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Implementation of smart contract in the Liquefied Natural Gas trade

Bachelor Project submitted for the degree of
Bachelor of Science HES in International Business Management

by

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Declaration

This Bachelor Project is submitted as part of the final examination requirements of the Haute école de gestion de Genève, for the Bachelor of Science HES-SO in International Business Management.

The student accepts the terms of the confidentiality agreement if one has been signed. The use of any conclusions or recommendations made in the Bachelor Project, with no prejudice to their value, engages neither the responsibility of the author, nor the adviser to the Bachelor Project, nor the jury members nor the HEG.

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Geneva, the 23rd of August 2019

Gary SANANES

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Executive Summary

In this Bachelor thesis, we will study all the key aspects for the implementation of a smart contract for a Liquified Natural Gas (LNG) trade. As starting point, a brief introduction about LNG is written to realise the specificities of the commodity traded. Then, smart contracts will be presented as well as its fundamental goal and the key concerns about how English law is regulating them.

Furthermore, we will learn that a smart contract, to respect legal requirements, is more eligible to work based on a “normal” contract. Therefore, an analysis will be conducted to choose a contract being the most suitable for a trade and fitting the best for the implementation phase. By chance, professional contracts written by large companies in the domain are available on internet.

Once the result of the analysis and comparison allows us to choose one contract, it needs to be shaped and formatted in a way to make it clear and easy to understand for a programmer to code it. The tool which enables this process is flowchart, which shows how contracts are predicting every situation and how clauses are interconnected. In addition, a deep understanding and explanation of the contract will allow us to learn in depth how the deal is conducted and important characteristics to take into consideration about LNG.

Smart contracts are mostly implemented on blockchain or at least platforms using blockchain technology which meant we could not make us escape the subject of blockchain technology. Therefore, we will have to first gain basic knowledge and note the difference between private and public blockchain. The next step will be to explore the question of which blockchain or platform the smart contract would be run and go through the main ones developed which are Ethereum, Hyperledger Fabric and R3 corda to conclude that Hyperledger is the most suitable.

Finally, for the last part, we will consider the implementation phase requiring certain computer science knowledge and more time than initially forecasted. We will come up with a solution allowing us to go deeper into the subject and to have a full implementation of the contract chosen in the near future. The solution brought is the double bachelor thesis. It consists to ask a student from “Informatique de gestion” which is a computer science branch of HEG to make his bachelor thesis on the second part of my bachelor thesis.

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1. Introduction

1.1 Subject presentation and report's organization

Logistics optimization is all about a commodity trading company aim. The company will constantly ask itself; how can I bring the commodity at the right place at the right moment and at the lowest costs? Therefore, all good traders are always searching for solutions to optimize the transactions on a physical basis. They are constantly asking themselves many questions such as; Is it a good idea to go through this country? Which tool can or should I use to cover the most risks at minimum costs?

When a trade is concluded, the logistic team will have to organize the transfer of the commodity as related to what was concluded in the deal. During the transfer, key documents are issued such as a bill of lading or an inspection certificate. They are used as proof to ensure the players that the commodity corresponds to the contract, to unlock payment process and as proof in case of litigation. We understand the importance of these documents.

The paper-based transaction has not changed for decades and suffers from inefficiencies. It has been proven by many studies that by implementing technological progresses, risks would be highly diminished, and savings achieved on operational costs and time spent. Indeed, a former student has already conducted this research and proven in his bachelor thesis through case studies the solution brought by smart contracts (COLLET Romain, 2018). Smart contracts promise benefits but has its limitations and risks associated (ALLEN AND OVERY, 2017).

In this paper, the goal would be to show, by using a real contract, if its implementation in smart contract is feasible. Each commodity has its specificities and therefore we will concentrate on LNG "Liquified Natural Gas" contract. To this end, we will go from scratch and first briefly explain LNG, ask ourselves what the legal perspectives of smart contract are, analyze and choose an LNG contract and finally, prepare the structure, give the indications and connections and instruct on which blockchain to implement the smart contract.

Hence, the ambition of this report is to answer the following question; Is it possible to have an LNG trade process fully automatized with a smart contract?

Furthermore, if it is possible, what are the changes that would result by using smart contracts? We are going to answer to all these questions through this report.

1.2 Literature review

According to Ernst & Young article “Overview of blockchain for energy and commodity trading”, energy and commodity transition provide clear use cases for the application of blockchain technology. Some companies have estimated significant savings from it. Many projects are currently being developed from collaboration. One of them regards a group of more than 20 European energy companies developing a blockchain platform to execute wholesale power and natural gas transactions. (Ernst & Young, 2017)

In September 2018, an article was published by Reuters about the launching of the first blockchain-based platform for the trading of commodities. This will be achieved by a joint venture called Komgo SA in Geneva founded by many banks and commodity trading companies such as Crédit Agricole Group, BNP Paribas, Mercuria, Shell and many others. Komgo SA works on the same domain than the subject of this thesis and include concrete references. (PAYNE Julia, 2018)

While some companies are investing huge amounts in the development of blockchain projects, other companies like Boston Consulting Group are less ambitious. In recent years, many commodity trading companies have invested in new IT systems and processes, but the article explains that in order to move operations to a blockchain-based-system, they would require to invest much more money. The only way for BCG that public blockchain can work is that all stakeholders must participate. (BENDER Jan Philipp and al, 2019)

A paper published by the Law School of the University of Adelaide in 2017 asking “Is a ‘smart contract’ really a smart idea?” brings insights from a legal perspective. Significant concerns of smart contract are raised regarding the difficulties to adapt to the current legal framework regulating contracts across different jurisdictions. It considers the potential issues from the use of smart contracts within common law put forward some possible solutions. (GIANCASPRO Mark, 2017)

Staying on the subject of smart contract, research about the implication of trust in the context of smart contract has been conducted at the University of Tartu (Estonia) in information Technology law. Published in 2018 “Creating markets in no-trust environments: The law and economics of smart contracts” talks about the differences by operating in public versus private blockchain as well as enforcement mechanism and trust relationship underlying contracts. This brings an insight about the impact of smart contract on trusted parties. (EENMAA-DIMITRIEVA Helen and al, 2018)

Finally, constant technology developments in the supply chain are being set making the use of smart contract more feasible. GeTS (Global eTrade Services) launched a blockchain platform where key stakeholders, like shippers and freight forwarders, share trade documents between each other. "*In essence, the blockchain platform will offer a user-friendly interface with 'drag-and-drop simplicity' to share trade documents between port operators*". In addition, PSA, one of the world's largest port operators did a partnership with the giant IBM to develop proof-of-concept[1] and uses blockchain solutions for supply chain. (Global eTrade Services, 2019)

[1] Experimentation showing the feasibility of a concept

1.3 Introduction of LNG

To implement a LNG trade, it is important to understand what LNG is and its key characteristics, like how it is handled. However, the aim of this section is just to get a global understanding of LNG. Hence, we will present it from a practical point of view and not an analytical one. In the analysis chapter, an in-depth study about the characteristics will be achieved by comparing LNG contracts.

Below are key points to know about LNG:

- There are three states of natural gas
    - In gas state, natural gas (NG)
    - Liquefied natural gas (LNG)
    - Compressed natural gas (CNG), highly pressured gas but not liquefied
- LNG is natural gas which is cooled to -162° Celsius.
- LNG facilitates the shipping and storage of natural gas.
- The volume is 600 times smaller than in gas form.

The main reason why natural gas has to be liquified is because it cannot be transported by pipelines, as there is no land connection or a really large distance with other countries. Hence, natural gas is liquefied which decreases the volume and allows it to be transported by sea. This explains why the main LNG exporters, which are Qatar and Australia, and main importer, which is Japan, are all Islands.

Another advantage relates to the storage. Usually, natural gas is stored under-ground in natural “caves” formed naturally. However, by liquefying it, LNG can be stored in tankers

which is safer and more convenient, in liquid form the gas is not flammable nor explosive. Finally, as developed in analysis section, it allows the gas to be purer.

Most of the times, once the LNG has reached its destination, it's turned back into natural gas in a process called re-gasification. However, if it has to be stored or when used as fuel for vehicles or vessels, it's kept in its liquid form which allows the energy to be stored in a smaller space. (DNG Energy, 2014)

Natural gas is considered as an energy of the future. The reason relates to the trend going on about sustainability. Indeed, natural gas is the cleanest fossil fuel and generates approximately 30% less carbon than fuel oil and 45% less than coal. The percentage will depend on the purity when taken out of the ground.

The structure of the market by countries are monopoly and oligopoly which are principally state-owned company. Henry Hub is the US benchmark for natural gas and considered as the biggest natural gas hub. The second one, situated in Europe, is the Britain's National Balancing Point (NBP), used as the main indicator for Europe wholesale gas market. Finally, the Dutch Title Transfer Facility (TFF) which includes a huge Groningen onshore gas field and is situated in the centre of a large pipeline network. EAX hub stands for East African Commodity Exchange.

The quantity of LNG delivered is expressed in Metric Million British Thermal Unit (MMBtu). Btu is the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. In practical terms, it is the amount of heat generated by one lighted stick of match. We understand that it is a representation of energy. (US Energy Information Administration, 2019).

1.4 Smart contract

1.4.1 What are legal contracts ?

Before to start explaining what smart contracts are, we will first define what constitutes legal contracts. They are legally enforceable agreements between at least two parties which contain essentially a set of promises under certain circumstances in exchange for a benefit. In order to be legally enforceable, the contract must fulfil 5 required characteristics explained below (BONNER Marianne, 2019):

1. Legal purpose: A contract must not have an illegal purpose, like a contract to kill someone.
2. Mutual assent: The parties must consent to the same terms on a voluntary participation and reach a "meeting of the minds."
3. Consideration: For a contract to be legally binding, each party must agree to give up something of value in exchange for a benefit.
4. Competent parties: To be competent, they must know what they are doing, meaning they have the mental capacity, they are legal age to sign the contract and not under the influence of alcohol or drugs.
5. Legal Intent: A contract is not valid if the parties did not engage in the agreement freely. This requirement refers to the intention of each party to conduct a contract.

We can concentrate now on smart contracts and discover how they differ from legal contracts.

1.4.2 What are smart contracts ?

The notion of smart contracts is getting more popular nowadays. This concept was introduced in 1994 by an American computer scientist named Nick Szabo. His aim was to remove trusted intermediaries and to execute the terms of a contract automatically. There are various definitions of smart contracts as they can be used in many different ways and by many different kinds of businesses, but today, with the implementation of blockchain technology, smart contracts are mostly understood as “a computerised transaction protocol which autonomously executes the terms of a contract.“[2] Indeed, in

[2] Don Tapscott and Alex Tapscott, Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business and theWorld (Penguin,2016).

1994, the infrastructure was inefficient to support such protocols. Today, the infrastructure is available and continuously developed.

The technology which made possible for smart contracts to be built is the same platform used for bitcoins. This platform is called blockchain. The technology of blockchain is the one underlying smart contracts as well as the platform on which they will be implemented. Basically, it works as a distributed ledger where all the transactions are grouped by blocks recorded by a network of computers. The participants are called miners, whom by posting transaction, create smart contract on that blockchain. After saying that, we understand that smart contracts are nothing more than the translation of contractual clauses from a legal contract into code to create a transaction.

A legal contract is composed of two parts, **operational semantics** which represents scenarios giving results and **denotation semantics** which are general terms and conditions. An example of operational semantics can be the scenario where the seller failed to deliver the goods due to a force majeure. The clause predicts that in this case, the affected party shall be relieved from liability for any delay or failure in performance. In fact, a smart contract is the codification of the operational semantics clauses into the blockchain. (The difference between the operational and denotation semantics of a legal contract are discussed in more details in the section 2.3 of this paper.)

