Logistical issues in a transnational supply chain project

An on-site analysis

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Abstract

In a current context of important material deliveries, mostly produced in Europe and shipped to China, many standards need to be set, rules to be established, liabilities to be defined. However, most of the time, to implement these concepts, the issues need to be faced first, and that is the situation at the moment in the Taishan project.

The choice in this master thesis has been made to focus on the overall delivery process, as well as the package opening once delivered to China, to detail the transmission of responsibilities and the actions to be implemented in case of problems.

This issue is of the greatest importance in such a project of Engineering and Procurement of two complete EPR\textsuperscript{TM} reactors\textsuperscript{1}. It is not the same treatment when a problem occurs on a simple valve and when it occurs on a several thousands euros worth element. The thorough study of the supply chain illustrates the theory to point out the main elements of concern.

From Sub-suppliers until building erection, the main points are discussed to give the reader an insight of integrated supply chain.

As a consequence this master thesis introduces and discusses the supply chain-related processes in the Taishan project, to give a clear overview of the reality.

\textsuperscript{1}European Pressurized Reactor
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Introduction

Today in China, 10 GW of nuclear power are already operating, and 30 GW are in progress. Among these 30 GW, 2 * 1.7 GW are constituted by the two EPR\textsuperscript{TM} reactors of the Taishan project conducted by Areva NP\textsuperscript{2}. Even though, after the recent events that occurred in Japan, the growth of nuclear power in China has slowed down, the authorities are just waiting for further security studies to keep this development on track. In the end of 2011, the project was almost on schedule, but later delays are expected, due to the evolution of the relationships with the sub-contractors that sometimes occur, as well as the fact that many delivered items present problems such as non qualities, and even the crates (technical term for boxes) these items are packed in may be damaged, leading to a refusal from the Client and thus to the obligation of a crate return. Nevertheless, the two reactors are still scheduled to be operating by the end of 2013-beginning of 2014.

In this big project, one of the main points of interest is the supply chain management, as all items for the first unit are built outside of China, and thus need to be transported, which implies many processes and agreements.

The purpose of this master thesis project is to give a knowledge of the logistics process of a transnational project, and to illustrate these notions with the actual Taishan project, to understand the differences between theory and practice, and to understand the importance of elements such as the communication means, or the IT systems.

Regarding the delivery of items, a massive and comprehensive logistics system had to be put in place, with regards to the transnationality of the project and the tightness of the schedule. As a consequence this master thesis first introduces transnational logistics with a literature review, before looking more into the Taishan project plan of action, with an extension to the problems occurring at delivery. In the end, a discussion is held as a comparison of both point of views.

\textsuperscript{2}Nuclear Power
Chapter 1

Presentation of the company and the Taishan project

1.1 Areva, the first company in the nuclear power area

Areva is a French company which has been created in 2001 and has been run by Luc Oursel since June 2011. In 2009, there were 47,851 employees, and its commercial presence is in more than 100 countries. The rankings place Areva as the 6th French energy company (in terms of turnover) [5]. But in terms of nuclear power, it is the 1st one worldwide, with a total turnover for the year 2010 of approximately 9014 M€, which represents a growth of 5.1% like-for-like compared to 2009.

Areva has five domains of action as can be seen on the figure 1.1, which are, for four of them, related to the nuclear power from one end of the cycle to the other. The fifth one is Renewable Energy and develops wind energy, bioenergy, solar power and hydrogen power solutions. Concerning nuclear power, it starts with a Mining division, to extract the uranium. It is completed by the Front End which converts and enriches the uranium and designs the fuel for the nuclear reactors. Reactors and Services groups the activities of design and construction of nuclear reactors and propulsion and research reactors, and the activities of maintenance of the nuclear power plants. The Back End recycles the used fuel and provides transport, clean-up and dismantling services. This is why it can be represented by a cycle on the figure below 1.1. The intermediary units are more detailed on it, and allow to get a better understanding of the fuel life-cycle and of Areva’s actions.
These different activities can be summarized in the following diagram:

![Diagram showing Areva activities](image)

**Figure 1.1.** Areva activities

Areva’s main goal is to supply solutions for power generation with less carbon. Actually, nuclear power is the energy source that rejects the least carbon dioxide of all, as can be seen on the following graph [6]:

![Graph showing greenhouse gas emissions from electricity production](image)

**Figure 1.2.** Greenhouse gas emissions from electricity production
1.2. THE TAISHAN PROJECT

It has no carbon dioxide emissions, as the general principle is to heat water by radioactive emissions, water which is stored in a closed loop (Primary Loop), and this water heats water in a Secondary Loop, which drives turbines and thus creates energy, but without producing greenhouse gases. The only emissions are linked to the life-cycle, because of the necessary extraction, transportation and treatment of the fuel, but they remain low.

However, nuclear power suffers from a bad image, as the wastes it creates are radioactive and have a long life. Plus it is not yet known how to treat or recycle them, and as a consequence they are just transported in very controversial trains (people being afraid of the radiations), to waste storage locations, where they are buried, waiting for a more "sustainable" way to deal with them.

That is part of the reason why Areva is also developing its influence in the renewable energies such as wind power, even though it still remains negligible compared to nuclear power.

1.2 The Taishan project

This project is the biggest ever engineered by Areva. The contract consists in the design and procurement of two EPR™ (European Pressurised Reactor) in China, whereas the construction is left over to the Chinese customer which is the China Guangdong Nuclear Power Holding Corp. Ltd. (CGNPC), represented by the Taishan Nuclear Power Joint Venture Company (TNPJVC).

The Taishan Project implements 4 contracts under a global agreement. A specific and separate Memorandum deals with the overall organization in place for the Taishan Project. The NI EP (Nuclear Island Engineering & Procurement) Contract was awarded to a three-party consortium encompassing Areva NP (ANP), CNPEC and CNPDC, among which ANP is the leader. A Consortium Agreement governs the relationship between these 3 entities. The ANP Taishan Project manages all contractual and technical interfaces with the client and manages its contractual and technical interfaces with its subcontractors and suppliers. It coordinates the design, engineering, procurement, manufacturing, installation and commissioning activities of the relevant Areva entities according to their contribution to the Taishan Project according to the Contract. The project ranges from contract notification, amendment and negotiation till take over and final acceptance of Taishan Nuclear Islands by the client, in respect with contract provisions and associated budget agreed by top-level management. As summarized here after, there are multiple contract agreements within the Taishan project environment. The following stakeholders are involved at different level:

- **CGNPC**: stands for China Guangdong Nuclear Power Holding Company (CGNPC), one of the large business groups with nuclear power as its core business in China,
CHAPTER 1. PRESENTATION OF THE COMPANY AND THE TAISHAN PROJECT

- **TNPJVC**: stands for the client Taishan Nuclear Power Company. It is a Joint Venture (JV) between CGNPC and EDF.
- **CNPEC**: stands for China Nuclear Power Engineering Company. It is a subsidiary of CGNPC involved in the field of Project Management & Procurement.
- **CNPDC**: stands for China Nuclear Power Design Company. It is a subsidiary of CGNPC involved in the field of Design & Engineering.

