detrimentally. During the production of the Antifer blocks, this was within the responsibility of MCQ as they were the contractor for the construction of these prefabricated blocks. There were some remedies implemented like cover sheets to prevent the evaporation, but only after considerable complains from the client and the main contractor.

Ad 4. The housekeeping and safety precautions of the site around the batch plant were very poor. Only after more than half a year after the production started were waste containers and sanitary facilities available for the employees. According to the contract with the main JV there had to be a health & safety supervisor allocated in the organisation of MCQ. In reality all health and safety issues were widely ignored and neglected by MCQ. On one occasion two employees were seen by the safety department of the Ras Laffan JV, on a ladder which was standing in the elevated bucket of a wheel loader. This unsafe behaviour was allowed by the management of MCQ and the employees were dismissed from the construction site. Safety regulations around the batch plant were poorly organised which resulted in many small injuries and accidents.

Besides written communication, there is of course also direct, in-person communication with the client. They are often present at site and want to get information about the products and services they are buying. In praxis, this means that the client is mainly interested in quality related issues and test results from the fresh and hardened concrete. They are present at times samples of raw materials are taken and when concrete test cubes are tested on compressive strength. The management from MCQ was not very service oriented towards the client and did not show any effort in providing them with the additional information or answering their questions. This did not improve the trust from the client in MCQ.

Most of the client's employees are Indian and a few are Filipino. The latter make it quite difficult for Europeans to interfere if they are in a conversation with fellow Filipinos. You never know if they translate 100% of what they have discussed so it gives you far less control in a situation. In some situations it gave the management of MCQ the impression as if they were left out and they did not exactly know what was discussed. This caused frustration to the managers of MQ, especially in cases there was a problem with the concrete production and the client was present.

1.7 Manpower

There is not very much manpower required for the operation of a batch plant. Depending on the timeframe of the production 2-3 plant operators and a production manager would be sufficient to fulfil the job appropriately. During the periods of August 2006 to December 2006 and January 2007 to July 2007 there were two plant operators from Germany present. The first one left because of problems with the production- and general manager and the second one didn't want to work abroad anymore and wanted to be re-united with his family.

In November 2006, a plant operator from the Philippines arrived and in February 2007 another two arrived. These plant operators had some experience in operating a batch plant, but not in such a sophisticated automatic batch plant as was present at MCQ. Training of these plant operators was done by the plant operators and the production manager on a very practical level. There was a big language barrier present, both the ‘students’ and the ‘teachers’ were not fluent in the English language. Besides that, a part of the operating system was not translated in English and still occurred on the screen in German. The instruction manuals were in German which also did not assist the Filipino operators. All in all, the education resulted in the situation where the Filipino operators could operate the batch plant and produce concrete with the required quality, but as soon as some unforeseen things happened they often did not know how to handle and solve these problems.

A typical working week would consist of 6 working days of at least 12 hours each. A normal day would start around 7 o’clock in the morning and was finished around 7 o’clock in the evening, depending on the situation that day. During the period that the in-situ concrete works started in July 2007, the hot weather season was at its maximum. Working in the period from May until October differs significantly from the rest of the year. In this period, the ambient temperature rises up to 50 degrees Celsius and seldom drops below 30 degrees Celsius at night. Working under time-pressure in hot weather decreases the output of employees significantly. In combination with 24 hours operation, it has to be notified that under such circumstances it is likely that people make more mistakes in comparison to ‘normal’ conditions. If the necessary amount of employees is planned, this fact can be dealt with. However, at MCQ there was often a under capacity at the batch plant which means the plant operators had a lot of different tasks at the same time.

The employees from European origin had an agreement for a leave schedule. This would be 8 weeks working in Qatar and 2 weeks leave in Europe. Such an arrangement is seen at many companies in this region. The conditions under which one has to work are harsh and the fact that the employees are separated from their family make it a necessity for such an arrangement. At MCQ, there was never a leave schedule. It was always arranged at the very last moment and other employees had to improvise and take over complete jobs from the people on leave, giving them a double workload. Often the periods which the employees worked were not 8 but up to 14 weeks and the leave was still 2 weeks maximum. The fact that one never knew if, when and for how long one could go on leave gave extra uncertainty in the everyday work situation.

