CHALMERS
UNIVERSITY OF TECHNOLOGY

Patents and Competitive Advantage in the Oil & Gas Industry

The Case of Oil Country Tubular Goods (OCTG)

Master's Thesis in the Master's Programme, Entrepreneurship and Business Design

VEASNA SAM

Department of Technology Management and Economics
Division of Entrepreneurship and Strategy
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2016
Report No. E2016:019

MASTER'S THESIS E 2016:019

Patents and Competitive Advantage in the Oil & Gas Industry

The case of Oil Country Tubular Goods (OCTG)

VEASNA SAM

Tutor, Chalmers: Bowman Heiden

Department of Technology Management and Economics
Division of Entrepreneurship and Strategy
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2016

Mr.

VEASNA SAM

Master's Thesis E 2016:019

Department of Technology Management and Economics
Division of Entrepreneurship and Strategy
Chalmers University of Technology
SE-412 96 Gothenburg, Sweden
Telephone: + 46 (0)31-772 1000

Chalmers Reproservice
Gothenburg, Sweden 2016

ABSTRACT

The exploitation of oil and gas as source of energy is a pillar of the contemporary industrial economy. The origin of innovation has been changing over time. Starting in the early 1980s, major oil companies began decreasing their research and development (R&D) investments, motivated by the decision to switch from building to buying new technology. This allowed oilfield services companies (OFS) to step in and fill the void by increasing their R&D spending. The growing rate of innovation within the oilfield service industry can also be seen in the rate of patent applications. The number of applications filed by the three biggest oilfield services have doubled between 1992 and 2002.

Technology has taken an increasing importance in the oil and gas industry, especially for oilfield service companies, which in turn has led to the increased use of patenting. While leaders in terms of profit in the oilfield services are also leaders in terms of patents granted, the strategic impact of patenting in the OCTG industry has not been studied. Therefore, the goal of this report is to investigate the role patents play in the creation of a technological based advantage in the oilfield service industry through a case investigation of OCTG premium manufacturers.

This report presents the effects of patents in terms of competitive advantage for OCTG manufacturers. The comparative case study has been performed by analysing the API market (commodity market), in order to understand the traditional source of competitive advantage in OCTG manufacturing, and the effect of patent in the premium market composed of proprietary products.

The patent protections benefits that have been identified in the premium OCTG industry are mainly as blockade and commercialization. Patents are used as an entry barrier towards new entrants. Patents also enables controlling actors to gain market shares, getting higher margins, generate royalties and create a lock-in effect on customers.

Keywords: OCTG, Oil & Gas, patents, Intellectual Property, Portfolio, Management

ACKNOWLEDGEMENT

This Master Thesis has been written as the last part of my education at the Intellectual Capital Management (ICM) track at the Master's program Entrepreneurship and Business Design at Chalmers. In parallel with writing the thesis, I started to work at Tenaris. I am very grateful that I got that opportunity where I learnt a lot and got to use my skills in real projects.

I would like to thank the Intellectual Property teams and employees at Tenaris who have been very helpful throughout the process by being inspiring and supporting me with a lot of good ideas.

I also want to thank my academic supervisor Bowman Heiden for his support. Moreover, I would like to thank all my classmates and all the staff and lecturers of ICM, which educated and supported me throughout the two years of the master program.

Last but not least I would like to express my gratitude to my parents and my two sisters for always believing in me.

Table of Contents

GLOSSARY

IOC

IOCs (International Oil Companies) are also known as major or fully integrated companies. They are also call fully integrated company as they explore and produce oil and gas, ship the oil and gas, refine it into refined products, and sell these products through wholesale and retail outlets. These IOC are typically Total SA, ExxonMobil Corporation, BP, ChevronTexaco, ConocoPhillips and Royal Dutch/Shell[1].

NOC

NOCs (National Oil Companies) are state-controlled oil companies. NOCs control more than 90 percent of the world's Oil control[2]. These companies are among the largest in the world and include Saudi Arabian Oil Company, Petroleos de Venezuela SA, National Iranian Oil Company.