The contract organization overview is the following:

**GLOBAL AGREEMENT**

**NI EP**
TNPJVC – consortium ANP/CNPEC/CNPDC

**NI TT**
CGNPC - ANP

**FA & EUP**
TNPJVC – ANP

**FA TT**
CGNPC – ANP

**Four contracts under a global agreement**

Consortium Agreement ANP/CNPEC/CNPDC

*Figure 1.3. Overview of the contract organization*

Within the global agreement, the 4 contracts are (in the same order as the picture above):

- nuclear island engineering and supply contract (NI EP)
- technology transfer contract relative to nuclear island (NI TT)
- supply of Uranium, enrichment and fuel assemblies fabrication services (FA & EUP)
- technology transfer contract relative to nuclear fuel (FA TT)

For each contract, the parties involved are written in the concerned boxes. In addition, all those contracts are covered by a Consortium Agreement between all
1.3. INTRODUCTION TO THE KEY NOTIONS

parties involved on the Supplier side (ANP for Areva NP, CNPEC and CNPDC).
The Consortium organization overview is the following:

![Organization of the Consortium](image)

**Figure 1.4.** Organization of the Consortium

The different parties, as well as their interactions are explained there, and for information, NI stands for Nuclear Islande, PLP for Primary Loop Package, and I & C for Instrumentation and Control. In green is the part regarding Areva, the Consortium leader, and in orange is the part regarding CNPEC, one of its partners, mainly responsible for the Engineering.

The Project Consortium has no common specific team, and works through a daily coordination between projects teams of all parties.

On a quantitative point of view, the net electric output which is to be installed is of $1.660\, MW_e$, while the reactor thermal output should be of $4.590\, MW$. This project mainly benefits to the customers in the way that the Taishan EPR™ project will bring a project certainty, an energy supply certainty, predictable business performances, an outstanding safety level and minimal environmental impacts.

1.3 Introduction to the key notions

The abbreviations that are to be used commonly are explained in the following table.
CHAPTER 1. PRESENTATION OF THE COMPANY AND THE TAISHAN PROJECT

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANP</td>
<td>Areva Nuclear Power</td>
</tr>
<tr>
<td>CNPDC</td>
<td>China Nuclear Power Design Company</td>
</tr>
<tr>
<td>CNPEC</td>
<td>China Nuclear Power Engineering Company</td>
</tr>
<tr>
<td>TSNPC</td>
<td>Taishan Nuclear Power Company</td>
</tr>
<tr>
<td>TNPJVC</td>
<td>Taishan Nuclear Power Joint Venture Company</td>
</tr>
<tr>
<td></td>
<td>(Owned by CGNPC (70%) and EDF (30%))</td>
</tr>
<tr>
<td>EDF</td>
<td>Electricité De France</td>
</tr>
<tr>
<td>CGNPC</td>
<td>China Guangdong Nuclear Power Holding Corp. Ltd.</td>
</tr>
<tr>
<td>NI</td>
<td>Nuclear Island</td>
</tr>
<tr>
<td>TT</td>
<td>Technology Transfer</td>
</tr>
<tr>
<td>EPR</td>
<td>European Pressurized Reactor</td>
</tr>
<tr>
<td>OPI</td>
<td>Open-Package Inspection</td>
</tr>
<tr>
<td>ECC</td>
<td>Equipment Condition Certificate</td>
</tr>
<tr>
<td>GVN</td>
<td>Good Variance Notice</td>
</tr>
<tr>
<td>CIN</td>
<td>Component Intervention Notice</td>
</tr>
<tr>
<td>NCR</td>
<td>Non-Conformance Report</td>
</tr>
<tr>
<td>TM</td>
<td>Trade Mark</td>
</tr>
</tbody>
</table>

Table 1.1. Common abbreviations

The Consortium is constituted of ANP, CNPDC and CNPEC, while the purchaser of the two EPR™ reactors is TNPJVC.

1.4 Project Management Procedures within the project

Project documents are custom made and are compliant with Areva NP Quality and Environment Systems. For each contract, a Quality Plan and a Project Management Plan are prepared to warranty:

- An optimized project organization to address client organization,
- The Contracts with the Client (and the Consortium Agreement) are declined in official procedures,
- The relevant regulations are declined within the projects,
- The contractual agreements and targets are met.

The Project Procedures will ensure that the Areva commitments are assessed and respected. Procedures shall be updated at any moment when required. A booklet of this procedures [8] is continuously updated and available to all members of the project.

The Taishan Project organization will follow Clients, Consortium and internal Reporting Procedures. On a monthly basis and according to the procedure, the
1.4. PROJECT MANAGEMENT PROCEDURES WITHIN THE PROJECT

Taishan Project Management will issue the respective Monthly Progress Reports corresponding to the relevant contracts.
Chapter 2

Working method and main goal

In this chapter will be introduced the way of working in this master thesis. To give a theoretical knowledge, a broad literature study will introduce the work. This review of PhD Thesis, research papers and different articles or studies is made from an objective point of view, with no regard to the project, but while keeping in mind that the main goal is to treat the supply chain of a transnational (Europe-China) project. By continuous contact with managers and engineers within the Taishan project, a clear illustration of the supply chain in this project is made.

2.1 Literature review

In order to get sufficient knowledge on the supply chain notions, and all related processes, a literature study has first been conducted. From researches in libraries, in manuals of the Taishan PMO\(^1\), and from the internet, information has been gathered to introduce the notions of supply chain, logistics, procurement, what is included in them, and the parallel processes such as the IT systems, whom understanding is necessary to grasp the complexity of the supply chain working field.

This part summarizes the information from an objective point of view, to give the reader a theoretical understanding of what the master thesis is about. No illustration is made with the Taishan project in part 3, because this is conducted later in the analysis part (chapter 9), where the theoretical knowledge faces the reality of the nuclear project.

2.2 Data collection

By data collection is understood the gathering of information about the Taishan project, in order to introduce the company, as well as the overall supply chain process, with its related issues.

\(^1\)Project Management Office
The main source of data in the project has been the everyday work within the PMO team, as part of its work is to write the working procedures, thanks to a continuous contact with the logistics and procurement managers, and even with the Client when problems occur. By being involved in the exchange of information, by being in touch with the major and minor problems, it becomes easier to understand the processes in order to write procedures and at the same time this master thesis.

2.3 Analysis of the general and specific elements of this project

To make a connection between the two previous parts, this final part illustrates the theory of chapter 3 with the customs of the Taishan project, to understand how reality varies from theory, and how no book can replace the experience of working in the concerned field of study.

After having introduced the reader to all necessary notions to understand the supply chain process, a broad knowledge will be given thanks to the comparison between theoretical sources and actual references from the biggest nuclear project ever. The main purpose of this paper is to give the reader a general comprehension of the specificities and difficulties of such processes, and to highlight the differences between literature that only gives basic and general notions, and real life experience. The singularities of this project will be introduced in both the general text and the analysis, and must be understood as examples characterizing the uniqueness of this project.
Chapter 3

Literature review

From PhD thesis, research papers, articles, studies and conferences, a theoretical introduction of the supply chain notion, and what is encompassed in it will be given. The known difficulties of a transnational project will as well be introduced.