The client from the project in Ras Laffan, QP, demanded a lot of paperwork to prove to them that the performed work met the requirements in the contract. This fact was completely neglected by MCQ. There was no administrative staff on site until June 2007. There were some Filipina women in the office in Doha for human resources and accounting, but they were not allowed to be on site in Ras Laffan. This was strictly forbidden by the C.E.O. of MCQ, the Qatari sponsor, because it would distract all the employees in his opinion. It was planned that some of the paperwork would be done from the office in Doha, but this never worked because all the needed data was present in Ras Laffan and the employees had no clue and no sense for what was required in the reports. In December 2007, there was theoretically enough administration staff present at site to arrange all the needed administrative tasks, but by then there was already such a backlog that it was very hard to implement an appropriate structure. An inconvenient detail in this is that one of the Filipino administration employees was 'persona non grata' within Ras Laffan in February 2008. This was because he was suspected of fraud with gate passes. This means another employee had to be allocated which also means a lot of time needs to be invested in training and education.

1.8 Organisational

On the organisational level a lot of unclearness about tasks, responsibilities and authorities existed. It was unclear how the relation with Gulf Beach was and who was working for which company.

Quite a lot of activities related to the production of ready-mixed concrete are outsourced to a subcontractor. This includes the transport of sand, the transport of cement partial and the loading of the aggregate hoppers from the batch plant. These activities are all performed by Gulf Beach, which is not by accident. Originally, it was the intention to acquire three price offers from different companies to get a reasonable price for these activities. This never happened in praxis. It is not hard to imagine that if one of the parent companies of a joint-venture is at the same time subcontractor for that same joint venture, a bias in objective judgement can easily occur.

The transport of the concrete is performed by Gulf Beach as a subcontractor of both MBK and SBK. Theoretically, this does not require any arrangements or interference from MCQ. At the requested time, MCQ loads the truck mixers from Gulf Beach and the only responsibility for MCQ from that moment on is the quality of the concrete. But

Gulf Beach had no supervision allocated to plan and control these activities. The personnel from MCQ had to deal with the everyday arrangements to achieve the daily completion of the concreting activities on top of their own jobs.

Gulf Beach and MCQ for long had one face towards the main contractor and the client. Although contractually seen the tasks of MCQ and Gulf Beach are clearly distinguished, in praxis it took until January 2008 before the main contractor tried to banish this situation. They successfully separated the responsibilities of MCQ and Gulf Beach which eased the situation at the construction site.

MCQ were ISO-9001 certified in November 2006. This was a strict requirement in the contract with the Ras Laffan Joint Venture. Before the official audit by TuV Sud-Middle East, Only a few trial mixes were made. Because the production had not yet started, there was no data available to test the practical outcome of the implemented management system. In obtaining the ISO certification, MCQ got assistance from a local consultant. This consultant, with an Indian background, had experience with the ISO certification of other companies in Qatar. These companies were not active in the concrete production. This lead to numerous difficult discussions and misunderstandings between the consultant and the management from MCQ. The consultant wanted a consistent ISO system and the management of MCQ wanted a system which was easy to work with and as little extra work as possible. Discussions often ended up at the point where the consultant asked a question like “how do you verify that” to what the management of MCQ would answer, “It is in the control system of the batch plant”.

1.9 Summary

These observations are a grasp of the relevant items for this thesis. There are many more, similar, everyday situations and experiences that underline the circumstances in which MCQ started their production in Qatar and the problems it faced. The observations as described here will be used to select critical incidents, see chapter 3.

2 Timeline Critical Incidents

The figure underneath shows a timeline from start of internationalisation towards Qatar until the end of the field observations of the researcher.