OFS

OFSs (Oil Field Services) provide services to IOCs and NOCs but do not produce oil or gas themselves. In the Upstream business there are two major areas where OFS are used – Drilling and Oilfield Services. Drilling is basically drill and pump oil out of the ground, and Oilfield Service is the setting up of oil and gas wells, and the maintenance of the equipment used[3].

Upstream

The upstream oil and gas sector is related to the exploration and production of oil and gas. This is why this sector is also known as exploration and production (E&P). The Canadian Association world petroleum council describes the tasks performed in Upstream as "*Companies will search prospective areas for potential reserves of oil and gas and perform geological tests called seismic tests, to determine the size and composition of the resource.*

[1] PetroStrategies, Inc (2015) *Industry Players,* Available at: http://www.petrostrategies.org/Learning_Center/industry_players.htm#Fully Integrated
[2] Ibid. 1
[3] Ibid. 1

Initial wells are often drilled to "explore" the basin, and if satisfied with results, a company will enter the production phase to extract the hydrocarbons."[4]

OCTG

Oil Country Tubular Goods (OCTG) is a family of seamless rolled products consisting of drill pipe, casing and tubing subjected to loading conditions according to their specific application.[5]

- Drill pipe is heavy seamless tube that rotates the drill bit and circulates drilling fluid. Pipe segments 30 ft. (9m) long are coupled with tool joints. Drill pipe is simultaneously subjected to high torque by drilling, axial tension by its dead weight, and internal pressure by purging of drilling fluid. Additionally, alternating bending loads due to non-vertical or deflected drilling may be superimposed on these basic loading patterns.
- Casing pipelines the borehole. It is subject to axial tension by its dead weight, internal pressure by fluid purging, and external pressure by surrounding rock formations. Casing is particularly exposed to axial tension and internal pressure by the pumped oil or gas emulsion.
- Tubing is pipe through which the oil or gas is transported from the wellbore. Tubing segments are generally around 30 ft. [9 m] long with a threaded connection on each end.

[4] Canadian Association World Petroleum Council (2014), *Upstream midstream downstream* Available at: http://wpccanada.com/yc/industry-info/about-the-industry/upstream-midstream-downstream.html

[5] International Molybdenum Association (2014) *Oil Country Tubular Goods (OCTG),* Available at: *http://www.imoa.info/molybdenum-uses/molybdenum-grade-alloy-steels-irons/oil-country-tubular-goods.php*

1 INTRODUCTION

This thesis describes the role patenting plays in the creation of technology-based competitive advantage in the Oil and Gas Industry. This part will give an introduction to the field and define the research questions that are answered in this report.

1.1 Background

The exploitation of oil and gas as source of energy is a pillar of the contemporary industrial economy. In 2013 the global oil and gas industry's total revenue totalled around 1.2 trillion U.S. dollars in 2011[6]. The petroleum industry is comprised of a wide range of companies having different sizes and functions in the value chain. The key categories for the purposes of this study include:

- International oil companies (IOC) are large international private companies involved on the whole oil and gas value chain (e.g. Shell, Total, BP, etc.).
- National oil companies (NOC) are state-owned by leading producing countries (Saudi Aramco in Saudi Arabia, PEMEX in Mexico, etc.), they are responsible to manage the production and defend their national interests in the oil and gas sector.
- Oilfield services companies (OFS) provides services and technology to the oil & gas industry (e.g. Schlumberger, Technip, Vallourec, etc.)[7].
- Oil country tubular goods (OCTG) producers are oilfield services companies specialized in the manufacture of tubes which are used in oil wells.

Technological innovation in the oil and gas industry started with Edwin L. Drake in the mid-19th century with the development of a method to separate oil and water. This method permitted the production of large quantities of oil. Innovation in the oil and gas industry aims to extract larger quantities of oil or gas from increasingly complex geologic structures in an environmentally safe and cost-effective manner.

[6] Statista (2015) World oil and gas industry revenue from 2009 to 2013 (in million U.S. dollars), Available at: http://www.statista.com/statistics/215892/revenues-of-the-world-gas-and-oil-industry/
[7] Planete energies (2015) Different Types of Oil and Gas Company, Available at:http://www.planete-energies.com/en/medias/explanations/different-types-oil-and-gas-company (Accessed: 11th January 2016).