Despite this, they do not necessarily need to be based on the blockchain platform; we will keep only this option for this paper. Therefore, even if blockchain is not our topic, we will discuss it later to choose on which one we will implement our smart contract. (GIANCASPRO Mark, 2017)

Fundamentally, the coding will allow the transaction to execute its terms upon the occurrence of predetermined events. When entered in the system, the instructions will operate by themselves. A simple example can be the sale of LNG at a certain date based on Henry Hub Natural Gas Spot Price which is the US benchmark and considered as the biggest natural gas hub. The benchmark and the blockchain are connected and at sale's date, the spot price of the Henry Hub is queried by the blockchain. Then, the sum of money due accorded to the spot price is automatically calculated and transferred from buyer to seller's account. It can be formulated in this way; If the price of the Henry Hub is X then the payment will be Y.

1.4.3 What is the fundamental goal of a smart contract?

The last example shows how it facilitates one transaction, but it applies to a wide number of transactions. The whole objective is simply to **facilitate transactions**. Another mean is to reduce dependence on trusted intermediaries like banks. Indeed, validation of transactions on the blockchain are done by consensus[3] and not by a trusted intermediary. With smart contracts, rather than the bank enabling the transfer of payment on the terms of the agreement, the coding of the contracts automatically does all the work and verifications by the completions of the protocols[4]. The participants only need to decide the terms of the agreement and how the contract will execute by itself. The blockchain will then address all critical aspects of the transaction from record-keeping to monitoring, enforcement and auditing.

To illustrate the benefits from the removal of trusted intermediaries, we will take as a concrete example the most secured method of payment for a seller after cash in advance; the letter of credit also called documentary credit[5]. In few words, it is a guarantee of payment where a bank (the issuing bank) issues a separated contract on behalf of the buyer (the applicant) to pay the seller (the beneficiary), provided that the terms and conditions required by the L/C are met by a predetermined deadline (validity date). In other words, this method, which is internationally recognised and used, is the verification by the buyer's bank that all the documents testifying the quantity, quality and many other characteristics of the sale are exactly complying with what has been agreed. The fundamental role of the issuing bank is to **undertake the credit risk** of a buyer that a seller takes when delivering goods. The credit risk is the possibility that the buyer may not pay the seller for the goods. (Credit Suisse, Letter of Credit)

Indeed, it is risky to transact directly with a stranger and even with a known party, when it comes to profit. A contract does not bring a sufficient guarantee that the other party will fulfil his obligation. Thus, a trusted party like a bank or a platform are present to bring trust in the value exchange. A typical example is Uber who pairs drivers with passengers. One goal of the platform called blockchain with the implementation of smart contracts is to bring trust between the parties and to replace trusted third party. The answer to how

[3] On consortium (private) blockchain, it means the validation of selected participants.

[4] A protocol is the program which forms the software backbone of the network. Different protocols were designed keeping in mind the differing objectives or use cases. Therefore, each Blockchain has its own protocol. (edChain, 2018)

[5] For more information about letter of credit please refer to Export Financing and Getting Paid v 2018 from commodity trading major

it brings trust is wide and is not the subject of this thesis, but services provided by the blockchain like peer-to-peer payment and supply chain tracking are typical examples.

Coming back to the example of Letter of Credit, with smart contracts, all this verification process done by the bank will be removed because each third party of the trade like the inspection company will become a miner in the blockchain. There is no separated contract. The inspection company will be authorised only on the part of the block where they are involved and will directly allow the process to go a step further if the goods are compliant and if not, will depend on what has been agreed in the contract. The need of a trusted intermediary is diminished because once all the steps are validated, the payment transfer is automatically generated.

As shown in the later example, the removal of the intermediate transaction which would normally occur first reduces the number of transactions as well as legal costs. The removed transaction is saving a lot of fees from administration, legal costs associated with the preparation, supervision and execution of written contracts. The charged fees just for the letter of credit depends on the country, the bank, the amount of the L/C, the risks and other aspects, which makes difficult to estimate. We will take Credit Suisse as the reference for the market. As referred to the charged fees of Credit Suisse in Appendix 1, if we just add the main ones for the L/C including the Notification, Assignment of proceeds, Liability commission including issuance fees and utilization we already reach 0.6% so we can easily assume that the total fees reach 0.75%. In addition, we assumed that the credit risks are the lowest possible. Hence, if the L/C value equal 10 million, the

charged fees would equal at least to 75’000 which represents a considerable amount. For more details about the fees, refer to Appendix **1**.

Finally, the key difference between a smart and a legal contract is the ambiguity. The smart contract has to predict and to be clear on the next step of any situation in order to be a self-executing program. For example, if the quality clause is a warranty, meaning that if the quality requirements of the contract are not respected, penalties will be applicable, it is frequent that contracts do not stipulate the amount of penalties which in case the quality is not respected, are subject to negotiations. On a smart contract, the amount of penalties will have to be precisely defined in accordance to the quality specifications to avoid ambiguity to be the most transparent possible and to avoid any discussion.

1.4.4 Key concerns about smart contract under English law (on private blockchain)

For the international trade on LNG, English law has significant benefits. Below are 3 of them;

6. Everyone, whatever their origin, is treated in the same way.
7. English law is the legal heritage of American, Canadian and Australian laws and therefore encompass a broad perimeter.
8. Finally, it sticks strongly to the jurisdiction and therefore make it easier to forecast decision. Even though, there must be small jurisdiction on smart contract, it still applies for LNG contracts.

We will try to answer key points regarding how English law regulates smart contracts, what are the issues smart contract faces against legal framework and if it must be underlined by another “normal” contract. To answer to this question, we will go through contract doctrines and principles. (GIANCASPRO Mark, 2017)

Formation and acceptation of contract

“Under English law, an offer is characterized by a party’s indication of willingness to be bound by the terms of a promise he or she has made to another party, with the latter being provided with the opportunity to elect between acceptance and rejection of the proposal. Unequivocal assent to the offer then confirms that it has been formally accepted and that a ‘meeting of the minds’ has occurred.” (GIANCASPRO Mark, 2017)

In traditional contracting, it's straightforward to assess an offer and an acceptance. In addition, it's well regulated; the Electronic Commerce Directive, regulation 2002[6], defines the effectiveness of offer and acceptance when forms of communication such as emails occur via internet.

However, via technology, it appears more difficult to identify the moment at which they occur. For instance, on blockchain, messages are sent using public-key infrastructure in the same way as emails. A question raised is whether the offer and acceptance will be subject to the Electronic Commerce Directive, or once the offer by the buyer has been authenticated through consensus of network users, or once it coded and added to the blockchain. My opinion is that for the sale of goods at least, the smart contract only represents the execution part and therefore has to be backed up by an underlying contract. In that respect, the smart contract doesn't deal with the acceptance process.

Certainty of terms

To be binding, a certain level of inherent clarity and completeness must be present under English law. Nevertheless, the language used to code smart contract is unreadable to anyone who is not a computer scientist or at least who has attended training. Thus, it doesn't follow the requirement of legally certain to be enforceable. It would be like to ask a Swiss judge to decide about a contract in Chinese. How could the court examine the content of the smart contract?

Again, there is a need to have the smart contract based on a legal contract. The terms drafted in normal language by the parties is then coded in programing language which will thus create a smart contract and allow the agreement to be self-executing. To come back to our judge, the natural version of contract would be the authentic one binding to the law. However, it would not be surprising that a "digital court" appear in the next few years which would master all digital and programming knowledge.

Translation of concept and principle

Another issue comes from the translation of concepts and principles into coding. In fact, the court frequently faces difficulties to assess normative standard such as reasonability. Indeed, the concept of reasonability may be even more difficult to be coded in programing language. Another example is the difficulty to reduce scenarios articulated in contract terms in code. On the other hand, some argue that it allows smart contract to

[6] The Electronic Commerce Regulations 2002 available on: http://www.legislation.gov.uk/uksi/2002/2013/contents/made

have clear and defined outcomes, as they cannot deal with ambiguity. As presented later, the contract stipulates “buyer should use reasonable endeavor to accept such LNG”. This sentence represents a typical example as ambiguous sentence.

Creation of new risks

A new risk could be initiated by an external source trouble. A smart contract might be programmed to unlock the payment process once a date is reached. The contract could link to the Henry Hub Natural Gas benchmark to determine the price, triggering the payment. In case of malfunction or inactivity from the Henry Hub benchmark, the smart contract can be affected, and huge losses could occur.

Hacking risks; the entire transaction between the parties is exposed to risk of hacking. Digital technologies are vulnerable and sensitive information can be stolen.

In conclusion, key concerns under English law stated above, **demonstrate clearly the need of an underlying contract**. The next step is to choose which LNG contract we will code.

2. Analysis

In order to learn more about LNG and to determine which LNG contract would be used or combined, we will compare key clauses of three LNG standard contracts. Before doing so, we need to understand the two types of contract used to trade LNG.

2.1 MSPA versus GTCs

LNG purchases are typically made on long-term contracts, often extending over 20 years using the Master Sale and Purchase Agreement (MSPA) framework. However, like we have seen with oil in the 80's, today there is a transition from long-term to short-term trades. Nowadays, most LNG trades are done through the use of a MSPA as shown on the four examples on the next page (MILES Steven, 2009).

LNG MSPA

LNG MSPA is a complex agreement between two parties usually for a long-term contract. The specificity is that by signing the MSPA, there is no binding commitment to enter into a transaction even though it might include some minimum quantity to be delivered on a regular basis. It includes all the clauses and represents the body. It functions as a legal basis for later trades. This allows the parties to buy/sell under the pre-agreement terms of the MSPA each time they want in the future and therefore to concentrate on the principal details of the deal, the "commercial terms" found in the Confirmation Notice (CN). Hence, once the terms are agreed in the MSPA, the parties can draft the Confirmation Notice. Therefore, MSPA does not contain any quantity or delivery date. The Confirmation Notice and the MSPA assembled together constitute the full binding contract. (MAALOUF Ruchdi, 2018)

Confirmation Notice

CN is a single agreement between the parties and can include additional legal provisions. It will contain all the important details of the trade like the LNG carrier or quantities. CN incorporates the MSPA terms and in case of an inconsistency between the CN and the MSPA terms, the terms of the CN prevail. Even if not signed by the parties, it is binding upon agreement. Confirmation notice can be found in the annex of MSPA. Example are provided on the following pages.

GTCs

However, the General Terms and Conditions "GTCs" for the sale and purchase of LNG works simply as the terms and conditions of a contract like most commodities are traded

today. The general terms are incorporated directly with the commercial terms. This alternative can be used for spot and short-term contracts. The reason being that the parties will not need to agree an MSPA beforehand.

Pros and Cons

A strong advantage of MSA is that after agreed, they just need to draft the confirmation notice to have a deal done. A renegotiation of all the terms is no longer required because all the terms that could be agreed once and for all will have been included in the MSA. (MAALOUF Ruchdi, 2018)

On the other side, GTCs do not need to be negotiated before a deal and can be more practical on short term and give greater flexibility.

2.2 Which contracts to choose?

Each big trading company or LNG association which provides a standard MSPA or GTCs online will be willing for it to be used as the reference contract in the market. The reason is simple, by creating it, the company masters all the clauses and details and so have a strong advantage in case of litigation. Therefore, they are all aiming to have their standard contract as the most used in the market. That is why they gave everyone on the internet access to it.

There are now four standard models of master LNG sale and purchase agreements ("MSPAs") available which are used by big trading companies. On the other side, only one GTCs is available which was published by a law firm. Below is the information about them:

1. The first MSPA was provided by **AIPN**, Association of International Petroleum Negotiators, in **2009**. Prior to the AIPN board action, there was no industry standard in the LNG market, with more than 100 different forms being used by buyers and sellers of LNG. The Objective was to help the industry establish a uniform short-term and spot sales agreement, thereby reducing transaction time, cost and uncertainty. AIPN is a not-for-profit association supporting international energy negotiators. This MSPA is the only one requiring fees to access it. In addition, it is the oldest one. Therefore, we will not be using this MSPA in our comparison.