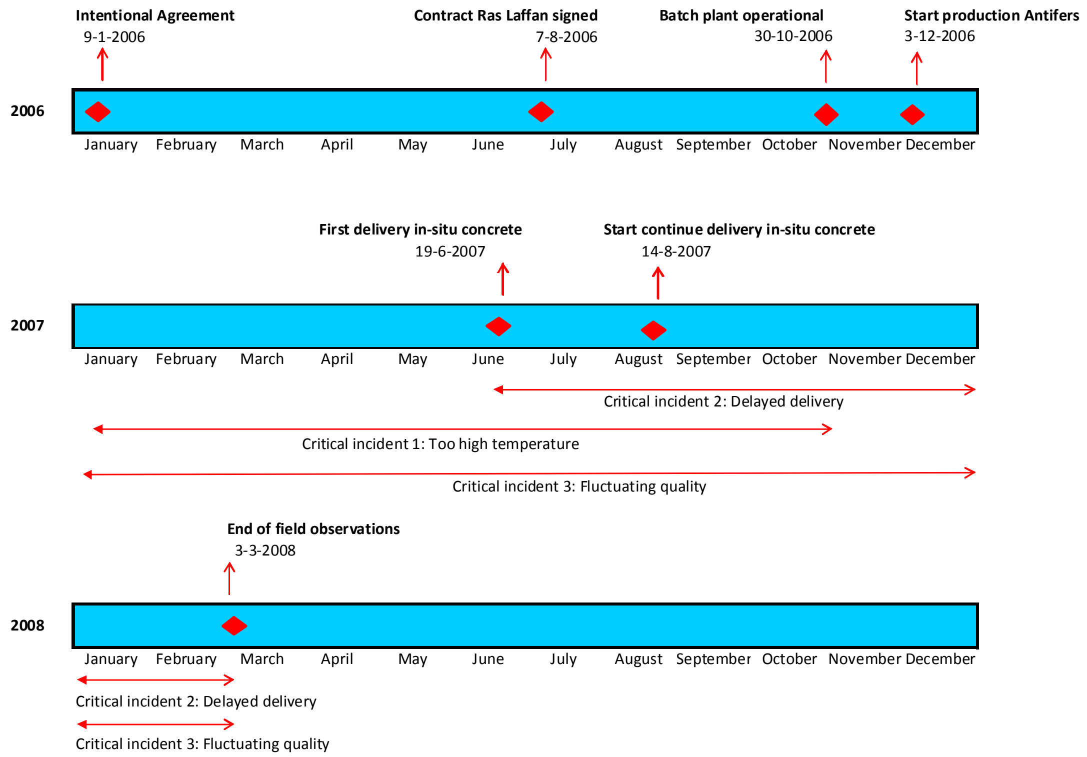


Figure 27, Timeline of Critical Incidents and important dates.

3 The Effects Of The Local Environmental Circumstances In The Gulf Region On Concrete

The performance of concrete is influenced by the local environmental conditions. Different climates have different effects on the performance. A distinction in climates can be made in macro- and micro climates. On a macro level, one can think for instance of severe freeze-thaw cycles in North America to relatively mild conditions in Europe to high ambient temperatures in the Arabian Gulf. On a micro level, there is a distinction between coastal areas, areas that are influenced by daily weather cycles and indoor areas that are hardly influenced by the environmental conditions. In most regions, these different circumstances are adopted in local standards to minimize the detrimental effects on the performance. In addition, in most parts of the world the demand for high performance concrete and the available technology evolved more or less synchronically in the last century. More knowledge about influences of local environments resulted in an update of the local standards and hence reduced the possible negative influences of local conditions.

However, in the Arabian Gulf this synchronic evolvement is not at all the case. When the demand for construction rapidly increased in the Arabian Gulf during the last 2 decades, there was no possibility for a gradual evolution of relevant 'Arabian concrete technology'. The construction industry had to acquire engineering- and production capacity from abroad as well as foreign regulations and standards to apply these documents to local contractual agreements. The adoption of information and guidance available for hot-weather concreting was not always appropriate as the environments of parts of the Arabian Peninsula are well outside the range of earlier hot-weather experience (Walker, 2002). Local materials were used without understanding their limitations, problems and correct proportions (Zein Al-Abideen, 1998). As a result, few of the possible problems were identified and deficiencies, mainly in durability, have resulted.

A survey in 1981 investigated the condition of structures near the eastern Gulf coast and showed a trend line suggesting that some structures would reach a terminal condition as early as 12 to 15 years after completion of construction (Fookes et al, 1981). In 1991, another survey (Fookes, 1991) showed that performance improved since the survey 10 years before, but the wide range of the results shows that only in the very best structures the performance will be equal to the level which is expected in less aggressive environments (Walker, 2002). Many of the problems have been recognized but improvements in the performance of new work will only result if there is a wider acceptance of the need for high standards. Some specification and general guidelines are available but they cover not all necessary aspects and not at the desired standard. Some experts even go further than region wide standards and spell the need for a concrete institute in the Gulf (Zein Al-Abideen, 1998).