In addition, the origin of innovation has been changing over time. Starting in the early 1980s, major oil companies began decreasing their research and development (R&D) investments, motivated by the decision to switch from building to buying new technology. This allowed oilfield services companies (OFS) to step in and fill the void by increasing their R&D spending.[8] For example, the world's four largest OFS firms have spent a combined 21.8 billion U.S. dollars in R&D from 1997 to 2012[9].

The growing rate of innovation within the oilfield service industry can also be seen in the rate of patent applications. According to Bloomberg Business (2013)[10], Schlumberger Ltd., Halliburton, and Baker Hughes, the world's largest oilfield service companies, received 1,257 granted patents in 2012 representing twice the number of granted patents they received in 1992. These three companies are leaders both in terms of patent filings and profit in the field of Oilfield services[11].

The increased number of patents for oilfield service caused the raise of enforcement litigation. Enforcement litigation have started in the past years with especially two cases which have been well publicized, WesternGeco (a unit of Schlumberger) has been awarded $105.9 million dollar in 2012 in its dispute with Ion Geophysical Corp. and Halliburton has been awarded more than $35 million in its dispute with Weatherford international[12]. The increased in litigation has led oilfield services company to be more cautious in the way their strategy in terms of patenting[13].

[8] Neal W.H. et Al. (2007) *Oil and gas technology development*, : NPC Global Oil & Gas Study, Available through → http://www.npc.org/study_topic_papers/26-ttg-ogtechdevelopment.pdf

[9] David Wethe and Susan Decker (2013) Oil Patch Follows Smartphone Makers in Patent Defenses, Available at: http://www.bloomberg.com/news/articles/2013-08-29/oil-patch-follows-smartphone-makers-in-patent-defenses (Accessed: 6th June 2015).

[10] Ibid 4

[11] Ball J. and Davies H. (2015) Where there is oil and gas there is Schlumberger,Available at: http://www.theguardian.com/environment/2015/may/18/where-there-is-oil-and-gas-there-is-schlumberger (Accessed: 20th May 2015).

[12] Ibid. 9

[13] Ibid. 9

1.2 Purpose

Technology has taken an increasing importance in the oil and gas industry, especially for oilfield service companies, which in turn has led to the increased use of patenting. While leaders in terms of profit in the oilfield services are also leaders in terms of patents granted, the strategic impact of patenting in the OCTG industry has not been studied. Therefore, the goal of this report is to investigate the role patents play in the creation of a technological based advantage in the oilfield service industry through a case investigation of OCTG premium manufacturers.

1.3 Research Question

To be able to achieve the purpose of the thesis, four interrelated research questions have been developed below:

The first step required is to understand the technology fields that constitute OCTG products and which technology fields are protected by patents. Therefore the first research question is:

1. Which technologies are involved in OCTG products and what is their patent profile?

The study of the OCTG API market, which is mainly governed by standards, will provide an understanding of the traditional sources competitive advantage in the OCTG industry where technology positions and patents are of less importance. Therefore the second research question is:

2. What are the roles of patents in the determination of competitive advantage in API OCTG?

The study of the premium OCTG market, which is composed of products having proprietary technology, is important for an increased understanding for how patents enable increased revenue streams in the industry. Therefore the third research question is:

3. What are the roles of patents in the determination of competitive advantage in Premium OCTG?

1.4 Delimitation

This report will focus mainly on patents protecting OCTG premium products features. The patent portfolio of Baosteel, JFE, TMK, and Vallourec have been analysed as they are amongst leading companies in the OCTG premium industry.

Patents related to OCTG premium products have been analysed in detail and patents have been related to products sold by Vallourec, however due to confidentiality, this research will not be presented.

Only granted patent and patent under prosecution have been analysed. The collection of data has been made in November 24th 2014 therefore only patents that has a first application between November 24th 1994 and April 24th 2013 were took in consideration, as the end of a patent is 20 years after the filing date and the 18 months rule between the application and publication.