The notion of Supply chain management, as defined in [9], can be explained as follows:

"Supply chain management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities [...], as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance, and information technology”.

It can be seen that in this notion, are included some others that need to be defined as well, such as logistics [9]:

"Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfillment, logistics network design, inventory management, supply/demand planning, and management of third party logistics services providers”.

Likewise, the procurement activities need to be introduced, as in [10]:

"Procurement is the acquisition of appropriate goods and/or services at the best possible total cost of ownership to meet the needs of the purchaser in terms of quality and quantity, time, and location”.

It must however be noticed that, as reminded in [11], Supply chain management is a relatively new process, and can be further explained as
"the integration of the activities [mentioned above in the definition], through improved supply chain relationships, to achieve a sustainable competitive advantage”.

As a consequence, and as expected, it is an improvement of the regular supply chain process the facilitates the communication and the relationships for a better overall efficiency.

The global supply chain evolution along the years can be found in the following figure [11]:

![Figure 3.1. Evolution of logistics toward supply chain](image)

where it can be seen that logistics evolved, to finally become fully integrated in the supply chain process, and make of this one a very thorough process including all the components of the linked activities.

It must also be said, as explained in the ACES (for American Consortium on European Union Studies) working paper [12] that it is not just a question of process, but as well a question of:

"procedures, supporting institutions, and business practices that link buyers and sellers in a marketplace for effectively managing the flow of materials from suppliers to final customers.”

It is thus a very comprehensive and exhaustive issue that requires a delicate attention, and dedicated departments within the entities. It starts at one end of the
cycle with raw material and continues to the other end with the final product and the user. In this same paper are distinguished four different types of flows that are:

- requirement information from buyer to seller which triggers all later activities
- the movement of goods from sellers to buyers
- transfer of ownership rights from seller to buyer
- and finally payment from buyer to seller

This highlights the complexity of supply chain processes, due to the interconnection of all those flows, and their related difficulty.

The main goal in a project is to keep these flows interdependent and continuous between the different stakeholders, either supplier, supplier’s suppliers, customer, etc.

Along with these flows, the IT system must work jointly, to ensure an optimal traceability of the elements and of the related forms. But this subject will be detailed later in this chapter.

As explained in the following schematic:

![Figure 3.2. The Integrated Supply Chain Framework [4]](image)

Logistics along with procurement are central in a project, and make the interface between the supply network and the market distribution network. The notion
“integrated” refers to the total implication of logistics in the supply chain, and the globality of the supply chain process from raw material to delivery. It also refers to the presence of information and knowledge flows along the chain, that are an addition to the regular physical exchanges. This integration is the current development of supply chain, and is a great progress to joint all project activities and flows in a common and general scheme.

Regarding more especially the logistics process, The National Export Initiative website [13] gives general guidance. It describes as well the common standards of packing, labelling and marking, as will be done in chapter 5. Among the inevitable standards are the Incoterms® [14], stated by the International Chamber of Commerce (ICC) and that set the rules for the commercial transactions (they will be further detailed in chapter 5.1).

As an addition to this introduction, the NEI1 website gives a non-exhaustive list of the common export documents, that can be used as a basis. Among the common export documents are:

- a Bill of Lading, i.e. a contract between the owner of the goods and the carrier
- a Commercial Invoice, which is, as its name suggests, the bill for the goods transfer of property
- an Export Packing List, i.e. a comprehensive list with information such as seller, buyer, shipper, invoice number, date of shipment, mode of transport, carrier, and itemizes quantity, description, the type of package, such as a box, crate, drum, or carton, the quantity of packages, total net and gross weight (in kilograms), package marks, and dimensions, if appropriate [14].
- an Electronic Export Information Form (Shippers Export Declaration)
- a Certificate of Origin
- in case the shipment is temporary, which occurs for the lending of tools for example, special forms are required, such as:
  - ATA CARNET/Temporary shipment certificate, to facilitate the temporary importation of products into foreign countries
  - Customs Certificate of Registration,

But as mentioned before, this list is not exhaustive and just gives an overview of the common forms.

The idea when delivering elements is to have the fastest possible process, and as explained in [15], the best way is to have an integrated supply chain to improve the speed and flexibility of the overall process, by setting points of inventory for

---

1National Export Initiative
the goods, but simultaneously having a moving process of the goods between these points. At the same time, and as Kilgore said [16],

"global trading today depends on an awkward flow of paper and misinformation"

Which points out the attention that must be drawn on both those elements, that are revealed as critical.

To cope with this huge amount of information and paper, every project of that scale now uses IT systems.

From a survey mentioned in [15], it is extracted that 90 per cent of the respondents were planning supply chain initiatives, but that only 18 per cent of them felt that their IT implementations adequately supported their supply chain initiatives. Note that this survey did not only deal with big projects. Anyhow, it can be seen that IT is now almost compulsory in all projects, but not all the time well managed. It is thus one of the main activities to develop in the near future, as its improvement will lead to a better overall efficiency.

But another important interest of that master thesis is the transnationality of the project, especially regarding the comparison between China and Western countries. That matter is treated in a recent study case from the Boston Consulting Group on the challenges in China operations [17]. It introduces the capabilities of China’s logistics sector as

"much greater than they were in the past"

This is why Chinese transporters (shippers in that case) are now great rivals to the Western firms, as they are maturing very fast and succeed to keep low costs and prices. In the near past (5 to 10 years ago), and as it is reminded by the author,

"Shippers would pack their trucks hazardly and secure their freight with a mess of ropes and tarps that could be untangled only at the final destination"

Now, this is no longer valid and the progresses they have made are so great that even in the case of fragile elements, Chinese logistics are chosen with regards to their price but as well to their skills. It is also reminded in this study that it is very long to ship item from China to the West, which is why, most Western projects occurring in relation with China must be aware that some items, either urgent or very fragile, will have to be delivered by plane. This is thus a parameter to take into account when signing a contract.

Another element raised in this study is the fact that by choosing a Chinese transporter,

"[it] will be cheaper and [there will be a] local knowledge and at least regional network coverage. But it can fall short in IT systems, standardized operations [...]"
Which shows how tricky the choice of the transportation company is.

The general idea of that paper is that, when planning a project with China, a big focus is to be made on the supply chain and logistics in general, as it is more difficult than between western countries. The extra-time required is to be taken into account from the start.

Apart from the logistics related problems, transnational projects may raise cultural issues, as discussed in [18]. These differences are known to:

”increase the risk of miscommunication and tension between partners”.

But however, it is stated that some studies

”provide evidence that cultural barriers are disappearing in countries such as China as organisations gain experience in these countries”.

It is not thus pointed out as a blocking point, but more like a way to improve the performances by taking advantage of some differences.

From the thorough explanation of what the culture is all about, Hofstede [19] [20] explains how the people’s differences can impact their exchanges, the communication between them. Plus the way the problems are tackled differs from one country to another, which adds to the overall complexity of problem solving in Supply chain processes. Such factors as the relative individualism of the people of different countries really impact a project in the way that it may cause incomprehension between them, and thus make the processes not optimal.