To understand the need for more regulations, the causes and effects of the severe environmental conditions need to be clear. The characteristics of the environment are (Walker, 2002):

1. Temperatures are very high and solar radiation can considerably increase surface temperatures,
2. Salt contamination in coastal regions is high and the humidity can be very high with large seasonal and daily variations,
3. High rate of evaporation during the day makes effective curing of concrete difficult and condensation at night combined with windborne contaminated dust can lead to rapid deterioration,
4. Combination of high temperatures and high humidity make working conditions difficult or even dangerous,
5. Cement and clinker are imported from a variety of sources which might result in variations in their characteristics,
6. Some natural sources of raw materials may be contaminated or unsound,
7. Groundwater and sub-soils in coastal areas are likely to be contaminated with salts,
8. Potable water is considerably more expensive than in temperate climates. Great care must be taken to check that all water is suitable for its purpose.

Combinations of these characteristics make it more difficult to achieve a stable quality level than in moderate climates. Small shortfalls in quality have a major influence on durability in this region. There are two principal causes of durability problems with concrete (Walker, 2002):

1. Corrosion of reinforcement,
2. Expansive salts in the concrete itself.

Ad 1.

Corrosion of reinforcement only occurs if all the following apply: presence of moisture, oxygen and non-alkaline or chloride contaminated conditions. Normally the alkalinity of the concrete around the reinforcement provides an electrochemically ‘passive’ environment in which corrosion will not occur. This state can be lost by carbonation of the concrete or by the presence of chlorides. Influencing factors are relative humidity, permeability of the concrete and the cementitious content and type. In this case the design does not incorporate reinforcement, which means that for this typical analysis this items is not relevant. However, in most construction designs in the Gulf region reinforcement is present, so one still has to bear this in mind.

Ad 2.

Aggressive salts, particularly sulphates, can damage the concrete. Sulphates can move into concrete in two ways:

1. From adjacent ground and movement within the concrete by capillary action,
2. By movement through the concrete's pore structure, driven by evaporation of water from the surface.

Sulphate resisting cements helps to resist a chemical sulphate attack but cannot prevent it completely. A type of internal sulphate attack is Delayed Ettringite Formation (DEF). This phenomenon causes an expansion of the aggregates and results in severe cracking of the concrete structure. The causes and circumstances when DEF occurs are not widely agreed in the literature, but mix design specifications (cement and aggregate type) and ambient conditions (especially temperatures above 65 degrees Celsius during hardening) determine the occurrence of DEF. An aspect that makes DEF dangerous is that the formation of ettringite molecules takes place within 72 hours after production of the fresh concrete, while the effects only become noticeable after 5 to 10 years.

DEF is noticed several times in the Gulf region and has great effects on the performance of the concrete, therefore designers of concrete structures in this region are quite anxious for this type of sulphate attack to occur. It even occurred in the harbour of Ras Laffan in Qatar, as can be seen in figure 27. The severe cracking shows that the ambient conditions provide the possibility for DEF to occur.

Figure 28, Effects of DEF in Ras Laffan Harbour, as can be seen in the severe cracking of the concrete structure.

4 Concrete Characteristics

4.1 Description of concrete and hardening characteristics

Concrete in its basic form consists of cement, aggregates, water and admixtures. Cement is an active hydraulic binder, i.e. a "binder that sets and hardens by chemical interaction with water and is capable of doing so under water without the addition of an activator such as lime" (BS 6100, section 6.1, 1984). It is a heterogeneous material made up of several fine-grained minerals which are formed during the clinkering process. It is obtained by burning a mixture of materials comprising lime (CaO), silica (SiO_2), a small portion of alumina (Al_2O_3), and generally iron oxide (Fe_2O_3) at 1450 degrees Celsius (Soroka, 1993).

Mixing cement, water, aggregates and admixtures produces a plastic and workable mix. Workability is describes as 'the property determining the effort required to manipulate a freshly mixed quantity of concrete with a minimum loss of homogenity' (ASTM C152). In other words, it is the property which makes the concrete easy to handle and compact without a risk of segregation. These properties remain unchanged for some time, a period that is known as the 'dormant period'. At a certain point, the paste stiffens and looses its plasticity and becomes unworkable. This is know as the 'initial set' and continues until the paste becomes a rigid solid mass, the 'final set'. Consecutively, the hardened paste continues to gain strength, a process which is know as hardening. These stages are visually showed in figure 28.