In addition the capabilities have not been studied as the research has been designed as comparative and after discussions with professionals capabilities in the API Market and Premium market are similar therefore the effects of this source of competitive advantage can be subtracted without affecting the results of the effect of patents on competitive advantage in the OCTG industry.

2 METHOD

In this chapter the data required to answer the research questions will be discussed and the chosen research design and methods will be presented. In the end of the chapter, the chosen data collection process will be discussed as well as considerations that have been made in order to ensure the reliability and validity of the thesis.

2.1 Required data

In Figure 1 the data needed to answer each of the research questions is presented. The data includes input from both primary and secondary sources. The first research question concerns the technology in the OCTG industry. In order to answer this question background information about technology fields is needed. The second research question is focused on competitive advantage in the API market. To be able to answer this question, theories regarding competitive advantage and information about the competitive environment in the API market is needed. To answer the third and last research question regarding how patents can be used to obtain a competitive advantage, theories regarding possible functions of patents and potential benefits of patent protection were required. In addition the patent landscape of selected players in the premium OCTG industry has been made and information about the competitive environment in the premium OCTG market was needed.

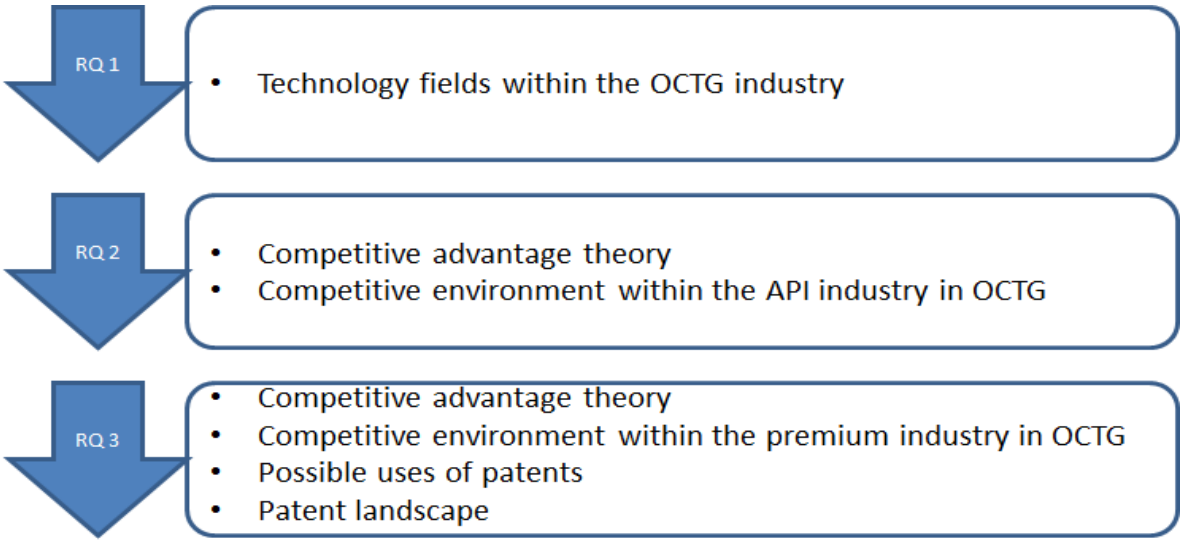

Figure 1: Data required for answering the research questions (RQ)

2.2 Research design

The research has been designed as a comparative design. The comparative design is used to understand a phenomena better by comparing two contrasting cases. With this design the phenomenon studied, in this case the role of patenting in the creation of a technological-based competitive advantage in the premium OCTG industry, can be better understood[14] as other sources of competitive advantage are similar in the case of API market and premium market and can therefore be subtracted.