In addition with the cultural differences, the Chinese laws and regulations are complex enough to impact the development of a project, because as explained in [21]:

”The Chinese legal system and culture do not provide strong institutional support for compliance with domestic law. Chinese labour law is complex, made more so by provincial adaptations and exceptions in special economic zones.”

Which points out the difficulty of working with the country on both the cultural and the institutional point of views.

In this very same paper is also introduced the notion of responsible supply chain management, on an ethical point of view, which includes some requirements, such as:

• developing an ethical purchasing strategy
• mapping the supply chain
• undertaking research
• implementing ethical business practices
• operationalising codes of conduct and compliance mechanisms
• investing in independent monitoring and verification
• engaging in global collaboration
• investing in capacity building.

This is another point of view on the Supply chain management, but depending on the major chosen criterias, a compromise between the different definitions is often decided.

From this literature review, an overview of logistics and supply chain is given. It is shown as a core domain in a transnational project [22] and as the main reason impacting the relationships between Supplier and Customer during the duration of the project. It is proven to impact the performances and eventually characterize its success.
Chapter 4

Current context of the project, and organization of the teams

4.1 Context in the beginning of December 2011

When talking about the current context, it has to be reminded to the reader that nuclear power is in a critical path, following the Fukushima accident [23]. Because of the earthquake followed by a destructive tsunami, causing major problems to the Fukushima nuclear power plant, people start seeing nuclear power as a dangerous and unsafe source of energy. As a consequence, many countries like Germany have decided to progressively stop their nuclear power plants, and simultaneously, all countries are now more cautious before signing a several billion euros contract. Thus, even though new EPRs\textsuperscript{TM} have been sold to the UK, most projects are now on hold, which raises taskforce problems.

Regarding the project progress itself, it can be said that the second half of the year 2011 is especially characterized by the transfer of skills and people from France to China, in order to be closer to the problems and to enhance the reactivity. The project director introduced this transition to China under 3 mains objectives:

- Adapt the project organization to the increasing location of activities in China
- Strengthen the cooperation within the Consortium and reassert Areva’s role as Consortium leader
- Increase the communication with the Customer with a dedicated focus on:
  - the ramping-up in the technical assistance for erection
  - the setting up of the commissioning technical assistance
  - the cooperation on the erection and test schedule
CHAPTER 4. CURRENT CONTEXT OF THE PROJECT, AND ORGANIZATION OF THE TEAMS

The dome has been erected on the first unit in October 2011, and simultaneously the technical files encompassed in the NI TT\(^1\) contract concerning the 2\(^{nd}\) unit are sent to the customer. The 2\(^{nd}\) unit is to be erected by the customer itself, backed by its own suppliers, but Areva remains available to help in exchange of a financial compensation.

At the moment, the critical phase that has been entered regards site mechanical erection activities. In that process, the main concern is the arrival of elements in crates, as lots of non-conformances appear and need to be dealt with. The reference concerning the delivered items is the packing list, which states which and how many items are to be delivered. This is used in addition with the Areva software VPRM, further introduced in chapter 5.2.4.

4.2 Organization of the different teams within Areva

To give a better understanding of the processes, the different divisions of the NIEP Supplier, as well as the different kinds of engineers and managers need to be explained. The so-called OPI Site Team is constituted by engineers from both Areva and CNPEC that are working on site (Taishan) and that are the most direct interlocutors with the Client, as well as the ones having the best position to detect new issues. On the contrary, HO stands for Head-Office and deals with the matters from the Areva tower located in Paris.

Within these units, the engineers are divided into several types:

- **Engineering Discipline Leaders (EDL):** They are 7 in this project, each one of them responsible for its own scope, either Process & Safety, System & Piping, Instrumentation & Control (I & C), Primary components, Auxiliary components, Commissioning or Installation. They make sure that the design is consistent with the contractual and technical terms of the project. They help in the detection of the technical risks and the resolution of technical problems, and simultaneously they make the link between the engineering teams and control the budget, the plannings and the quality. They report to the Engineering Manager.

- **Project Managers (PM):** They are 5 in this project, each one of them responsible for its own scope and dedicated to equipments, Primary Loop Package (PLP), Instrumentation & Control (I & C), Auxiliary Equipment (AUX), Heating, Ventilation and Air Conditionning (HVAC) and Bulk or Site activities. Their teams are constituted of project engineers. They are responsible for the documents and the equipments of their respective scope.

- **Engineering Managers (EM):** His role is to be responsible for the whole technical part of the project. He manages all of the engineering entities, with regards to the internal procedures, the budget and the planning.

\(^1\)Technology Transfer
Moreover, a CNPDC-ANP common organization exists under the name of JDO (Joint Design Organization) and is on site.

## 4.3 Information exchange

When exchanging important information with the client, that may need to be referred to later on, or that represents an important milestone for the project, a simple formal e-mail does not constitute a sufficient proof and can lead to problems of responsibilities. To avoid such matters, the important information is exchanged via a specific mean called channel.

It always states who is the sender, the receiver, the date, the object, the reference of the channel (with a specific number, automatically incremented), and it has to be signed by the Deputy Project Director to make it official. All of the exchanged channels are kept available in a big database called Documentum. To send such channel, one must contact the PCO (Project Correspondence Office) which is the only department allowed to send them.

Every month, about 2600 channels are treated by the PCO, constituted of 7 persons. The fact that these persons are hired only to treat these channels makes that each channel has a cost, whether it is received from the Customer or from a Supplier, or if it is send by Areva NP. They have goals and part of the salary is reserved to improving their methods and the duration of treatment. After calculation, the channel cost has been set to about 14 € per channel emission or reception, but it is being re-evaluated, because the number of channels is not constant throughout the whole project, and the direction would like to save money on that particular issue.
Chapter 5

Shipment process of the project

Most of the items that are delivered to China are produced in Europe. Thus a transportation needs to be organized, and it has been proven that the cheapest way, even though not fastest, to transport material from Europe to China, is by boat. However, it can happen that some expensive, or urgent items be sent by plane, which leads to a different process (different forms, and different Incoterms®), not to be detailed in this report.

But regardless of the mean of transportation, the transnationality of the trip raises some problems, such as:

- the choice of a common language, understandable by both customs
- the choice of a transportation company
- the company responsible during the trip
- the presence or not of an employee from one or the other company
- the forms to be signed to ensure good traceability and acceptance of the delivery
- etc.

After negotiations, a Chinese transportation company, client of the Client, has been chosen. As a consequence, once loaded onboard, the material responsibility goes to the Client. That is why, before being loaded onboard, the equipments are checked and sealed into crates. Once the adequate documents, i.e. transportation specification, quality release, certificate of compliance, packing list and other notifications have been signed and released, the responsibility is officially transferred from the Supplier to the transporter. This is included in the Incoterms® definitions, and the last check before the ship departure is performed by a quality inspector who vouches for the compliance of the cargo.

Furthermore, it may seem obvious that Europe and China do not share the same culture, but it also raises problems, which will be further developed in the
discussion of chapter 9. Some are obvious, like the time difference, but others are deeper in the culture and just revealed the differences along the project way.