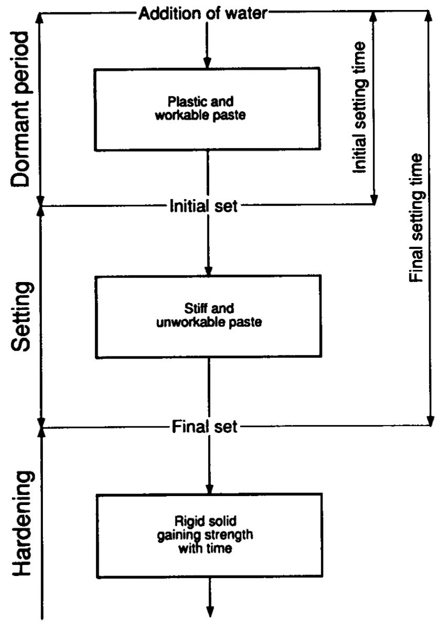


Figure 29, Stages of setting and hardening of cement paste (Soroka, 1993) .

In contact with water, the cement hydrates to give a porous solid, usually defined as a rigid gel. The hydration proceeds from the surface of the cement inwards over time, the rate decreases over time because it is conditional on the diffusion of water through the layer. The stages and composition of hydration products is visualised in figure 29.

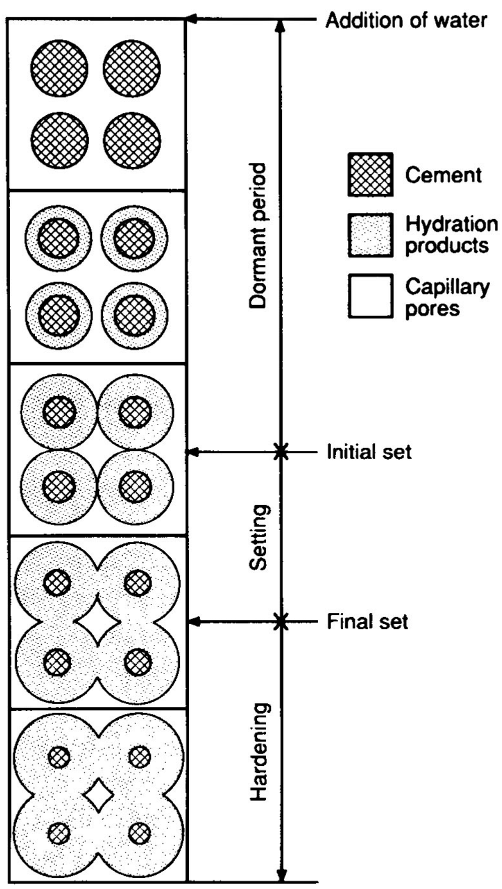


Figure 30, Schematic description of structure formation in cement paste (Soroka, 1993)

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The rate of chemical reactions, in general, increases with a rise in temperature. For the hydration of cement, the rate of the chemical reaction increases by a factor 3.59 at 50 degrees Celsius compared to the reaction at 20 degrees Celsius (Soroka, 1993), see figure 30. This fact is experienced in everyday practice and is widely used to accelerate strength development in concrete (for instance steam-curing).