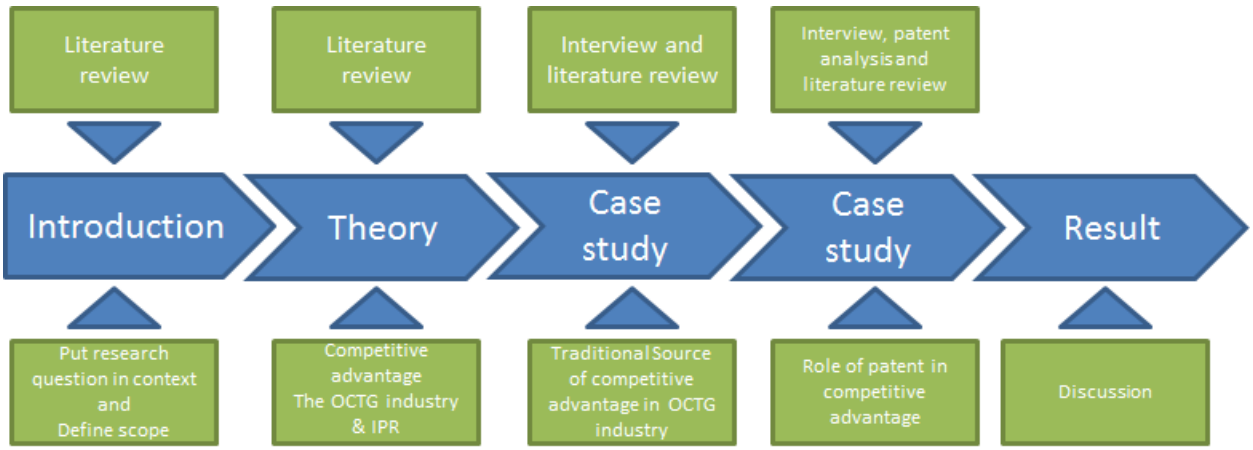

Figure 2: Research method overview

An overview of the method for this thesis is pictured in the figure 2 above. The introduction is used as a starting point to put the research in context and define the scope of the research. The theory part is composed of the necessary theory used to build a theoretical framework. This part was built through a literature review.

The first case study has been used to understand the traditional sources of competitive advantage in the OCTG industry by studying the OCTG API market, which is also known as the commodity market. This case study has been perform through interviews with professionals and reports performed by consultants.

[14] Ibid. 13

The second case study has been used to study the competitive environment in the premium OCTG market. This case study has been made through interviews with professionals, reading reports made by consultants, and patent analysis. The premium OCTG market is mainly composed by proprietary technology products (protected by IPRs), by comparing the competitive environment in the premium industry and API industry we will be able to determine the effects of IPRs on competitive advantage in the OCTG industry. Capabilities and other resources except IPRs are similar in both scenario.
The last part will be used to present the results along with a concluding discussion.

The theory presented in the next chapter is the necessary theoretical framework needed to understand the context of the research.

A deductive approach has been used in the research where the author has inductively created his theory based on existing sources[15]. The theory has been used to conduct the case studies, which are presented further down in the report.

2.3 Data collection

To be able to answer the three research questions a mix of primary and secondary data was used.

2.3.1 Theoretical Framework and literature review

The theoretical framework has been built as a ground for the thesis. The main concepts that were investigated in the theoretical framework were:

1. Concepts of competitive advantage
2. Means to protect innovation
3. Patent as a mean to appropriate value.

When searching for theory about these subjects, Google, Science direct and Chalmers' library database have been used.

[15] Bryman A. and Bell E., "Business Research Method", *Oxford University Press*, 2011

When conducting the literature review, the data was mainly collected from management consulting reports, articles found on website specialized in Oil and Gas issues, and public hearings transcripts of managers from major OCTG companies in front of the United States International Trade Commission (USITC).

2.3.2 Interviews

Several interviews were held with employees at Tenaris. The objective of interviews was to confirm findings from the literature review. The interviewees had mainly technical backgrounds and different levels of seniority ranging from 4 to 29 years of experience in the OCTG industry. Positions held by interviewees ranged from analyst to executive management. The goal of the interviews has been to get an understanding of relevant issues in the OCTG industry and provided validation for literature review. Interviews held were unstructured interviews during which interviewees have been asked what in their view constitutes a competitive advantage for OCTG companies. The unstructured interview allowed the person questioned to respond freely, with the interviewer simply responding to points that seem worthy of being followed up. Unstructured interviewing is very similar to a conversation[16].