5.1 Definition and Introduction

The Taishan contract has been signed under ExW and FoB conditions, and the overall supply chain process is linked to these notions and to some others, which is why some definitions need to be given first. Plus these notions differ in different EPR™ projects, which will be later discussed in chapter 9. The moment characterizing the transfer of responsibility is of the greatest importance, which is why the choice of the Incoterms® has to be made cautiously.

The following definitions are taken from the Incoterms® 2010 [14]:

1. ExW for Ex Works (named place of delivery). The seller makes the goods available at its premises. This term places the maximum obligation on the buyer and minimum obligations on the seller. The Ex Works term is often used when making an initial quotation for the sale of goods without any costs included. ExW means that a seller has the goods ready for collection at his premises (works, factory, warehouse, plant) on the date agreed upon. The buyer pays all transportation costs and also bears the risks for bringing the goods to their final destination. The seller doesn’t load the goods on collecting vehicles and doesn’t clear them for export. If the seller does load the good, he does so at buyer’s risk and cost. If parties wish seller to be responsible for the loading of the goods on departure and to bear the risk and all costs of such loading, this must be made clear by adding explicit wording to this effect in the contract of sale.

2. FoB for Free on Board (named port of shipment). The seller must load themselves the goods on board the vessel nominated by the buyer. Cost and risk are divided when the goods are actually on board of the vessel (this rule is new!). The seller must clear the goods for export. The term is applicable for maritime and inland waterway transport only but NOT for multimodal sea transport in containers (see Incoterms® 2010, ICC publication 715). The buyer must instruct the seller the details of the vessel and the port where the goods are to be loaded, and there is no reference to, or provision for, the use of a carrier or forwarder. This term has been greatly misused over the last three decades ever since Incoterms® 1980 explained that FCA should be used for container shipments.

3. Special Tools. The Special tools are tools which are not available on the standard tools market and which are necessary for handling, erection and maintenance of the equipment.
5.2. LABELLING, PACKING AND MARKING REQUIREMENTS

4. Preliminary Shipment Schedule (PSS). The Preliminary Shipment Schedule gives a comprehensive list of the equipment to be delivered in the frame of the NI EP Contract. It covers the whole scope of equipment and reflects the estimated delivery dates of the equipment in the next 3 months. Every other month, the Preliminary Shipment Schedule is updated providing a 3-month look ahead detailed view of forecasted shipments.

A clearer view of the Incoterms® can be found in Appendix A.1.

When shipping an item from Europe to China, the question of packaging and marking is crucial. A good identification avoids any waste of time when receiving the items, that can thus be stored at the right place straight after delivery. And a good packaging is necessary in order to avoid any damage caused to the items, as one damaged item requires treatment, forms filling, decisions making, and possible re-supply, thus a huge waste of time and money.

As a consequence the requirements in terms of labelling, packing and marking will now be introduced.

5.2 Labelling, Packing and Marking Requirements

This section defines the different rules followed by the NI-EP Supplier in terms of labelling, packing and marking, which is the chronological line of events. They are applied by the NI-EP Supplier for every equipment shipment to the Purchaser.

5.2.1 Labelling

For every equipment shipment to the Purchaser, the NI-EP Supplier shall ensure that a label is attached to every Elementary Package. The labels are provided by the NI-EP Supplier or the Sub-Supplier and they enable a clear identification of the Elementary Package. This labelling is done in order to ensure that different Elementary Packages can never have identical labels.

However, problems often occur because of a wrong labelling, which is why continuous efforts are made to ensure a clear and readable labelling on the packages, as a return of all mis-labelled equipments would be very detrimental to the Supplier.

5.2.2 Packing

When talking about packing, some requirements (called Packing Standards) are mandatory in order to respect the rules:

- SEILCA (Syndicat de l’Emballage Industriel et Logistique Associée) if packing is operated in France
- HPE standards if packing is operated in Germany
Equivalent local standards if the packing operations occur in other countries.

International regulations and wood treatment (NIMP15)

The packing will be designed in order to ensure an efficient protection of the Equipments during the logistic phase, with regards to the guarantee, and to facilitate handling, lifting, lashing, securing of the cargo at any stage.

As mentioned earlier, one of the biggest problems concerns the warranties, because the aim of a project is to make money and as a consequence the warranties must be dealt with cautiously. Furthermore, if the packing is done hastily, it may not prevent the items from damages, and thus lead to an extra cost.

As an example, a water proof element is handled like no other. Water proof enclosures shall be designed in order to allow repacking by the Purchaser, as when received, the package is opened to check the content, but this is done on the jetty and thus the item still needs to be carried to site or to be stored. In order to restore the water proof enclosure to its original state, and store it as required (with temperature and humidity controls), the Purchaser shall apply the Packing Standards and NI-EP Supplier/Sub-Supplier packing recommendations in order to maintain the equipment warranty. After the opening of the water proof enclosure by the Purchaser, the packing warranty is no more applicable.

It can thus be seen how important a simple detail such as the opening of an enclosure has contractual implications.

5.2.3 Marking

Except for mandatory marking (fragile, IPPC logo, SEILA or HPE logo, centre of gravity, "this way up"...), Sub-Supplier emblems or signs on outer surfaces of wooden boxes or components are not permitted.

The marking shall not impair the usability of the parts.

5.2.4 VPRM, Vantage Project Resource Management

VPRM is the NI-EP Supplier’s integrated IT tool used during the entire logistic process i.e. from the labelling step to the final delivery. For instance, it is used to issue documents that are sent to the Purchaser and follow the Equipment shipments.

5.3 Consequences

It can thus be seen how a project is impacted by the standards, and how the contract negotiations must have been tricky, as it is always a choice between the Supplier’s requirements and the Purchaser ones, which sometimes cannot lead to a compromise.

Before launching a project, implying the delivery of elements, these kinds of standards need to be set and written in procedures accepted and signed by both the Client and the Supplier, because without common standards, errors might occur.
5.3. CONSEQUENCES

This also shows the importance of project procedures, because apart from the contract, they are the key official documents, that are used as a reference in the different exchanges. But even though the Taishan project is four years old, some codification problems still occur, as for example IT systems are continuously being developed and sometimes require the addition of new digits in the codes, addition that requires acceptance from both parties.

Once all of the standards for shipment have been set and accepted, the real deliveries can take place, but agreed standards do not at all imply a total absence of problems. Actually, even though the packing is done according to plans, that does not prevent a crate from falling, or an unexpected shock to occur. And when the crate is delivered, the warranty starts at the crate opening. As a consequence, the opening of the crates is a process that need to be thoroughly carried out by both the Purchaser and the Client to enable discussions in case of problems.
Chapter 6

Open-Package Inspection (OPI) [2]

6.1 Definitions

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<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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<tr>
<td>OPI</td>
<td>Open-Package Inspection</td>
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<tr>
<td>CCC</td>
<td>Cargo Condition Certificate</td>
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<td>ECC</td>
<td>Equipment Condition Certificate</td>
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<td>HCC</td>
<td>Hand Carry Certificate</td>
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<tr>
<td>PCC</td>
<td>Package Condition Certificate</td>
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<td>GVN</td>
<td>Good Variance Notice</td>
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<tr>
<td>NCR</td>
<td>Non-Conformance Report</td>
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<td>CIN</td>
<td>Component Intervention Notice</td>
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Table 6.1. OPI related abbreviations

Below can be found all the paper forms, shared between the Customer and the Client, and dealing with different stages or equipments.