2. Then, **GIIGNL**, International Group of Liquefied Natural Gas Importers, published the second MSPA in **2011**. GIIGNL is also a non-profit organisation

providing analysis of LNG industry, a forum for the exchange of experience and information among its 83 LNG members and many other services in the LNG industry. MSPA Available below is one of the 3 used for the comparison: https://giignl.org/system/files/publication/111231_giignl_fob_msa2011_final_.pdf

3. A few years later in **2017**, a MSPA was published by **Trafigura** aiming to be the LNG standard LNG MSPA. The Swiss trading house is one of the largest physical commodities trading groups in the world and is specialised in metals and energy. It was the first time that a trading company issued a standard MSPA. MSPA Available below is one of the three used for the comparison: https://www.trafigura.com/.../trafigura-master-lng-sale-and-purchase-agreement.pdf

4. LNG contract template "LNG GTCs (General Term Clauses) **2018**", developed by Ruchdi Maalouf, chair of oil and gas at law firm **De Gaulle Fleurance & Associes.** The objective was also to facilitate short term transactions. The French law company is a small/medium size with 113 lawyers. The company is not specialised in the commodity trading sector, which makes it less reliable and after analysis we realised that this document was not relevant. Therefore we decided not to take this document in account.

5. Finally, newly developed at the end of March **2019,** LNG MSPA by **BP**. Specialised in Energy, BP is like Trafigura, one of the world leading producers and traders of LNG. MSPA Available below is one of the 3 used for the comparison: https://www.bp.com/content/dam/bp-trading/en/global/trading/Documents/LNG/bp-master-ex-ship-lng-sale-and-purchase-agreement-2019-edition-pdf.pdf

Even though MSPA are usually done on a long-term basis, it seems that the four standardised versions are more focused on spot or short-term trade but can apply to medium-term as well. The standardised versions focus only on the trade of the LNG while long term MSPA includes other aspects like the financing agreements, the obligation of the parties to buy and sell on a regularly basis and shared liabilities on some part of the extraction and liquefaction process. These deals amount to billions of dollars to secure the production and the sales which make the contract more specific and complex. We will just focus and compare the standardised versions of Giignl, Trafigura and BP which are the three latest MSPA published.

We will look at the three key clauses and compare with between each contract in order to acquire a better understanding and to analyse which is the best for a LNG trade and secondly the best fit for our smart contract. Hence, we will create a table comparing the contracts on many characteristics like completeness, clearness and relevance. By going through the clauses, points will be attributed which will determine which contract will be chosen. The completeness of the content is to avoid unpredicted situations, the clarity to prevent ambiguity and allow the contract to be self-executing and relevance to include last practices, corrections and prevent the possibility to be not valid.

2.2.1 What are the incoterm used and why / TRANSFER OF TITLE AND RISK clause

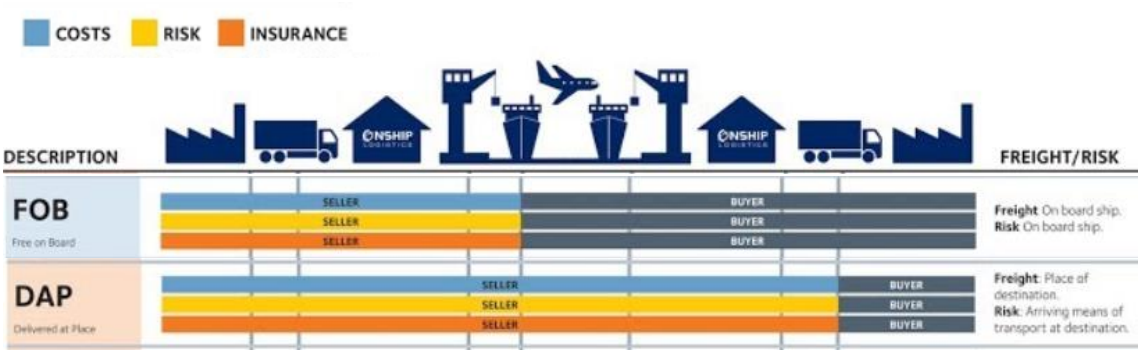
For each clause comparison, a table showing the corresponding clause in each MSPA will be displayed in order to allow the reader, if wanted, to read the clause corresponding.

MSPA	Incoterm	Transfer of Title and Risk clause n°
Giignl	FOB	8
Trafigura	FOB and DAP	9
BP	DES	11

Incoterms deal with risk transfer, delivery obligation and costs. They are sets of rules delivered by the international chamber of commerce (ICC). The last version provided by the ICC is the “INCOTERMS 2010”. Incoterms do not deal with property because each country’s law is different.

FOB “*Free On Board: Risk passes to buyer, including payment of all transportation and insurance costs, once delivered on board the ship by the seller*” according to INCOTERMS 2010.

DAP “Delivered at Place: Seller bears cost, risk and responsibility for goods until made available to buyer at named place of destination. Seller clears goods for export, not import” according to the INCOTERMS 2010



https://i.ytimg.com/vi/IRK_uNBNFcA/maxresdefault.jpg

The first interesting point is that Giignl using FOB and BP using DES are still referring to INCOTERMS 2000. Only Trafigura uses the last version. It is also noticeable that the Trafigura MSPA gives the possibility to choose between FOB and DAP.

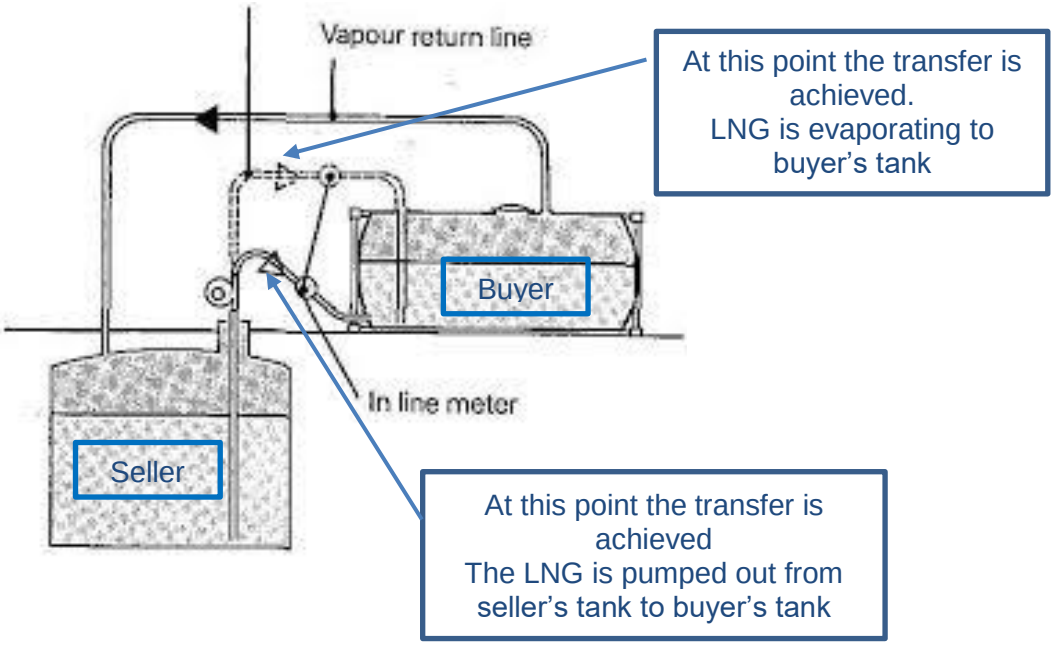
For **FOB** the main difference between 2000 and 2010 is that in the 2000 version the transfer of risk passes over the ship's rail[7] but on FOB 2010 version, it passes when goods are on board of the vessel. It seems that this change was implemented mainly for containers because it would make more sense to pass the risks when the goods are loaded on the ship. However, for oil and LNG, as it goes through pipes, the previous version was a better fit. But at the end, this makes no difference because the delivery point in the three contracts where the transfer of risk occurs are specifying the same specific point in the pipe explained below.

In INCOTERMS 2010 **DAP** replaced **DES**. By reading both, we can figure out that DES applies exclusively for ships, while DAP can be used with other means of the transport like railway. However, LNG will always be transported by ship. The transfer of risk passes when the LNG will be available/ at disposal for the buyer. We understand that the seller bears the costs and risks of discharging the LNG. In both Trafigura and BP contracts, the specific point of transfer of risk and title is clear and well defined. It is the same specific point that is written on the GiigIn contract with FOB incoterm. The only difference is that with the FOB incoterm, the transfer point is at loading port, but with the DAP/DES incoterm the transfer point is at discharge port.

The specific transfer point for an FOB delivery is stated as follow*: "as it passes the point at which the outlet flange of the vapour return line of the LNG Ship connects with the inlet flange of the vapour return line of Seller's Facilities*" (Trafigura LNG MSPA, 2017, p. 9)

7 "*The **ship's rail** is the **railing (rampe)** around the outside of the deck (pont) which stops someone walking on deck from falling overboard. The writer has used this form of words to try to explain to an uninitiated reader what FOB means*." (OWEN, 2015)

Below a small illustration:



Therefore, there is no consequent difference for the transfer of risk, but the main changes on the 2010 version[8] on page 2 explains electronic documentation in more detail. Indeed, the possibility to provide electronic documentation is frequently stipulated. This addresses a major point because the smart contract will connect all the documents together and to do so, the documents will need to be standardised. This would make only electronic documents possible. **1 point** for Trafigura as it is the only contract referring to INCOTERMS 2010.

Why are only FOB or DAP/DES available in the standard contracts?

When natural gas is delivered by ship, it needs to be liquefied, meaning it has to be cooled down to minus 162 degrees. The gas is transformed into liquid form because it takes up 600 times less volume which therefore makes it much easier for shipment and storage. A gas **pipeline** is linking from the extraction plant to the seaside where it will go through a **liquefaction plant** to be liquefied. Then it can be shipped or stored for later shipment. The liquefaction plant will always be situated on a coast. That is why, in

[8] INCOTERM 2010 https://oneworldship.com/wp-content/uploads/2017/09/INCOTERMS-2010.pdf

LNG trade, only sea incoterms will be used. However, in gas (not liquefied) traded by pipeline, only inland incoterms will be used.

Then, the difference between FOB and DAP depends upon the willingness of the seller to take care of the shipping side. Indeed, if he is willing to take more risk and to take care of the LNG until the discharge port, the incoterm DAP/DES will be used otherwise he will use FOB incoterm. Below is an illustration of existing liquefaction plants and regassification terminals in Asia-Pacific at end of 2017. (Giigln Annual Report, 2018)