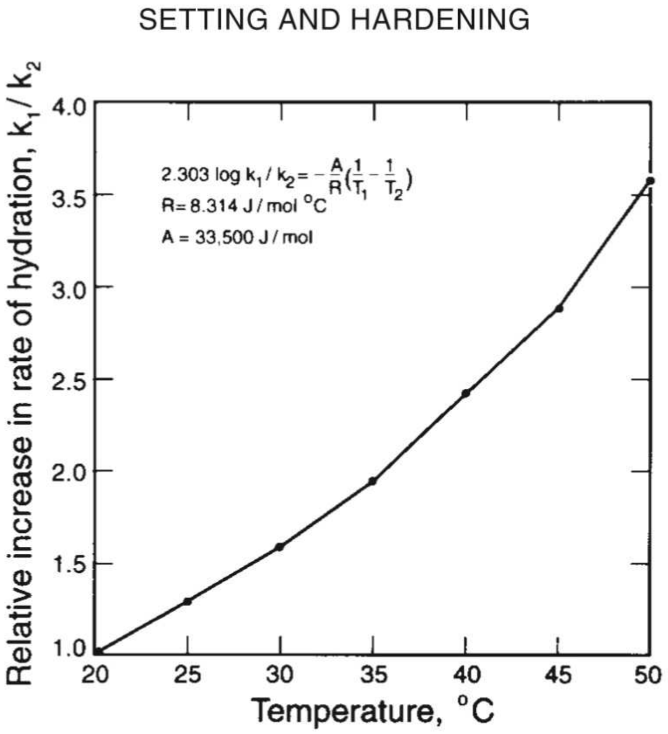

Figure 31, Effect of temperature on the hydration rate of Portland cement (Soroka, 1993) .

The accelerating effect of temperature manifests itself in implications that are relevant to concreting under hot-weather conditions. These include the reducing effect of temperature on setting times, accelerating effect on the rate of stiffening (slump loss) and an increasing effect on the rate of temperature rise inside the concrete. The increased rate of hydration implies that the cement combines with the water at a higher rate. The amount of free water in the mix is reduced and this increases the stiffening of the mix. The rate of stiffening is further increased by the more intense drying with the rise in ambient temperature. These combined aspects are shown in figure 31.

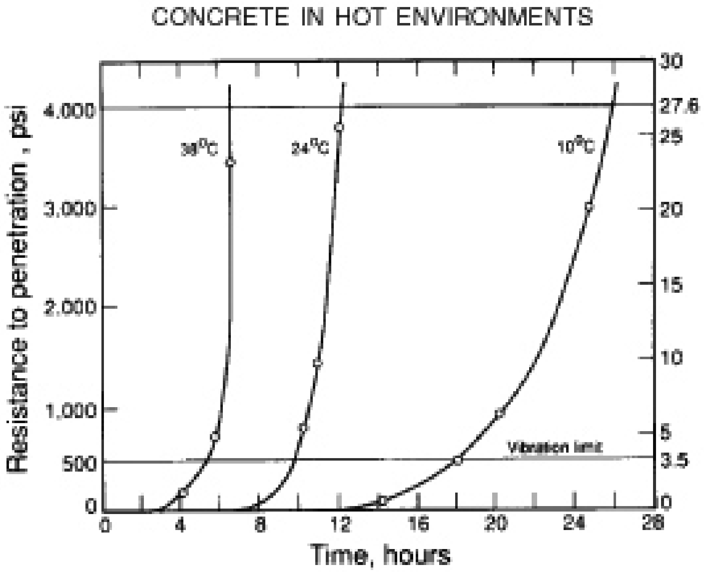

Figure 32, Effect of temperature on setting of concrete (Soroka, 1993) .

4.2 Cooling of concrete

The aforementioned detrimental effects of temperature on the durability of concrete can be reduced by cooling the concrete. Cooling of concrete can be divided in pre-cooling and post-cooling arrangements. The difference between these is whether the remedying arrangements are implemented in the stage where the concrete mix is designed and produced or in the stage where the concrete is placed.

Pre-cooling arrangements

These implementations try to limit the temperature development of concrete by choosing materials and proportions that have less temperature development during hardening and by producing concrete with cooled materials. A method to reduce the temperature rise in the concrete structure is the replacement of a part of the cement by mineral admixtures. These admixtures are either pozzolanic or cementituous. Common pozzolan admixtures are pulverised fly-ash and silica fume. The most common cementituous admixtures is granulated blast-furnace slag. The idea behind these components is that they contribute to the hardening of the concrete without introducing as much heat as ordinary cement would. The effect on the total heat of hydration in relation to the proportion of the replacement of the cement content can be seen in figure

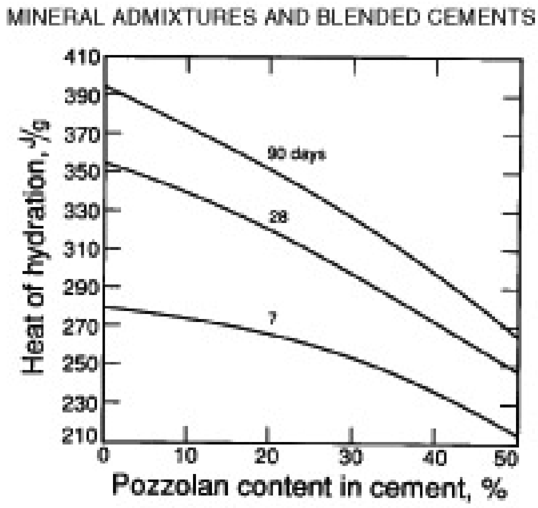

Figure 33, Effect of partial replacement of Portland cement with an natural pozzolan on the heat of hydration (Soroka, 1993) .