1. A CCC is filled in while checking the crates
2. A PCC is filled in while checking the package condition
3. An ECC is filled in at Open-Package Inspection
4. An HCC is applicable to some small pieces of material and quality documents which are delivered or mailed to site directly by the Supplier. The inspection method is the same as that of package inspection and open-package inspection and HCC will be issued instead of CCC, PCC and ECC.

6.2 Timeline of the inspection

When delivering items, many things need to be set, such as the expected delivery date, the number of crates, the number of items per crate, and so on. Regarding
the time schedule, a Preliminary Shipment Schedule is the key document, and is exchanged between Supplier and Customer. Regarding the items, a packing list is always attached to the crates to state what has been sealed in. This is done to prevent any loss or theft during the transportation process. This packing list is checked when sealing the crates, and at the opening, to share a common view and end up on an agreement.

But to give a clear timeline of the process, it can be described as follows:

1. The Supplier informs first the Client through a shipment notification that the equipment will arrive on site. When the crates arrive on site, the Client checks them, their visual aspect, as they have the right to refuse a crate if it is obviously damaged. If it were so, the responsibility would have to be defined:
   - either it is the Supplier’s responsibility, who loaded a damaged crate on the ship, in which case it is its duty to re-supply the items
   - or it can be the transporter’s responsibility, in which case a financial compensation will be asked to this transporter, and a possible re-supply of the crate will be discussed

2. A Cargo Condition Certificate (CCC) is issued after checking the crates and is then distributed to the Supplier by channel, for information.

3. The next step is the open-package inspection, which is performed at the site after arrival of the equipment except as otherwise agreed by the Parties.

   A notification to perform is sent by the Client to the Supplier:
   - Concerning open-package inspection (OPI) of imported materials, the Client shall inform the Supplier or its representatives 20 calendar days ahead by written notice and the Supplier to confirm its attendance by e-mail or telephone 10 days before the inspection. This is done to enable both parties a clear view of their upcoming planning, and have them both attend the main part of the OPIs.
   - Concerning open-package inspection of domestic materials, the Client shall inform the Supplier 7 calendar days ahead and the Supplier shall confirm its attendance by e-mail or telephone 3 days before the inspection

The delays of notification and answering process are the fruits of long negotiations, regarding a compromise between the will of both parties to attend the OPI, as an OPI performed by only one party could obviously financially favour the one attending, and a shared desire to have a quick process, because as long as the OPI has not been performed, the items are not usable and thus a critical construction can be blocked. Moreover, if the construction delays are important, the Supplier will have to compensate by a decrease in the price.
6.2. TIMELINE OF THE INSPECTION

The notifications are sent by channel. It has been decided in the contract that both the Client and the Supplier should attend the OPI, in order to agree on the comments and to jointly decide of a solution and define the responsibilities. However, if the Supplier or its representatives was to fail to arrive on site on time upon receipt of notification, open-package inspection would be performed as scheduled and the result would be regarded as agreed by the Supplier. Even though it is damaging to the Supplier not to attend, as unilateral decisions are rarely objective, some OPIs are performed every month without its attendance.

During the OPI, the following checks are performed:

- the delivered quantity is in accordance with the packing list
- the equipment is delivered without damage.

4. The inspection results are distributed by the Client through the emission of an Equipment Condition Certificate (ECC). The ECC is issued 2 weeks after OPI performance, in case an internal discussion is required, except if some clarifications requested with the Supplier have not been answered. An official letter containing the inspection results is sent to the Supplier by channel.

As it can be read here, there is no trust in such a contract, which is totally understandable. By both attending the inspection, the Supplier and the Customer can jointly decide of the implementation of a solution in case of problem, so as to avoid later discussions and disagreements on why such action has been undertaken.

The forms are written in such a way that by being filled in, they state what the matter is, on which item, which solution to implement, and the responsibilities. This enables both parties to have a shared view of the issue, and to jointly state the warranties to be put in place.

Furthermore, as the decisions taken during OPI have cost implications, every information regarding it and exchanged afterwards requires a channel emission, i.e. a 14€ traceable e-mail. It is thus fixed for good and no party can decide to modify it then.

A specific team has been created on the Supplier side to attend these OPIs, and is called the OPI Site Team. However it can happen that they are lacking time to attend all OPIs, which sometimes triggers, as mentioned before, the automatic acceptance.

This team is in regular contact with the PMO of the Taishan project, as they have the best position to highlight the recurrent problems that need to be dealt with in a procedure in order to state an official solution and have a stronger position when facing the Client.
Chapter 7

Possible deviations

7.1 Introduction

When a crate is delivered on site, after shipment, both the Customer and a member of Areva on site team witness the opening of the crate, to vouch for the good number and quality of the delivered items. This operation is called the OPI for Open Package Inspection and is the main source of concern at the moment.

From this point on, it is assumed that the CCC and the PCC have been filled in and processed.

Several problems can occur:

- the number of items does not match the packing list
  - if there is an excess of items, a technical file is edited, called a GVN+\(^1\) [24]
  - if there is a missing item (or missing items), the technical file is called GVN-\(^2\) [24]
- some elements are damaged, in which case a NCR\(^3\) [25] is emitted, stating the matter and the concerned items.
- the crate itself is damaged in which case the OPI is not even performed and the whole crate is sent back (more related to the PCC).

When a NCR is emitted, it can lead to several solutions:

- the item is used as it is (minor damage)
- if the item is a very important and expensive one:

\(^1\)Good Variance Notice, the + stands for an excess
\(^2\)- stands for a lack
\(^3\)Non-Conformance Report
– either is it repaired on site (CIN\textsuperscript{4}) [26]
– or it is returned for repair (shipment, repair and shipment again leading
to a new OPI)

• if the item is not that expensive:
  – it can be repaired on site (CIN)
  – a new item can be found in the spare parts to replace it
  – a re-supply can be decided, with a new crate leading to a new OPI

7.2 Consequences

As these deviations tend to occur and the regularization process tends to last,
improvements still need to be achieved, in the overall process of deviation manage-
ment. The main goal regards the communication between the Customer, the OPI
Site team, and the Supplier head-quarters based in France. When a new problem
occurs the information shall be transmitted to the PMO for a solution to be jointly
decided, and eventually a procedure to be edited.

In order to do so, every month, each department manager issues a monthly
progress report, to be sent to the Project Management Office, which will be included
in a general monthly progress report signed by the project director and used for
exterior communication about the project. The highlights of this report are the
main recurrent problems requiring improvements, and the new arising issues that
need to be tackled.

One of the main goals concerning site activities is to issue procedures dealing
with all these deviations, for a standardized way of action to be set.

When those events occur, the OPI site team sometimes does not quite know
which form to fill in, as not everything is clearly defined in the contract. Thus the
first step is to issue the forms to fill in at OPI, and then to write corresponding
procedures, that are to be used as a training for the teams.