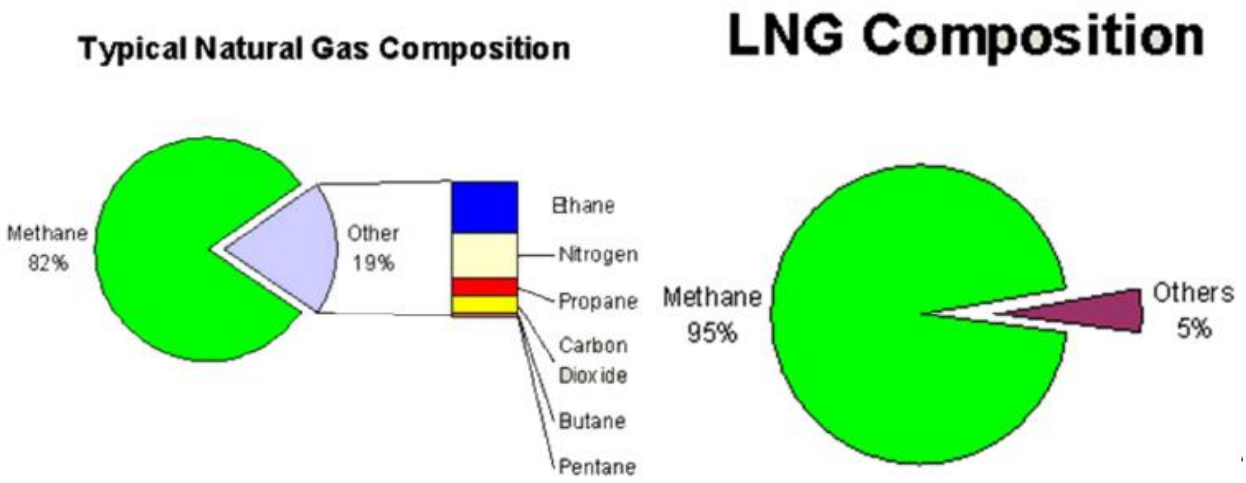

MIDDLE EAST
ASIA
JAPAN
AUSTRALIA
Idku
Damietta
Hadera
Sumed SW
Aqaba
Jordan LNG
Mina Al Ahmadi
Ras Laffan
Das Island
Ruwais
Jebel Ali
Qalhat
Port Qasim SW
Port Qasim Excelerate
Dahej
Hazira
Dabhol
Kochi
Map Ta Phut
Arun
Melaka
Pengerang
Singapore
PFLNG Satu
Lumut
Bintulu
Sontang
Donggi Senoro
Tangguh
Lampung
West Java
Benoa
Port Moresby
Darwin
Gorgon
Wheatstone
Withnell Bay
Pluto
APLNG
GLNG
QCLNG
Sakhalin II
Tangshan
Dalian
Tianjin
Qingdao
Incheon
Samcheok
Pyeong-Taek
Tong-Yeong
Boryeong
Gwangyang
Qidong
Rudong
Shanghai
Zhejiang
Fujian
Taichung
Yung-An
Dongguan
Yuedong
Zhuhai
Guangdong
Beihai
Hainan
Ishikari
Hachinohe
Shin-Sendai
Shin-Minato
Niigata
Joetsu
Naoetsu
Hitachi
Higashi-Ohgishima
Ohgishima
Kawagoe
Sodegaura
Sakai
Sodeshi
Futtsu
Hatsukaichi
Himeji
Chita
Negishi
Tobata
Hibiki
Yokkaichi
Yanai
Senboku
Otta
Sakaide
Nagasaki
Mizushima
Kagoshima
EXISTING LIQUEFACTION PLANTS / FLNGS
EXISTING REGASIFICATION TERMINALS
EXISTING FSRU/ FSUs

2.2.2 Quality and off specification clause

To better understand the quality and off specification clause, an introduction of Natural Gas quality and LNG quality follows. There is no need to be a chemist to understand the basics of the gas composition.

LNG specification

As previously explained, LNG is natural gas cooled down to obtain its liquid form. Natural gas contains a high pourcentage of methane but also other components like ethane, propane, butane or nitrogen. The greater the proportion of methane, the purer the gas or LNG is considered to be.



(Johannesson Staffan, 2014)

During the liquefaction, the non-methane components like butane and pentane are removed from the extracted gas. That is why compared to natural gas, as we can see above, the LNG will contain on average only 5% of non-methane components, rendering it purer. (JOHANNESSON Staffan, 2014)

This can be achieved because, with the exception of nitrogen, the hydrocarbons present in the natural gas liquefy before the methane. Therefore, in most situations in the cooling process the other components are able to be removed. For certain utilisation like as fuel for truck, some hydrocarbons are kept on purpose. Below is a graph of the boiling temperatures of the components usually contained in natural gas. (JOHANNESSON Staffan, 2014)

	Boiling temperature at atmospheric pressure (°C)
Nitrogen	-195.8
Methane	-161.5
Ethane	-88.6
Propane	-42.0
N-Butane	-0.5

Removed during the liquefaction process

(JOHANNESSON Staffan, 2014)

The gas quality will vary depending on its origin. Apparently, studies based on the average compositions from different countries conclude that the highest quality of gas comes from Alaska and Egypt, while the worst comes from Libya and Indonesia. Although it is likely that this will change over time.

There is no mention of classification for the LNG included in the three contracts. However, we understand that the best grades would be the ones with the highest methane composition. Below is a table classifying LNG into three groups according to its density like crude oil; light, medium and heavy.

Molar Composition (%)	**Light LNG**	**Medium LNG**	**Heavy LNG**
Methane (CH_4)	98.60	92.30	85.87
Ethane (C_2H_6)	1.18	5.00	8.40
Propane (C_3H_8)	0.10	1.50	3.00
Butane (C_4H_{10})	0.02	0.60	1.20
Pentane (C_5H_{12})	–	0.10	0.23
Nitrogen (N_2)	0.10	0.50	1.30
Density (kg/m^3) (−162 °C/ 1.3 bar)	427.58	451.58	474.87
LHV (kJ/kg)	49,935	49,557	48,984

(Fernández Ignacio Arias and al, 2017)

Now that we better understand the gas quality, we can compare the quality clause of the three standard contracts.

MSPA	**Clause n°**

Giignl	4
Trafigura	5
BP	6

First part regards the **seller's obligation to provide information about the quality** to the buyer.

The three clauses are similar regarding the seller's obligation to provide information about the quality. Within 48 hours after loading, a certificate, (a notice for BP) is required from the seller, specifying the quality to the buyer. All refer to the specification set in the confirmation notice which is more detailed in the Giignl.

The three clauses deal with the consequences of the LNG not respecting what has been agreed in the confirmation notice. The content is quite similar. The consequences for the seller in case of off-specification will depend only on one fact, when the off-specs was discovered.

They all specify that if the buyer is aware of the **off-spec LNG before the reception** (on the vessel under FOB and in the buyer's facility under DAP), he should use reasonable endeavours and good faith to accept the off-spec LNG. Small parenthesis, this represents a typical example of issue that we have seen in "translation of concept and principle" into smart contract. Indeed, 'reasonable endeavours' or 'good faith" are not possible to code into smart contract. This clause would have to be modified and state clearly to what extent he shall accept the LNG.

Our interpretation of this clause and what we will consider later on this thesis is that the buyer is not obliged to accept the off-spec LNG but in the case that he still accepts it, he can then charge the following costs and expenses to the seller.

On Giignl, there is no limit for the charging costs to the seller.
On BP and Trafigura, the charging costs limit is set to 25% of the "original price".

In case **the buyer realises the off-spec after having taken the LNG** (on the vessel under FOB and in buyer's facility under DAP) and he is able to treat the LNG:

On Giignl, the limit is free to be set.
On BP he can charge up to 100% of the original price.
On Trafigura, the limit is up to only 50%.

The reason why there is such a big gap between before and after, regarding the limit for the costs, is because the off-spec LNG can have big damages on the liquefaction plant.

Indeed, depending on the use of LNG, when delivered to the buyer, the LNG goes to a liquefaction plant to retake its natural form. It has strict requirements on gas purity to prevent freeze out, corrosion and erosion. It would be similar to putting the wrong fuel in a car.

What really shows us these differences is the extent to which the seller is liable in case of off-specs. We can notice that on Giignl, the seller is more liable. We can assume that, it was written with more of a buyer's perspective. Inversely, on Trafigura, in case of off specs, he is less liable which make us assume that it was written more on a seller's perspective. Finally, the BP contract found the right balance between both which therefore earns **1 point** in up-to-date characteristic. This clause can lead us to the following question;

Does it make the quality clause a **warranty** or a **condition**?

When the clause is a condition, in the case of it being breached, the contract can be terminated with possible indemnities required while if it is a warranty, it cannot be terminated but the defaulted party must just pay indemnities.

As we can read above, in the first situation when the off-spec is determined **before** reception, the buyer can refuse and terminate the contract which clearly makes it a condition. The complication lays in the situation of the buyer realizing the off-spec once the LNG has been received.

Indeed, a general characteristic of a clause to be a condition is the refusal of the goods. However, the contract does not even involve this possibility to bring back the LNG and assume that the buyer keeps the LNG. This confirms that in most cases the LNG is degasified in the buyer facility and there is not the infrastructure to liquidate it and bring it back to the vessel. Indeed, as shown on the illustration above with existing liquefaction plants and regassification terminals, they are never both at the same place.

Then, even if the LNG is not brought back and the buyer is unable to treat the LNG, he can charge the total price of the LNG plus direct losses, costs and expenses. In conclusion, it's a mix of a warranty and a condition because the fact that LNG is kept is contrary to a condition but the consequences of the off-spec are the ones applicable under a condition because the applicable costs to the seller are much more than only indemnities.

2.2.3 Measurement, Sampling and Testing

This section includes many technical and detailed information which we will separate, compare and analyse by answering two key questions.

MSPA	Clause n°
Giignl	7
Trafigura	p.41, p.51 schedule F
BP	10

Before answering the key questions, a first glance at the ISO standard and the LNG Custody Transfer Handbook is required.

ISO, International Organisation for Standardisation *"creates documents that provide **requirements**, specifications, **guidelines** or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose."*[9] ISO provide standards as well for different measurement and testing procedures of LNG used in the MSPA.

LNG Custody Transfer Handbook has been developed by Giigln and represents the best current practices at the time of publication. The manual works as a reference to determine the energy quantity of LNG transferred from vessels to terminals and inversely as well as other measurements. It includes procedures, practical issues and requirements of LNG ship-shore custody transfer application. The latest version is the 5th published in 2017 and is available on internet.

Where the testing happens and who is responsible to perform it?

First of all, the place of measurement will depend on the incoterm. To understand, it's important to make the distinction between 2 verifications; first the quantity (volume) and temperature and secondly the composition (quality) verifications. When there is a FOB contract, the quantity and temperature measurement will take place at the loading, by comparing the quantity in each tank before and after loading, and the quality determination by utilising **seller's facilities' instrumentation.** While if it's a DAP, the quantity and temperature are verified by the buyer on the ship with the ship instrumentation and the composition determined with the **Buyer's Receiving Facilities** instrumentation.

[9] ISO website: https://www.iso.org/standards.html

Differently from most of commodities traded, the testing process of LNG is not achieved by an Inspector but by a Surveyor. It appears that only the nomination changes but the services provided by an inspector are the same as a surveyor. An **independent surveyor** can be appointed **to witness** that the right methods of verification of measurement are in line with what has been agreed and **verify and test** the quality. Therefore, he has to be present during the transfer of the commodity. For instance, the BP contract is the only one where appointing an independent surveyor is not compulsory, and can occur only at the request of either Party (BP contract, p.25 paragraph 10.5). Fees and charges of the Independent Surveyor are shared equally. In addition, each party has the possibility to name its surveyor and has the right to have representatives present to witness calculations. In the case of disagreement, determination of the Independent Surveyor(s) shall prevail.

Giigln and BP contracts state that the "Independent Surveyor shall be qualified by education, experience and training to monitor such LNG activity" which is not present in the Trafigura contract. If we think contractually, in the case of disagreement, the parties could try to play on the experience of the surveyor or other qualifications which could carry some complications. In the Trafigura contract, it just states that both parties must agree together to choose one surveyor.

What are the methods for the sampling and composition determination used?

Regarding the method of verification for both the quantity and the composition the three contracts are divergent in a certain way. All of them are referring to the LNG Custody Transfer Handbook" published by the GIIGNL (defined above), however, Giigln refers to the version of 2010 while the others to the latest version published. The 5th edition is from 2017 and includes new methods and new best practice which makes the 2010 version outdated.

Giigln and BP are referring to only one ISO standard, ISO 6976:1995 for the composition determination otherwise they always refer to the LNG Custody Transfer Handbook. Trafigura also refers to this ISO but many others too. The point which can cause some conflict is that most of the time, it is stated that the verifications must be in accordance with an ISO standard and the latest edition of the LNG Custody Transfer Handbook. Firstly from a practical point of view, it can be inconvenient to follow both of them for the same verification and secondly from a legal perspective, if the ISO standard and the Handbook are contradictory or give different result, it can cause some troubles and

inefficiencies. It's even more probable considering that the Handbook is regularly updated.

In Trafigura MSPA, as we have seen before, there are two incoterm possibilities; FOB or DAP. For the Measurement, Sampling and Testing clause, it is difficult to understand what applies to which incoterm, which would add difficulties to code it in smart contract.

Conclusion

In conclusion, Giigln and BP lose 1 point for all the characteristics needed for the surveyor and Giigln loses another point because referring to the 2010 Handbook. Trafigura loses 1 point for the legal perspective between ISO and the Handbook and another point for lack of clarity between the 2 incoterms.