A practical example of the effect of replacing a part of the ordinary Portland cement with a pozzolan admixture on a mass concrete structure can be seen in figure 32.

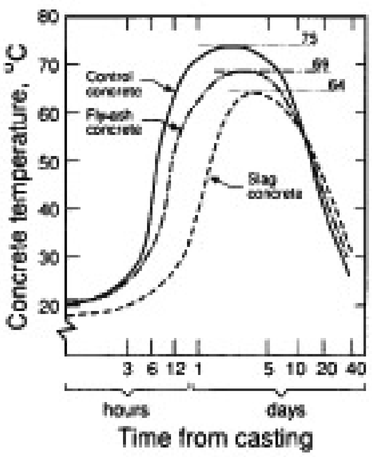

Figure 34, Temperature rise measured in mass concrete (Soroka, 1993) .

Another option to control the temperature rise is to reduce the initial temperature of the fresh concrete. This is an important aspect in conditions with high ambient temperatures because a lower initial temperature implies a higher initial slump and thus a better workability with the same mix design. The relation between these two parameters is shown in figure 34.

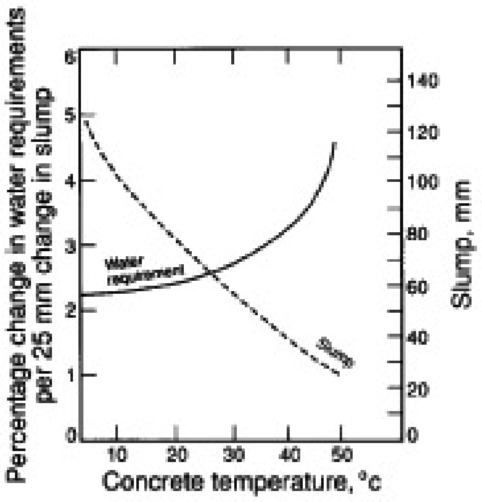

Figure 35, Effect of concrete temperature on slump and amount of water required to change the slump (Soroka, 1993) .

Lowering the fresh concrete temperature an be achieved in different ways. Some evident means concerning the batch plants are insulating water supply lines and tanks, shading of materials and production facilities from direct sunshine, painting drums of truck mixers and cement silos white. These means are used in conjunction with other means which are capable of lowering the fresh concrete temperature below ambient temperatures. These are the use of cooled materials and in particular the use of cold water or crushed ice. The coarse aggregates constitutes some 50% of concrete ingredients, therefore the use of cooled coarse aggregates will bring about a considerable reduction in concrete temperature. The most common method to cool coarse aggregate is by using cold water for spraying and shaded storage.

Post-cooling arrangements

Control of concrete temperatures after placement may be effectively accomplished by circulating cool water through thin-walled pipes embedded in the concrete (ACI 207, 1998). Depending on the size of the pipes, volume of fluid circulated, and the temperature of the fluid, the heat removed during the first several days following placement can reduce the peak temperature by a significant amount. An empirically derived value is that the maximum temperature decreases to about 17 degrees Celsius below the initial peak value (ACI 207, 1998).

The post-cooling arrangements are quite complex and expensive to install and operate and are in most situations only feasible on large mass concrete structures like dams.

5 PESTEL Analysis Qatar

A PESTEL analysis describes the political, environmental, socio-cultural, technological, economical and legal factors of a country. It provides an overview of macro-environmental factors which assists organisations in their decisions on their international operations and analyses market potential and –situations. The PESTEL template comprises six sections; Political, Economic, Social, Technological, Environmental and Legal. In this thesis, the PESTEL analysis is used to provide some basic background information about Qatar so that the reader can get a very broad impression of the country.