After being edited, the procedures lead to additional work, as efforts are required
to train the people and the partners about the new decided customs, which is why
there is always a time before the applicability declaration of a procedure, and its
real use.

\textsuperscript{4}Component Intervention Notice
Chapter 8

ECC Clearance process [3]

8.1 Explanation of the principle

Following an OPI\(^1\), the issuance of an ECC (Equipment Condition Certificate) is considered as the unique and central document that enables to declare that the OPI process requires a specific action to treat the acknowledged deviation. The ECC template contains the GVN\(^2\) and the NCR\(^3\) reference triggered at the occasion of the OPI. Simultaneously with the OPI performance, an ECC sheet is filled in.

ECC can happen in two ways:

- **Case 1:** Right after delivery, if no deviation is acknowledged. Result of Open Package Inspection is communicated through Equipment Condition Certificate (ECC) issuance, OPI leads to the issuance of an ECC without comment, the ECC is considered as 'CLEARED'.

- **Case 2:** Right after delivery, if a deviation is acknowledged. ECC will include comments and considered as 'CLEARED' once the treatment process (GVN, NCR (leading to consecutive CIN or Re-Supply,..) is closed.

---

\(^1\)Open-Package Inspection  
\(^2\)Good Variance Notice  
\(^3\)Non-Conformance Report
The general process of ECC clearance is described in the following schematic:

![Diagram of ECC process](image)

**Figure 8.1. ECC process**

The whole idea of the procedure to be emitted on that issue is to decide when the guaranty starts and when it ends in order for Areva to save the maximum amount of money.

From the beginning, the main interlocutor of the PMO has been the Contract manager, who is the person in a project that knows best the initial contract that was signed and what is encompassed within it.

The contractual definition required in this procedure regards the exchange of official documents that state the agreement regarding the closure of a deviation.

To be clearer, when a deviation occurs, whether qualitative or quantitative, a form is issued to state what the problem is and on which item. Once the deviation has been treated, it leads to the closure of the form, either by signature of both parties (case of the CIN), or by emission of a channel that sumarizes all complementary documents and the proof that the deviation has been cleared (case of a GVN for example). The Contract manager will tell which document constitutes a sufficient proof that will then no longer be debatable.

Even though, in the lifetime of the project, the contract manager has changed once along the way, this manager remains one of the most important PMO inter-
8.2 Detailed Explanation

The first matter regards the closure of the different open forms. As an example, the case of a crate which will trigger 1 NCR, 1 GVN+ and 1 GVN- will be studied (definitions of the terms in chapter 6.1.

Once the NCR is opened, the decision needs to be made regarding the appropriate action to undertake. As a reminder, it can be said that the item can be:

- either used as is (minor damage)
- or repaired on site (CIN)
- or returned for repair (shipment, repair and shipment again leading to a new OPI)
• or a new item can be found in the spare parts to replace it

• or a re-supply is decided with a new crate leading to a new OPI

Whatever the chosen solution is, the opened NCR can only be closed once the item is functional (i.e. has been repaired, either on site or in factory which by the way is a really time-consuming and expensive process), or once it has been re-supplied (implying a new OPI and acceptance stating that the new item is functional). If, for example, the NCR has led to an intervention on site, i.e. the opening of a Component Intervention Notice (CIN) form, the end of the intervention and the compliance of the element with the standards will enable the final signature of the CIN form by both parties, and thus state the agreement.

In this example, the closure of the NCR is stated by the final signature of the CIN form which implies the regularization. This completed signed form will be used as a proof of closure to state the Clearance of this part of the ECC. However the overall clearance is not yet achieved.

If, on the other hand, the item needs to be re-supplied, only the formal acceptance of the item at the new OPI (i.e. a cleared ECC concerning this particular item) will provide the necessary proof of the regularization.

In parallel, the GVN+ needs to be regularized as well, meaning that a common decision needs to be validated:

• either the item is sent back in which case the transportation cost will be the supplier’s duty, so this would only be for an expensive item

• or the item is kept by the Customer for use as spare parts.

This issue is the least problematic of the three, and does not really require any important action. As a consequence it does not really impact the ECC Clearance, because it does not delay the construction or lead to any inconvenience.

Third of all, the GVN- needs to be taken care of. Thus an item will need to be supplied. Here, the choice of word is quite tricky. Indeed, the wording "Re-supply" is dedicated, and suggests that an item was broken and needs to be supplied again because it has been broken (or discovered broken at the OPI). But in the GVN-case, the item is missing so it is a regular completion of purchase, as the extra cost is the exclusive duty of the Sub-supplier who did not complete the purchase. For the Customer, it just has not been delivered. However, an extra cost could be needed because a period of time is necessary for this purchase completion, and this can delay the construction or any other event. In some cases, if the event is on the schedule critical path of the project, the Customer is entitled to demand indemnities. These are called LDs for Liquidity Damages, and they precisely are what the Supplier wants to avoid, as it reduces its benefits in this project that has already been signed with a very thin margin.
8.2. DETAILED EXPLANATION

In the end, the overall Clearance of the ECC can only be declared when both the NCR, GVN+ and GVN- will be closed and the according files completed. This explains the complexity of the process and the risk of having a permanently open ECC if one of the problems cannot be solved.
Chapter 9

Analysis and comparison between theory and practice

From the literature review and the customs of the Taishan project, parallels can be drawn, to illustrate the similarities and differences of this project with other ones of such a scale.

As logistics and the general supply chain process occur between Europe and China, the project is to be seen with its related issues, whether they are cultural, or just linked to the distance between producer and customer.

9.1 Cultural differences

Regarding the cultural differences, and as a reminder of chapter 5 that introduces some issues, it must be seen that Chinese customs are really different from Western customs. For example Chinese people do not work on Friday afternoon, which, combined with the time difference, is kind of tricky when exchanging channels, as one sent from France on Friday can only be treated in China on Monday, regardless of the fact that the liabilities are running from the sending date in some cases, but not from the reception/treatment date.

Another example concerns the planning, as the Chinese people really think that schedule respect is the A-goal of the project. When a French manager decides to allocate more time to a job, in order to ensure safety and even though it may increase the cost, a Chinese manager will instantly decide to allocate many more people for the task to be carried out on time, even though some steps may be missed in that process. It can often be seen as an improvement but can as well lead to later problems and is thus a knotty point in the relations.

A third cultural problem is that Chinese people, in the everyday relations, are difficult when trying to find a compromise, and often want to take the lead in decisions, even if they are lacking experience in the subject. This makes some meetings stormy, and sometimes delays the decision making. But in the end, a joint solution can always be found, as it is nobody’s advantage to be blocked.
CHAPTER 9. ANALYSIS AND COMPARISON BETWEEN THEORY AND PRACTICE

As a consequence, the cultural difference firstly raises many extra issues, as introduced above, but as explained in chapter 3, it is also a way to challenge the people, and in the end to improve the efficiency by taking advantage of the differences. Moreover, and as cited as well, the cultural barriers are fading away with China, which facilitates the project work, and makes it theoretically possible to respect the schedule.

In addition to this cultural problems, the laws are also different in both countries (chapter 3), which could raise problems in the beginning of a project. However, most of these issues are handled while signing a contract and are thus of no consequence later on. Once the customs clearances are dealt with, the law-related differences do not much matter.