Below is a table which illustrates the points acquired in the 3 clauses and shows us that the best standard contract to be used for the implementation in smart contracts is that from BP.

	Clause			
MSPA	Transfer of Title and Risk	Quality and off specification	Measurement, Sampling and Testing	Total
Giignl			-2	-2
Trafigura	1		-2	-1
BP		1	-1	0

With regards to this analysis, my recommendation for the BP contract would be to change the incoterm DES from the 2000 version in DAP from the 2010 version. Secondly, to remove the qualifications required for the Independent Surveyor and state, like in the Trafigura contract, that the only requirement is that both parties must agree on the Independent Surveyor.

2.3 ***Assessment of the BP contract and preparation for the implementation phase***

Now that we have chosen our "traditional" contract, preparation is required for the implementation phase, in other words, separating the operational clauses from the general clauses as explained in more detail below. Once the operational clauses have been selected, they can be transformed in flowcharts in order to make it more understandable and clearer for the developer. This shows us how the contract is predicting every situation and each possible aspect as well as how they interconnect

between each other. As some clauses can be difficult to understand due to trading terms, LNG specificities or specific contract terms, some explanations are provided which should be considered before the flowchart. The Operational clauses have been separated from semantics (general) clauses, certain clauses may appear in both categories because they contain information about both. The aim of this exercise is to allow the coder to code without the need to have any knowledge of law or of LNG and without losing time going through the whole contract.

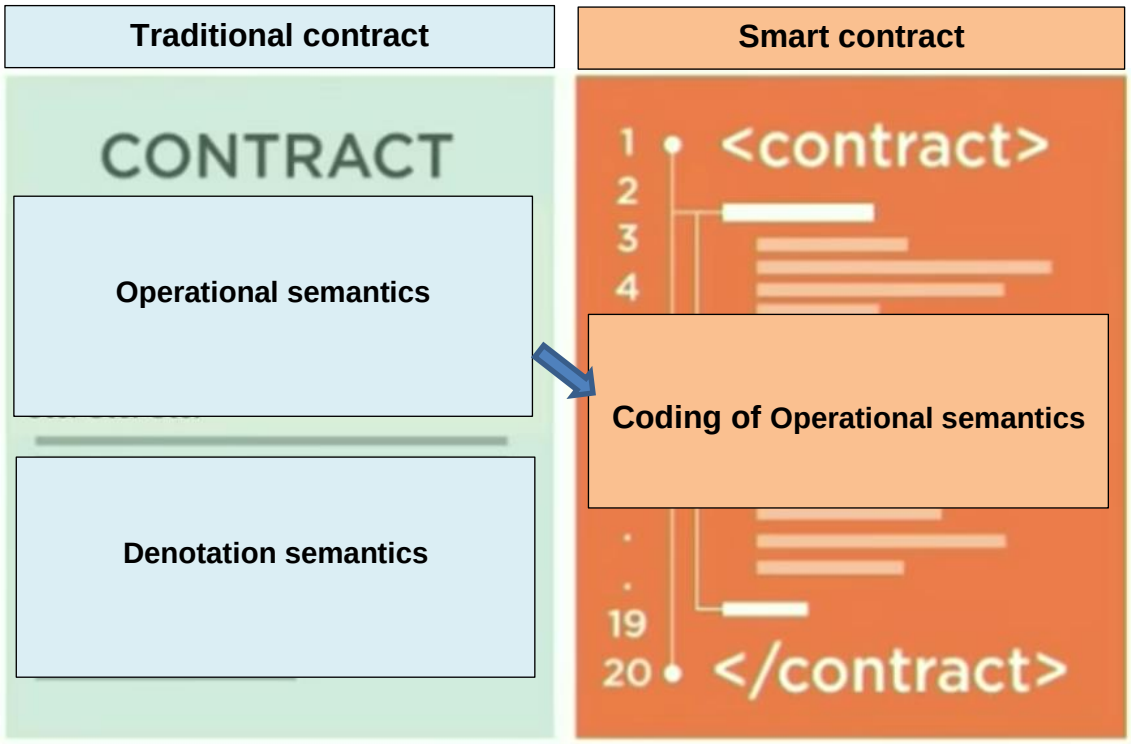
Preparation for the implementation phase

Traditional contract contains 2 parts (RIKKEN Olivier, 2018)

1. **The operational semantics** are operational agreements which represent scenarios with results depending on action and data. For example, **if** the market price per ton is X, **then** I am going to pay out XXX. We can compare it to the formula on Excel; =if().

2. **The denotation semantics** are the general term and conditions of the contract. For example, under what laws the contract is agreed, or under which court a conflict between the parties would be settled.

The translatable parts of a traditional contract are the operational semantics. Indeed, it does not make sense to code general clauses. Then, by coding the operational clauses, you have the execution being done by itself.



(adapted from RIKKEN Olivier, 2018)

The next step is to go through each clause to check if it is an operational clause. Then to write it as simply and clearly as possible in flowcharts which will be used in the coding phase. For the rest of this chapter, the quotations are always referring to the **BP LNG MSPA 2019**.

Clauses which are Operational Semantics

Remember that reading the comments of the clauses is advised before approaching the flowcharts. Below, in PDF format, are the 6 flowcharts based on the clauses of the BP contract, they transpose the text from the clauses into a more simple and accessible format to aid understanding and making connections between each operational clause.

5.1 Failure to receive.pdf | 5.2 Failure to Deliver.pdf | 6. Quality.pdf | 7. Laytime (shipping).pdf | 10. Measurement, Sampling and Testing | 12. Payment.pdf

Below is a video that I produced, summing up what we have seen so far and illustrating the execution of a transaction when it is transformed into a smart contract.

Illustration of a transaction in smart contract available on:
https://www.youtube.com/watch?v=7gDC6gltWa8&t=123s

5. FAILURE BY BUYER OR SELLER

6. QUALITY / 10. MEASUREMENT, SAMPLING AND TESTING

The clauses 6 and 10 are directly linked to each other. In order to better understand better the flowcharts of these two clauses, some explanations are required.

Having seen and explained these clauses in the comparison of the three MSPA, there are two important points to remember;

1. The difference between the quantity and the quality verification.

In this contract, the quantity is checked only once. It occurs when the LNG is unloaded. This step is done by the seller and he has 48 hours following completion of unloading to notify the buyer of the quantity delivered.

The quality is checked twice. The first time is from the seller's facility, when he sent the notice to the Buyer specifying the quality (max 48h after loading). The second time is from the buyer's facility.

This leads to the point, that the surveyor (if requested) shall be present at the seller's facility and at the loading port as well as at the unloading port and the buyer's facility.

Most of the commodities' quality is checked only once which will occur at a certain place depending on the transfer of risk. The LNG is checked twice because the LNG contains high chance to change during transportation. Indeed, if not well handled, it's highly probable to change and to become off-spec even if the LNG was on-spec at the seller's facility. Even if it's well handled, the seller still takes a possible variance into consideration. Hence, it is understandable that only specialized vessels are used for the LNG knowing the value of a vessel full of LNG.

2. Verifications must be performed in accordance with ISO 6976-1995 and the "LNG Custody Transfer Handbook"

The measurement, sampling and testing is a key step which can make difference of billions. Therefore, even if it's written in the contract that a surveyor is appointed only at the request of a party, we deduce that there is always a surveyor appointed. Thus, it's highly probable that a third party (the surveyor) will directly interact with the transaction and therefore with our smart contract. His work will be quite simple on the blockchain. After witnessing the testing and verifying the results, he will have to insert in the blockchain that the LNG is on or off-specification once at the seller's facility and once at the buyer's facility, as shown in the flowchart.

7. SHIPPING

Notice of Readiness (NOR) is a notice provided by a ship master saying that the vessel is ready to load/unload.

Lay time is the amount of time agreed by the seller and the buyer to berth (included in this contract but not always) and the amount of time to load/unload the goods. If extra time is used, demurrage (fees) are charged.

Boil-off compensation applies when the used lay time takes more time than allowed. Due to heat entering the tank during the transfer of LNG when unloading, a part of the LNG in the tank continuously evaporates creating a gas loss called Boil-Off Gas (BOG). Therefore, when more time is used than allowed, the Boil-off loss increases and the quality of the LNG can even be impacted.

15. FORCE MAJEURE

Clause implemented in 5.1, 5.2 and 7 flowcharts.

12. PRICE AND PAYMENT

Clause implemented in 5.1, 5.2, 6 and 12 flowcharts.

The clause stipulates a payment at sight meaning upfront payment following the delivery of the goods. As specified in the contract, the payment must be settled within 10 business days after receipt of invoice. (p.28, paragraph 12.4)

21. CONSEQUENCES OF DEFAULT AND TERMINATION

A typical case when the buyer is defaulting the seller, is because he went bankrupt and he is no anymore able to pay the goods received. Clause implemented in flowchart 5.1.

Clauses which are Denotation Semantics

We inserted all the denotation semantics clauses which do not require any comment in order to keep a global view of the contract and then, all the clauses which are commented.

2. SALE AND PURCHASE, 3. QUANTITY, 4. TERM, 7. SHIPPING 8. BUYER'S RECEIVING FACILITIES, 9. SAFETY, 11. TRANSFER OF TITLE AND RISK, 13. TAXES AND CHARGES, 14. PERMISSIONS AND APPROVALS, 16. LIABILITIES, 18. CONFIDENTIALITY, 19. ASSIGNMENT, 20. DEFAULT, 25. ANTI-CORRUPTION, 26. COMPLIANCE WITH TRADE RESTRICTIONS, 27. GENERAL

17. NOTICES

The address of the Parties for service of notices to be inserted.

22. GOVERNING LAW AND JURISDICTION

English law is applicable for this contract.

23. CREDIT SUPPORT

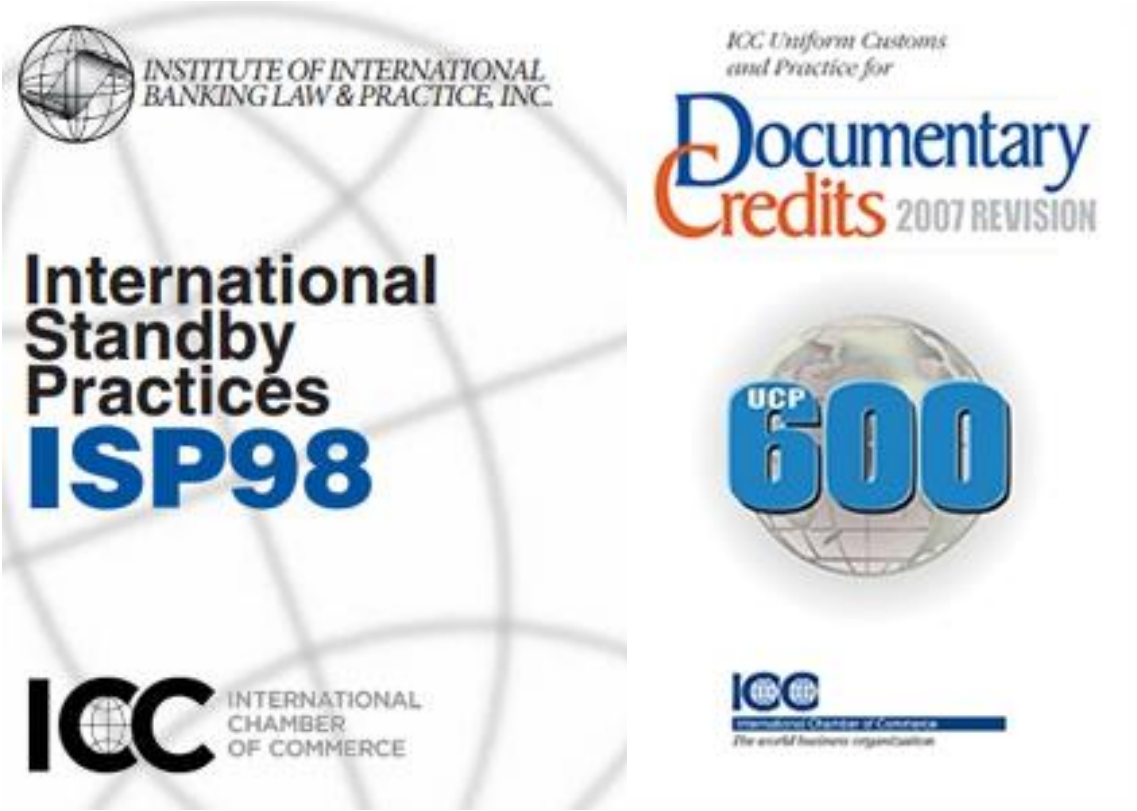
Refer to the SCHEDULE 3 (of BP contract): Form of Parent Company Guarantee and to the SCHEDULE 4 and 5 (of BP contract) for Standby Letter of Credit

This clause is important from our smart contract perspective. As explained earlier, one of the key advantages of the smart contract is to reduce the dependence of trusted parties and this clause is referring to the methods applied to guarantee the payments. It includes the possibility of 2 means of guarantees. In a first time, we will explain them and on a second time, try to apply and understand how the implementation of smart contract can be used to reduce the dependence on trusted parties.