<table>
<tr><td>FACTOR</td><td>RESULT</td></tr>
<tr><td>Political
Regulatory bodies and processes
Political system
Government policies
Government term and change</td><td>Qatar is an Arabic Emirate with an absolute monarchy where the Al Tharni family ruled since the mid 1800’s.
The Emir of Qatar is not only head of state, but as well the head of government.
His role is influenced by continuing traditions of consultation, rule by consensus, and the citizen’s right to appeal personally to the Emir.
Although the Emir is accountable to no one, he cannot violate the Sharia, the Islamic Law. He must consider the opinions of leading notables and the religious establishment
The position of the Emir was institutionalised in the Advisory Council
Advisory Council is an appointed body to assist the Emir in formulating policies.
There is no electoral system.
Political parties are banned.
Qatar transformed itself from a British protectorate.
Politically, Qatar evolved from a traditional society into a modern welfare state.
The Consultative Assembly has 35 appointed members with only consultative tasks.
Human rights: The Qatari authorities seem to keep a relatively tight rein on freedom of expression and equality issues; however in comparison to neighbouring countries such as Saudi Arabia for instance, Qatar is relatively liberal.</td></tr>
</table>

Economic • Economic situation • Economic trends • General Taxation issues • Taxation specific to product/ services • Seasonality/ weather issues • Market and trade cycles • International trade/ monetary issues	• Petroleum is the most important product of the economy of Qatar (although LNG is likely to overtake this position spoon) and counts for more than 70% of total government revenue, more than 60 per cent of its GDP and about 85 per cent of export earnings. • Proven oil reserves should account for a continued output at current levels of roughly 23 years. • Qatar is an oil- and gas-rich nation, with the third largest gas reserves and with one of the highest GDP per capita in the world. (cp. HDI, 2009) • Production and export of natural gas are becoming increasingly important. • On the long run Qatar aims to establish the development of off-shore petroleum and the diversification of the economy. • According to the Human Development Index, Qatar is now the riches country in the Muslim world. • Qatar has tightened the administration of its foreign manpower programs over the past several years. Security is the principal basis for Qatar's strict entry and immigration rules and regulations.
Social • Media views • Ethnic/ religious factors • Ethical issues	• The Emir Sheikh Hamad increased the freedom of press since his reign commenced in 1996. • The Qatar-based Al Jazeera television channel (established in late 1996), is widely regarded as the only example of free and uncensored source of news in Arabic countries. • By law and Islamic customs the activities of Qatari women are closely restricted. Women are largely merely limited to roles within the domestic home. For instance are they not allowed to obtain a driver's license without the permission of their husband. (cp. Encyclopedia of the Nations, 2010) • 75 per cent of the people in Qatar are non-citizens who make up for the workforce, but yet are discriminated against and sometimes also mistreated. (cp. Encyclopedia of the Nations, 2010) • Public health services and education are free by the state through the Ministry of Labor and Social Affairs. • The Islamic religion is present in everyday life and has a big influence on business as well.
Technological • Research • Manufacturing	• Qatar is investing a lot of their revenues on improving of their Research & Development program.

maturity and capacity • Competing technology development • Technology access, licensing patents • Global communications • Information and communications	• Science & Technology parks are built lately to improve the worldwide position of Qatar. • The construction industry is quite straightforward and uses basic skills of mainly unemployed workers. • The supply industry contains basic goods but does not provide typical detailed product catalogues.
Environmental • Ecological/ and environmental issues • Environmental awareness	• Qatar is investing heavily in protecting and preserving the environment. • Sustainability and "green" initiatives are more and more important on all projects in the country. • SCENR is the Supreme Council for the Environment and Natural Reserves. Their duty is to issue policies to protect the environment.
Legal • Law enforcement • Acceptance of law enforcement • Justice • Role of court • Role of Police • Crime statistics	• The Sharia law determine inheritance and child custody matters and favours men. (cp. Encyclopedia of the Nations, 2010) • Qatar has a discretionary Legal System controlled by the emir, although civil codes are being implemented. Islamic law is significant in personal matters. • Qatar has a strict interpretation of its laws and orders. Therefore fines and punishments are executed highly. • Criminal rates are one of the lowest in the whole world. • Until nowadays corporal punishment is still allowed by the law, although amputation is not. (cp. Encyclopedia of the Nations, 2010) • The Basic Law of Qatar 1970 institutionalised local customs rooted into Qatar's conservative Wahhabi heritage – granting the Emir preeminent power.