9.2 Logistics related issues

Many reviews and books introduce or even get really detailed about the general process of logistics (chapter 3), but however it can never be copy-pasted to an actual project, as there are always slight or major differences that make of each and every project of that scale a unique one.

However, the issue remains the same, and the problems introduced in the literature can often be observed in an actual project. That is why the integrated supply chain is currently being implemented, to make all supply chain related processes parallel, and facilitate the communication and the different flows. All processes are interconnected now, and make of the supply chain a thorough process from raw material acquisition to final material delivery.

Involved in the logistics is the transportation process. A Chinese transportation company has been chosen in this project, and the Supplier Areva only produces the elements (with its sub-suppliers) and delivers them to the port for them to be shipped. The choice of the transportation company has been made with regards to its price, its skills and the general agreements encompassed in the contract. It has of course not been done hastily. Plus this company is a partner of the Client and as a consequence it has facilitated the signature process. The Customer “owns” the items from the European port onto its final destination. However, if a damage was to be found on an element, even during the erection of the buildings, the liability of the Supplier would still be at stake if it can be proven that the damage was here and has not been caused. But most of the damages and non-conformances are discovered during the Open Package Inspection, which almost signifies the end of the Supplier’s responsibility. In parallel to this choice of transporter, specific Incoterms® have been chosen. In the Taishan project, they are ExW and FoB, which means that the supplier’s responsibility never goes past the departure port. This raises problems, as the Supplier often likes to be aware of what happens during the shipment, which is impossible here. Many of the problems introduced in this thesis are linked to this change of responsibility regarding the transportation. The
most Areva can do in the process is to fix the elements in the crates. This specific choice, different from the one of the two others EPR™ has raised many problems because of damaged items and definition of responsibilities. It must thus be seen as a choice to be made with the most delicate attention.

Several necessary papers for the supply chain process are described in chapter 3. As revealed in [16], this flow of paper is tricky to handle, and is thus one big point of concern in very big projects. It always is very important to keep track of the forms and not to lose any of them.

As showed, logistics and procurement are a comprehensive subject where nothing is left to chance, and which is continuously evolving (as it is the case for Taishan) because the discovery of new problems shows the need for new forms and documents to handle them.

As a reminder of chapter 3, it can be said that the idea when delivering elements is to have the fastest possible process by improving the speed and flexibility of the overall process, by setting points of inventory for the goods, but simultaneously having a moving process of the goods between these points. In the Taishan project like in any other, a schedule has been set in the beginning, for all logistics-related transportations, and a financial compensation has to be paid if the delivery is late, which is why the improvement of the supply chain cycle is key. The main goal being, for all elements, to be on site on-time for the erection to be carried out. As a consequence, the critical path of the schedule must be respected cautiously. Plus, the massive amount of papers linked with it needs to be handled for misinformation not to spread [16]. This means that what needs to be set and handled is this flow of documents, because it is easy to be overwhelmed by those, and miss the important information. Thus a selection of the relevant documents is to be made in order to avoid the disturbances, and recording them in an IT system prevents losses and often facilitates the overall process.

9.3 IT systems

The last main analysis focus point is regarding the IT system. It has been introduced as a necessity and it truly is, and at a same time it is a continuous process because the creation of a new document needs to be referred in the IT system. Regarding the Taishan project, and even though it is already halfway through, a new IT system is being developed to cope with this amount of documents and to enhance the traceability. Thanks to a good and efficient software, no more discussions will arise on where such item is, and whose responsibility is at stake. As revealed in chapter 3, the implementation and adequation of an IT system is rarely ideal, which is why a new one is developed in the Taishan project.

As a summary, the requirements for an IT system are:

- Always check the applicability with the partners
• Try to be thorough from the very beginning
• Think about the compatibility with other softwares

This subject is probably the most challenging one, and will be the center of focus for most coming projects, as a well-developed IT system enables to save a lot of time, and facilitates the records.

9.4 Summary

This analysis shows the importance of every detail in the contract signed when starting a project. Even though concessions need to be done, in order to enable the signature and with regards to the other companies which might be cheaper, it has to be understood that it can lead to further liability and rigor problems as the customs may differ. In the Taishan case, these customs are not identical between Europe and China, and the experience is not the same either because the Chinese transportation company is in that case rather young. By comparing literature and practice, the complexity of supply chain is well understood and its variability as well. Further studies are still led to improve all processes, in particular in IT systems, and about the integrated supply chain, because even though it is a mature process at the moment, it still requires some adjustments and improvements.
Conclusion

Through the study of the Taishan project, a compared and detailed analysis has been conducted to illustrate the project’s customs with literature references. The advantage of having Taishan as a reference is the fact that it is a transnational project, about a new technology, and different in parameters from other similar ones. The analysis can be summarized as the discovery of the great variability of supply chain and logistics, from one project to another, depending on countries involved, the kind and size of the project, the tightness of the schedule, thus on all variable parameters.

Logistics in a transnational project are an important matter, as it has implications on all deliveries and thus on the overall erection of the building in the case of an industrial project. The transnationality raises customs problems, but at the same time cultural problems. Moreover the time difference raises communication issues.

Supply chain management also treats the general relation between sub-suppliers, supplier, consumer and intermediaries such as the transportation company. It is thus a key process, and takes place all along the project life.

However, and as seen here, it is just an intermediary step. In this industrial project, the erection of the buildings (that can be carried out thanks to the elements supplied by logistics) remains then, and problems linked to the supply chain may occur there, with all the repair or re-supply needed and discussed before. The wrong management of logistics would be disastrous to the whole project because of these implications, and procurement and logistics people are often key interlocutors in a project because of their broad knowledge.

The complexity of a project is thus characterized by the interconnection of all the processes, and simultaneously of the communication management (contact between all teams), even between Customer and Supplier, for actions to be undertaken and solutions to be found.

The IT systems are a powerful help when communicating because they enable continuous contact, shared information, and limit the massive usage of paper with its related risk of loss. Nevertheless, researches are still being led and this subject which will constitute the main developments of this area in the coming years.

Furthermore, this master thesis gives an insight of how the theory, from chapter 3, is impacted by the reality, in an actual project. Even though the basis of a project
comes from the theory, it must always be open to changes, as what is actually faced takes over the theory in the working procedures.

In the end, it can be said that the Taishan project is a robust one in terms of logistics, because it sticks to the schedule even though the number of elements to be shipped is tremendous in price, number and weight. It can really be taken as an example of supply chain management. However, the specific choice of Incoterms® made in this project remains a uniqueness (among EPR™) and is not proven to be better than the ones chosen for the Finnish and French reactors. Plus the general management of IT systems may have been improved in the Taishan project, which highlights the need to fix the technologies to be used from the beginning (if it is possible), in order to save development and implementation time later on, because introducing a new IT system halfway through a project always is a very delicate and time-consuming process, which requires persuasion and trainings.

Thus some factors may still require improvement, and, like any other, this project can only constitute a basis of reflection for the implementation of supply chains.
Bibliography


Appendix A

Additional information
Figure A.1. Scheme explaining the Incoterms notions