Standby Letter of Credit is a guarantee by a bank that if the buyer fails to pay the seller, then the bank would pay the seller the amount he should have normally received. It works like an automatized Standard Letter of Credit meaning that only if the buyer doesn't pay, the seller has to present the documents called under the Stand-by L/C and get paid by the bank. The procedure is simpler than Letter of Credits. The documents required are **usually** (BARRAS Guy, 2019):

1. *Copy of Invoice marked "unpaid"*
2. *Copy of the transport document*
3. *Seller's statement certifying that the documents were sent to buyer for payment and that buyer failed to pay*

Against the documents, the bank should pay the seller at sight meaning directly. For more details and rules regulating Stand-by L/C refer to UCP 600 and ISP 98.



However, in the Stand-by L/C provided in the schedule 4 and 5 of the BP contract (p. 58 for fixed price Stand-by L/C), the document required is only the seller's statement certifying that the documents were sent to the buyer for payment and that the buyer did not pay (p.61).

The Stand-by L/C exists because of Americans. Banks in United States cannot issue guarantee and hates documentary procedures. It is usually used by large companies when there is a high degree of trust between the parties.

Parent Company Guarantee can apply only when the trade is achieved with a subsidiary which is a wholly-owned direct subsidiary. In that case, the parent company becomes "Guarantor" by entering a **Deed of Guarantee,** which means that if the counterparty (the subsidiary) makes any default, the parent (the Guarantor) shall within 10 days of demand in writing pays the amount of the default to the Beneficiary.

This method of Guarantee is interesting from both sides. It allows the buyer to avoid paying fees to a third trusted party. From a seller's perspective, even if a trusted party like a Bank is more reliable, Parent companies are usually large, and the risk of bankruptcy is much reduced. Like the Stand-by L/C, this method is used when dealing with big companies and a high degree of trust (p. 51 to 57).

How the implementation of smart contracts can be used to reduce the dependence on trusted parties?

When a payment is due under a smart contract, the order of payment should automatically initiate the payment. Therefore, it should avoid the default risk of counterparty and remove the need to have any guarantee. But what happens if there is not the fund to be withdrawn in the counterparty account?

The answer is clear, if the funds are not in the account, there is no payment which means that there is no guarantee. In the other way, if the funds are locked/frozen from the moment the trade is agreed, it's as well pointless because the owner of this fund could not use or earn any interest on it during that time. From a trade finance point of view, it is inconceivable to ask such big amount to be frozen. We are facing a conflict between risk and return which means that if we freeze the amount, the counterparty risks are avoided but no return on that money meanwhile. Inversely, if the funds are not frozen, there is no guarantee.

Before to bring our solution, it's important to understand what prevent the contract. As referred to the Price and Payment clause, (p. 25), the payment is at sight and must be settled within 10 business days after receipt of invoice. On smart contract, the payment could be initiated after 2 events. After that the total volume agreed has passed the point of transfer of risk and title, and after the surveyor has checked the quality and quantity and validated them or not, refer to flowchart 6. The reason is to protect the buyer in the case he discovers that the LNG is off-specification or that the quantity delivered does not correspond to what has been agreed.

Secondly, a requirement for the Standby L/C and Parent Guarantee is that they must be provided at least 5 days prior to the commencement of the Arrival Period (included in confirmation notice p. 47). Hence, if the arrival period is the 10th of June, the guarantee must be provided at latest the 5th of June.

This information helps us to conclude that indeed, it's impossible to freeze the funds months before the trade is done however, it could be frozen 5 days prior the commencement of the Arrival Period which would allow meanwhile to gain return on the funds and to give a guarantee to the seller before the dischargement.

There is still one problem, as shown in flowchart "failure to receive", if the buyer fails to receive except under certain conditions stated in the flowchart, he will have to pay the difference between the price which has been agreed in the contract and the price at which the seller succeeded to resell it. How the seller could get a guarantee in this

situation to be compensated if there is no money on Buyer's account without the need to go to a trusted third party?

A typical instrument answering this question is the performance bond which protects one party of the contract against failure of the other party to fulfill his obligation. Nevertheless, it is mostly issued by Banks and the aim is to reduce the dependence on them.

Because smart contract can initiate payment and as referred in flowchart "failure to receive", if buyer fails to receive LNG under certain conditions, buyer shortfall payment would be initiated. Hence, if a certain percentage of the contract value is frozen on the buyer account, it would result in the same way than a performance bond. As per the contract, this percentage should be equal to cover the expenses to find another buyer and the difference of the price between the original price agreed and the one at which it was resold.

Typical performance bond ranges from 1% - 5% (Viking Bond service. Inc, 2019). To determine the percentage would require some experience but for our case, we will take the highest rate used for performance bond which is 5% of the contract price. This amount should be frozen in the buyer's account 5 days prior shipment. Then if the expenses to find another buyer auditioned with the difference of price are higher than 5%, the buyer would still owe that amount to the seller. The seller won't have any guarantee over 5% with the smart contract but he could still go to court. We understand that the buyer would be obliged by the contract to freeze this 5% 5 days prior shipment and that if the buyer fails to receive the LNG, the 5% would be directly withdrawn.

Finally, there are two situations where **the seller would be as well liable**. First situation is, as referred to clause and flowchart "failure to deliver", if the seller fails to deliver the LNG, he is liable to 40% of the original value. The second situation is as referred to the quality clause and flowchart, if he delivers the LNG which is off-spec and untreatable, he is liable also for 40% plus costs of treating such LNG. All the other situations would result only in a diminution of the price he should receive initially. Therefore, the Stand-by L/C and the Parent Company Guarantee are not prepared only to guarantee the seller but as well the buyer.

The option to ask the seller to freeze 40% of the contract value is not conceivable. It would be interesting to know if sellers are in real trade, undertaking a stand-by L/C. Here we would require experience of a professional but we will make an assumption.

Our assumption is that as explained before, companies trading LNG are huge and have high degree of trust between each other. Hence, we assume that the seller would not

add expenses by entering a stand-by L/C which means no other guarantee for they buyer than going in court if the seller does not deliver the LNG. Therefore, no money would be neither frozen on seller's account. However, if the usual way of doing is that the seller is as well entering a Standby L/C, the smart contract solution to protect buyer from failure by the seller to deliver would be to freeze 5% of contract value on seller's account 5 days before shipment.

To sum up, we raised 3 situations where the smart contract would reduce or even remove the need of a third trusted party.

1. First situation integrates how the seller can be ensured to be paid after delivering the LNG. Indeed, by freezing the amount owned by the buyer 5 days prior the commencement of the Arrival Period, the seller would be ensured that if he respects the other clauses, he would be paid. This solution removes the need of a trusted party.

2. Second situation deals with the question of how the seller can be indemnified if buyer fails the receive the commodity. We brought the idea to freeze 5% in buyer's account 5 days prior shipment. The problem is that the costs incurred by seller could be higher than 5% and therefore the seller is not cover at 100% but no costs of Standby L/C would occur neither. There is always trade-off!

3. Third part includes the two situations where seller would be liable which are if seller fails to deliver and if the LNG is delivered off-spec and untreatable. We did not find a better solution than to conduct a standby L/C to protect the buyer or to freeze 5% of the contract value on seller's account 5 days before shipment.

We understand that the requirements above should be included in the standard contract as a condition. Finally, the flowcharts have been written exactly as per the contract and therefore includes the invoice process which would be removed when implemented in smart contracts. Therefore, I highlighted the step in yellow where the smart contracts would stop because of automatized payment but we kept the following in order to show the procedures that can be avoided by using smart contracts.

24. DISPUTES

[SIAC/LCIA] Rules as stated in the contract are referred to the following meaning;

"SIAC" means the Singapore International Arbitration Centre

“SIAC Rules” means the Arbitration Rules of the SIAC, as may be amended, varied, superseded or replaced.

“LCIA” means the London Court of International Arbitration;

“LCIA Rules” means the Arbitration Rules of the LCIA, as may be amended, varied, superseded or replaced from time to time as the primary arbitration rules of the LCIA.

(BP LNG MSPA 2019)

3. Implementation phase

After analysing the available LNG MSPA and choosing and preparing the best one fitting to our need, we can start the implementation phase. In other words, the transformation of the standard contract into a smart contract. As a first step, a comparison between private and public blockchain is performed. Once we choose the type of blockchain, we can concentrate on the available ones and select the one most adapted to insert our smart contract. Then we can find the best solution to code the smart contract.

3.1 Is a public or a private blockchain the best option to implement the smart contract?

There are 3 types of blockchain; public blockchain (which is fully decentralised), private blockchain (which is centralised referred as permissioned blockchain) and consortium (which is a mix of both). To choose which one to operate depends on 3 differences. For a deeper understanding refer to the "discussion and feedback" part. (EENMAA-DIMITRIEVA Helen and al, 2018)

1. The identifiability of persons transacting on blockchain: On public blockchain, the participants (miners) are anonymous while on private they must be authorised to transact. On a commodity trade, each participant unlocks a specific step of the sale, and therefore it is important to have to authorise them and to verify their identity. Hence, regarding the identifiability, a permissioned blockchain would be more suitable.

2. Selection of node: A node is a computer which becomes a part of the network, a device on the blockchain.

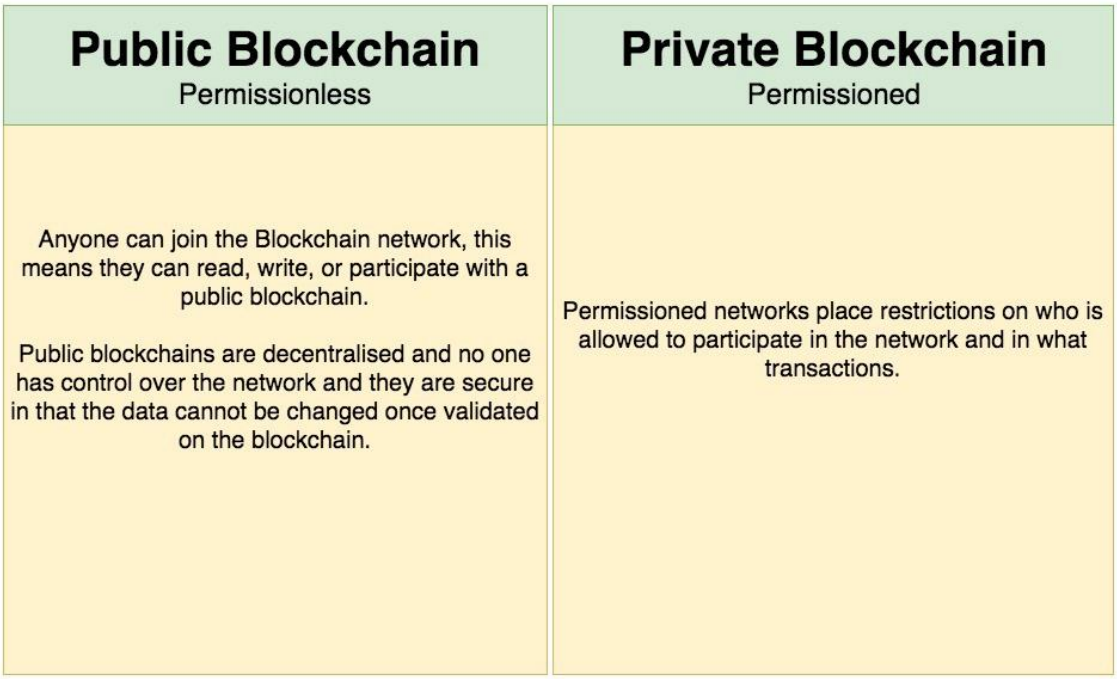
   On private blockchain, only authorised machines can become a part of the network and their number is relatively small. Indeed, to gain access to the platform, the person must be invited and then validated by the network starter to contribute to the transactions. Therefore, the blockchain is called a **permissioned blockchain** where nodes are **centralised**.

   On public blockchain, anyone can participate and therefore is called a **permissionless blockchain**. No one has a control over the network and no authorisation is required to participate where nodes are **decentralised**.

   This represents a key difference regarding the consensus process. Consensus mechanism is a protocol which ensures that all the nodes or the majority agrees

with each other on the decision about a transaction. Therefore, on a private blockchain, as fewer miners are participating, the consensus process is quicker and more efficient. (Blockgenic, 2018)

3. Transaction transparency: If blocks contain sensitive information, a private blockchain is more advisable as on public blockchain anyone can read the content of the blocks, there is no privacy for transactions. When private, the designer can restrict the access of users to certain blocks. Indeed, the inspection company could access only the block corresponding to the verification of goods. The seller of LNG doesn't want the inspector to know the price at which he sold the LNG.



(MASSESSI Demiro, 2018)

After stating the differences above, it seems that a private blockchain is the best solution for any commodity trade and specifically for our LNG trade.

3.2 Which blockchain platform to use?

The question of private vs public blockchain was solved. Indeed, a private blockchain platform is required to code our contract. But there are different private platforms that can be used to develop our smart contract. When I started to compare the private

blockchains I excluded Ethereum which is a public blockchain. I realised I made a mistake when I noticed that Komgo SA[10] is using Ethereum.

When talking about blockchain, people are in fact talking about public blockchain in which anybody can participate to the blockchain and everyone have access and read the data. We can read on many sources that Ethereum is the most popular platform utilised to develop smart contract. Ethereum has its own crypto currency which is Ether and is based on decentralised exchange protocols and therefore is related to a public blockchain.

We will first present the 2 most used and developed “permissioned blockchain” platforms which are Hyperledger Fabric and R3 corda and then compare it with Ethereum.

Hyperledger Fabric vs. R3 Corda

First of all, it’s important to understand that both of them have no crypto currency and are open source hubs which use and seek to develop cross-industry blockchain technologies. The two of the leading Distributed Ledger Technology platforms have two different type of offerings. (GRUYCHEV Krasimir, 2019)

Hyperledger is part of a multi-project effort, hosted by The Linux Foundation and originally sourced by IBM which concentrates on Business to Business transactions aiming to interconnect a number of different business sectors. Their offers are designed for asset life cycle, supply chain application and commodity trading including finance application. The programming language mainly used is Golang which was developed by Google. A programming language allows to codify the transactions in smart contract.

On the other hand, **Corda** is the main product of the R3 consortium and takes adoption among financial institutions as a global independent network. Its solution is designed for financial institutions and provides solutions such as insurance applications and loan / finance applications. The programming language used is kotlin.

We understand that they are not really competing but provide different solutions in different segment of the markets. Between Corda and Hyperledger, the offer from Hyperledger is the best option for our LNG trade. This leads us to the last question.

Which blockchain between Hyperledger and Ethereum is the most interesting for this LNG trade?

[10] Refer to second paragraph of the literature review

This comparison is difficult and complicated as it implies many computer science terms and is constantly in development. As explained above, Hyperledger has been developed specifically for the trade of commodities, while Ethereum was created for a wider purpose. In addition, even if it seems that Ethereum can incorporate some features of a private blockchain, it is basically based on public blockchain which should make more complicate the implementation of our LNG trade. The table below compare the features of the 2 platforms.

Hyperledger vs. Ethereum: Comparison

Features	Ethereum	Hyperledger
Use Case	Popular with generalized applications and mostly used for Businesses to consumer operations	A preferred platform for business 2 business operations, mainly used in enterprises
Confidentially	Transparent	Highly Private thus Confidential transactions
Mode of Peer Participation	Can be both private and public thus a permission-less network	Being a Private Network Permission is needed to access network content
Consensus Mechanism	Proof of Stake algorithm as consensus is achieved through mining	Relies on Pluggable Consensus Algorithm On a Lack of Mining
Programming Language	Smart contracts powered by Solidity programming language	Relies On Google's Golang Programming Language
Cryptocurrency	Powered by Ether native currency.	Does not an have an Inbuilt native Cryptocurrency

(MASSESSI Demiro, 2018)

The **key point** which confirms that Hyperledger is more suitable for our trade is the confidentiality. The commodity trading includes highly confidential information where data worth a lot. Therefore, it would be surprising to run a contract on a platform where everyone could have all the information of the trade. Finally, it seems that the exchange of money on Ethereum can be done only with Ether which can add complexity due to its fluctuation and uncertainty. In conclusion, we decided to run the smart contract on Hyperledger Fabric.

Before, to validate this step as my knowledge are small on that domain, I asked feedback from the expert in blockchain Mr. Lapinte, whom showed me the trad-off between the utilisation of Hyperledger and Ethereum.

Finally, there is still a question what seems nonsense from our analysis. Why Komgo is using Ethereum knowing that the information is transparent. The answer is brought in the "discussion and feedback part".

Hyperledger introduction

A video has been developed by Hyperledger which introduces what they do, available on this link: https://www.youtube.com/watch?time_continue=171&v=EKa5Gh9whgU

3.3 Implementation phase

To implement the contract into the platform is a long process which requires a lot of time and IT knowledge. As we reached this last step, which is primordial, we had to take a decision how to implement the contract. Below are the steps which we have undertaken and the final solution.

1. I gathered my brother, whom is an engineer in Micro Technik with programming skills, and a friend, whom has a bachelor's degree in informatic. After spending three days downloading software to allow me to code on Hyperledger, my brother and I realised that we would require 3 more days. Meanwhile, my friend told me that to code my contract would require too much time and that he could just code a small part, but it would not look professional at all. This experience was already conducted by a former student which resulted in something different than smart contract (COLLET Romain p. 83, 2018). All that made me give up on this option as I hoped for something clean and professional.

2. As I realised that it requires a lot of work, the double bachelor idea came to my mind. I remembered that there is a branch called "Informatique de Gestion" (computer science) at HEG. My idea was to ask a student to make his bachelor thesis on the second part of my bachelor thesis. Hence, I could work with him and gather all the knowledge I got from these three years in International Business Management with his knowledge in computer science to end up with the smart contract of the BP contract on the Hyperledger blockchain. After confirmation was received from Mr. Trabichet, head of the Computer Science branch that a double bachelor thesis is possible, 1 month and half before the end

I sent an email to all the students in their last semester. Unfortunately, it appeared that it was too late, and it did not work out.

3. I still did not give up. I learned that differently than in the IBM branch, during the first semester of the year, IT students are doing their 6th semester and finishing their bachelor. Therefore, my idea is to go to an IT class when courses start and present my idea to motivate a student to do a double bachelor thesis with me. If my advisor and the HEG agree, it would not change much for my rating because my part is already done but I would engage myself to continue to invest my time and my energy to support the second part of this thesis.

4. Discussion and feedback

4.1.1 Discussion by phone with Cyril Lapinte (first interview)

Mr. Lapinte is one of the founders of Geneva Devchain, which organises blockchain Conferences and communities based in London and Geneva, mainly for computer science people. Cyril is a blockchain expert and a smart contract developer. I had the chance to have contact with him as we were colleagues at SIX Group a few years ago.

Through our discussion about my project, he explained to me some points which lit up some shaded areas.

When I explained him that a private blockchain fits the best to my trade, which made me decide to use Hyperledger and not Ethereum, he stopped me and developed the following; Private blockchain does not exist. It is purely a marketing strategy. IBM called Hyperledger a private blockchain as it sounds fancy and allows to enhance “the psychology of change management”. This strategy shows that to change the minds of hundreds or thousands of people, the help of psychology is required. Indeed, the commodity trading way of doing did not change for a while. The psychology behind it is that by making a link between the major discoveries improving the performance, it allows you to change the mind-sets and the behavior of companies and employees. This is the strategy used, according to Mr. Lapinte, to change business practices (in commodity and other domains) and thus giving a better outcome.

Defending my findings, I started naming the key differences about the characteristics between private and public blockchain, like the identifiability of persons transacting. For an LNG trade, it is impossible that the parties involved are anonymous, which is the case on public blockchain.

After agreeing, he added that on Ethereum, you can choose to allow the access to the parties, or you can make the participants (miners) anonymous.

I answered that a public blockchain is an absolutely immutable blockchain and therefore avoids any manipulation of the ledger which in case of error would make it impossible to be modified. In addition, an error in the coding is probable and that on commodity trading, it was common to have amended transactions. He agreed but explained that from the moment the involved parties accept to modify the smart contract, the latter contract is stopped and will stay recorded on the platform but not used anymore and that a new contract will be issued on which the trade will continue.

At that point, it became clearer why Komgo SA[11], the first blockchain-based platform for the trade of commodities founded by many banks and commodity trading companies, is using Ethereum.

Then my argument was that indeed I can implement my LNG trade on Ethereum, but it would require more work as it is not specifically done for private trade in comparison of Hyperledger.

Finally, he concluded by saying that what I am calling private blockchain are different kind of data base, like he cited Oracle and slack and that it was maybe not a bad idea to use Hyperledger Fabric.

4.1.2 Event "Blockchain Hands on" and discussion with Cyril Lapinte (second interview)

The event was organized by Devchain and specifically Cyril Lapinte. A meeting is organized every first Tuesday of the month. The goal is to build a community interested in putting their hands on blockchain and smart contracts, which explains my venue.

During the presentation and at the end, I had the chance to discuss some important points with Mr. Lapinte and Noé Curtz, whom has a bachelor's in engineering, a doctorate in physics and is highly involved in blockchain. When I showed them the flowcharts and explained how concretely the operational side will happen, as referred to the **video "Illustration of a transaction in smart contract"**, the following questions were raised;

Some millions would be in game, how can ensure that a party would not pay a third party to enter wrong data in the platform and make lose millions to the other party?

To illustrate the question, we will keep the example used in the video except that in this case, the seller realizes the LNG is off-specification in his facility and corrupting the independent surveyor, whom is in charge to validate the LNG in the blockchain. The independent surveyor will then react like the LNG is on-spec in both seller's and buyer's facility. By corrupting the independent surveyor, a payment on the blockchain of 100% will be generated for an LNG, which in fact was off-specification.

My thinking is that smart contracts do not cover from any risks. In that situation, as it would happen without the use of smart contract, the buyer would have to go to court to

[11] Refer to second paragraph of the literature review

find justice. Indeed, the fundamental goal of smart contract is to facilitate the transaction, but it does not in every situation.

4.1.3 Feedback on the third part "implementation phase" from Cyril Lapinte

After sending the third part of this thesis to Mr. Lapinte, we had an hour-long call where he brought me his feedback.

The first subject of discussion was the 2 characteristics that I mentioned when comparing the public vs private blockchain.

The first characteristic mentioned was the transaction transparency which answers the following question; **How can big trading companies accept to have the whole information of their private trade on Ethereum being accessed to everyone?**

He explained that indeed, all transactions being executed on Ethereum are recorded and being accessible to everyone. However, there are 2 ways to diminish the information being accessible. The first method is to disclose the minimum of information in the smart contract and the second method is to use multiple IP addresses which can possibly allow the parties to stay anonymous. Hence, the information provided can be restricted but only to a certain extend.

Then he mentioned the "selection of node". In fact, it is a part of what is called the Governance which is what defines the rules. The public blockchain has predefined rules which define who, what and how. It prevents fraudulent manipulations of one party on public blockchain as to modify the rules that the majority of miners must decide so and it usually represents a large number. It is true that a data base platform (private blockchain) has lower costs, is simpler and run transactions faster than public blockchain but there is not the possibility to learn from the other trades and previous mistakes and secondly the risks of hacking are higher. The aim of public blockchain is to be like internet but from which everything is contractual and liable.

Most of the functions which can be done on private blockchain can be done on public blockchain but not inversely.

5. Conclusion

This paper has explored all the key questions to transform a standard contract in a smart contract starting from law implication, continuing with commodity trading aspects and finishing on technology. Each answer was conducted by using real data and contracts based on analysis and comparisons.

We successfully managed to show the feasibility of implementing a smart contract into the blockchain, but the research faced some limitations particularly due to the time restriction and computer science knowledge missing.

Indeed, the need for future research is present and the solution brought is the double bachelor thesis, which could allow the students to go through the limitations and try to develop a professional project. The merger of two faculties and two theses should allow a deeper delve into the subject. However, we have learned that the double bachelor is difficult to be achieved at the same time. It would be like starting to write the end of a story without knowing the beginning. Hence, we will achieve it in deferred, my part is now finished and next semester the computer science student will write the second part with a continuous implication from my side.

Billions are invested in new technologies; the largest commodity trading companies are gathering to create joint ventures on blockchain and the year 2019 saw already some trades conducted with smart contracts. These facts clearly show the belief in changing the traditional way of conducting deals, which has not changed for decades. In conclusion, we are convinced that the technology developed over the last few years gives us the necessary tools to realise such a project.

6. Bibliography

ALLEN AND OVERY, 2017. Smart contracts for finance parties, *Allenovery.com* [online]. [Accessed on June 18 2018]. Available from: http://www.allenovery.com/publications/en-gb/lrrfs/cross-border/Pages/Smart-contracts-for-finance-parties.aspx

BARRAS Guy, 2019. *Main Characteristics of an Oil Documentary Credit: Using Documentary Credit or Standby Letter of Credit?* [Booklet], March 2018. Geneva Business School of Administration, commodity trading major course, 2018-2019, document given by hand by M. Barras

BENDER Jan Philipp and al, 2019. Capturing the Value of Blockchain platform [online]. Available from: https://www.bcg.com/en-ch/publications/2019/capturing-blockchain-value.aspx

Blockgenic, 2018. Hackernoon Website, Article on Different Blockchain Consensus Mechanisms [online]. Available from: https://hackernoon.com/different-blockchain-consensus-mechanisms-d19ea6c3bcd6

BONNER Marianne, 2019. Website, blog on "What Is a Legal Contract?" [online]. Available from: https://www.thebalancesmb.com/what-is-a-legal-contract-462462

Browne Ryan, 2018. HSBC says it's made the world's first trade finance transaction using blockchain [online]. Available from: https://www.cnbc.com/2018/05/14/hsbc-makes-worlds-first-trade-finance-transaction-using-blockchain.html

CHEN James, 2019. Investopedia, definition of performance Bond Website Available from: https://www.investopedia.com/terms/p/performancebond.asp

COLLET Romain p. 83, 2018. Bachelor Thesis at HEG, Smart Contracts: The Use of the Blockchain Technology in Trade Finance [online on RERO doc]. Available from: http://doc.rero.ch/record/323523?ln=fr

Credit Suisse, Letter of Credit. Pdf on types available of Letter of Credit, different constructions, and procedures [online]. Available from: https://www.credit-suisse.com/media/assets/private.../akkreditive-en.pdf

DNG Energy, 2017. Website available from: https://dng.energy/about-us/

edChain, 2018. Blog "A Comparison Between 5 Major Blockchain Protocols" [online]. Available from: https://medium.com/edchain/a-comparison-between-5-major-blockchain-protocols-b8a6a46f8b1f

EENMAA-DIMITRIEVA Helen and al, 2018. JSD Yale Law School, Creating markets in no-trust environments: The law and economics of smart contracts [online]. Available from: www.sciencedirect.com

Ernst & Young, 2017. Article “Overview of blockchain for energy and commodity trading” [online]. Available from: *https://www.ey.com/...overview-of-blockchain-for-energy-and-commodity-trading/.../ey...*

FERNANDEZ Ignacio Arias and al, 2017. Article in Renewable and Sustainable Energy Reviews [online]. Available from: https://www.researchgate.net/figure/LNG-classification-based-on-density-and-composition-6_tbl1_309454957

Global eTrade Services, 2019. Global eTrade Services Facilitates Trusted Connections… [online]. Available from: https://www.prnewswire.com/.../global-etrade-services-facilitates-trusted-connections-a...

GIANCASPRO Mark, 2017. Law School, University of Adelaide. Is a ‘smart contract’ really a smart idea? [online]. Available from: www.sciencedirect.com

Giigln Annual Report, 2018. The LNG Industry [online]. Available from: https://giignl.org/sites/default/files/...LNG/5_LNG.../giignl_2018_annual_report.pdf

RIKKEN Olivier, 2018. GOTO 2018 • Developing Smart Contracts, Youtube Available from: https://www.youtube.com/watch?v=lcHPqJhgoF4

GOYAL Swati, 2018. Article on Hyperledger vs Corda R3 vs Ethereum: The Ultimate Guide [online]. Available from: https://101blockchains.com/hyperledger-vs-corda-r3-vs-ethereum/#prettyPhoto

GRUYCHEV Krasimir, 2019. Article on Hyperledger Fabric vs. R3 Corda [online]. Available from: https://medium.com/newcryptoblock/hyperledger-fabric-vs-r3-corda-7954035a4884

INCOTERM 2000, FOB. Website Available from: http://stalct.com/INFO/Incoterms-2000/inc2000fob.htm

INTERNATIONAL CHAMBER OF COMMERCE, 2017. Rethinking Trade & Finance [online]. July 2017. Available from: https://cdn.iccwbo.org/content/uploads/sites/3/2017/06/2017-rethinking-trade-finance.pdf

JOHANNESSON Staffan, 2014. LNG Blue Corridors Project supported by European Commission. Gas Quality [online]. Available from: lngbc.eu/system/files/deliverable_attachments/LNG%20BC%20D%203.2%20Gas%20Quality.pdf

MAALOUF Ruchdi, 2018. “Improving Efficiency and Liquidity in the Short-Term LNG Markets” [online]. Available from: *asiapacific.cwclng.com/wp-content/uploads/2012/09/Leaders-Forum-Article-4.pdf*

MASSESSI Demiro, 2018. Article on Public Vs Private Blockchain In A Nutshell [online]. Available from: https://medium.com/coinmonks/public-vs-private-blockchain-in-a-nutshell-c9fe284fa39f

MILES Steven, 2009. “New Model LNG MSA ‘Will Promote Development of LNG Secondary Market’, [online]. Available from: http://www.bakerbotts.com/news/2009/09/new-model-lng-msa-will-promote-development-of-ln__

OWEN, 2015. Forum [online]. Available from: https://www.italki.com/question/290794

PAYNE Julia, 2018. Banks, traders launch first commodities blockchain platform [online]. Available from: https://www.reuters.com/.../banks-traders-launch-first-commodities-blockchain-platfor...

Sourcing Innovation. Blog about innovation, The Purpose of a Contract is Easy to Define [online]. Available from: http://sourcinginnovation.com/wordpress/2010/02/02/the-purpose-of-a-contract-is-easy-to-define/

Trafigura, 2017. Website, Trafigura presents standard master sales and purchase agreement [online]. Available from: https://www.trafigura.com/news/trafigura-presents-standard-master-sales-and-purchase-agreement-mspa-for-the-lng-industry-during-gastech/21326

US Energy Information Administration, 2019. MMBtu. Website available from https://www.eia.gov/energyexplained/index.php?page=about_btu

Viking Bond service. Inc, 2019. Website Available from: https://www.performancesuretybonds.com/contract/typical-performance-bond-cost/

7. Appendices

7.1 *Appendix 1: Commissions and Charges for Letters of Credit of Credit Suisse*

ments complying with the letter of credit have been submitted. Unlike a transferable letter of credit, the responsibility for submitting the documents rests solely on the beneficiary of the letter of credit.

Commissions and Charges for Letters of Credit

Commissions are charged for services rendered in order to offset credit and settlement risks, and to cover the cost of providing collateral.

Unless stipulated otherwise in the letter of credit, these commissions are charged to the seller. If the letter of credit stipulates that the charges are to be borne by a party other than the buyer and if these charges cannot be collected, the buyer is ultimately held liable for their payment (Article 37 of UCP – Uniform Customs and Practice for Documentary Credits).

Exception: Under a negotiable credit the negotiation commission (interest) is charged to the seller unless the letter of credit explicitly states otherwise.

Standard conditions for letters of credit

Export

Notification	0.10%, min. CHF 200, max. CHF 1,500
Confirmation commission including period for deferred payment or acceptance	In addition to the notification commission, depending on the actual risk profile of the issuing bank in the respective country min. CHF 300 per transaction
Prepayment of a deferred payment under-taking (in addition to the interest) if applicable	CHF 200
Assignment of proceeds	0.10%, min. CHF 200, max. CHF 1,500
Pre-advice	CHF 100

Import

Liability commission including **Issuance** including period for deferred payment	Min. 0.20% per quarter Min. CHF 250 per quarter or fraction thereof, min. CHF 500 per transaction
Release of goods	CHF 100

Additional commissions and charges

Utilization (Examination of documents) **incl. payment**	0.20% Min. CHF 300 per set of document(s)
Deferred payment/acceptance Monitoring of due date(s)	CHF 200
Amendment	CHF 200
Discrepancies in the documents	CHF 100
Cancellation or Expiry without utilization	CHF 100
Query/Tracer	CHF 50
Postage and telecommunication	Actual costs, min. CHF 25
Special handling e.g. Structuring and Advisory – time and effort	CHF 200 per hour, min. CHF 100

All commissions and charges are due on performance of the service.

Prices in effect from January 1, 2013
Prices and services are both subject to change.

Tools & Seminars

- Tools
  Handbooks, Checklists, and Forms.
- Seminar Registration
  Whether you're attending an introductory seminar or a workshop – you're bound to benefit.

(Credit Suisse, Letter of Credit)

7.2 Appendix 2: Note from the video GOTO 2018

Blockchain can be used basically for 3 things;

1. Transfer of value without the need of trusted third party
2. The secure storage of data
3. Storage of logics. This logic is called smart contract.

Smart contracts can work fully autonomously as they are transaction driven. Cannot look outside their blockchain and even limited within their bockchain.

Traditional contracts contain 2 parts; the operational semantics (if this happens, then I am going to pay out) and denotation semantics which refer to the general term and conditions.

The translatable part to a smart contract is the operational semantics. Then by coding it, you have the execution being done by itself.

As referred to the video “developing Smart contracts” on Youtube by Olivier Rikken, a smart contract can be legally binding on the condition that the purpose of the code is at least written in formal language as well as being distributed to the parties involved. There is still the problem that judges do not know coding language

Smart contracts are always triggered by a message or transaction.

The coding should be kept as simple and brief as possible as there is a smaller chance of mistakes and the less code used, the cheaper the contract will be to be implemented on blockchain.

7.3 ***Appendix 3: The six Flowcharts***

Below are the 6 flowcharts in PDF format based on the clauses of the BP contract.


5.1 Failure to receive.pdf


5.2 Failure to Deliver.pdf


6. Quality.pdf


7. Laytime (shipping).pdf


10. Measurement, Sampling and Testing


12. Payment.pdf