2.3.3 Patent analysis

The patent analysis has been performed using the internet patent database, Patbase.

The first step was to define the research string. The research has been made towards the patent assignees Vallourec (which also file patents under “V&M”, “V & M”, “VAM”, “Mannesmann”, “Sumitomo”[Sumitomo has a strategic partnership with Vallourec]), TMK, TPCO, Tenaris (which also file patents under Hydril), Baosteel.

In addition another limit put into the research string was the earliest priority date in the family. The collection of data has been made in November 24th 2014 therefore only patents that has a first application between November 24th 1994 and April 24th 2013 were took in

[16] Ibid. 13

consideration, as the end of a patent is 20 years after the filing date and the 18 months rule between the application and publication.

Another restriction added was the use of the international patent classification (IPC) class F16L and E21B. F16L is the class representing "PIPES; JOINTS OR FITTINGS FOR PIPES; SUPPORTS FOR PIPES, CABLES OR PROTECTIVE TUBING; MEANS FOR THERMAL INSULATION IN GENERAL"[17] and E21B represents "EARTH OR ROCK DRILLING (mining, quarrying E21C; making shafts, driving galleries or tunnels E21D); OBTAINING OIL, GAS, WATER, SOLUBLE OR MELTABLE MATERIALS OR A SLURRY OF MINERALS FROM WELLS"[18]

The last restriction used was a full text search with the terms "thread*" or "steel composition. The final research string used was "(((PA=(V&M or V & M or vam or vallourec or mannesmann or sumitomo or TMK or TPCO or Tenaris or Hydril or Baosteel)) and (EPR=19941124:20130424)) and (IC=(F16L or E21B)) and (FT=(thread* or steel composition)))".

The second step was to analyse each patent individually. The scope of the claims and the description allow to determine whether or not it is a patent belonging to premium connection. The analysis has been made by the author and it reflects his point of view. The author of this work has one year experience with intellectual property in the OCTG industry.

2.3.4 Research validity and reliability

According to Guba and Lincoln[19] propose to use trustworthiness to evaluate the validity and reliability of a qualitative search. Trustworthiness is composed of four criteria; credibility, transferability, dependability, and confirmability[20].

[17] WIPO (2015) *International Patent Classification (IPC),* Available at:*http://web2.wipo.int/classifications/ipc/ipcpub/#refresh=page* (Accessed: 5th June 2014).
[18] Ibid. 16
[19] Lincoln YS. and Guba EG. , "Naturalistic Inquiry", *Sage Publications*, 1985.
[20] Ibid. 13

The credibility of the research depends on the ability and effort of the researcher[21]. The interpretation of both case studies can be questionable as it reflects the author's point of view. The interpretation of the author can be biased as he is working in the field so it can reflect the view of the company he is working for. In addition the people interviewed are working in the same company as the author, this can also affect the credibility of the research.

The transferability is a criteria used to determine to which extent a study is applicable in other contexts[22]. The results which will be presented are applicable to the OCTG industry. There exists similarities between the OCTG industry and other oilfield services branch however it is not possible to say with certainty that the findings are transferable.

The dependability of the research is used to show that the findings are consistent and could be repeated[23]. The dependability of this thesis is believed to be quite high as data used were publicly available at the time of the research.

The confirmability relates to the level to which the results of the study could be confirmed or corroborated by other. The confirmability of this research is believed to be low since the research has been conducted by a single author. The degree of confirmability has been slightly raised as the results have been reviewed by top level managers having more than 20 years of experience in the OCTG industry.

[21] Ibid 19
[22] Ibid 19
[23] Ibid 19

3 THEORY

The theory chapter presents the underlying theory that the thesis is built upon. It starts by explaining the types of competitive advantage before moving to the source of competitive advantage. The Position effects and the resource as source of competitive advantage will be explained with more details.

Types of competitive advantage

The different types of competitive advantage have been defined by Michael Porter in his book "Competitive advantage"[24] in 1985. According to Porter the creation of a corporate strategy should be based on an existing or a potential competitive advantage. The main goal of competitive advantage is to create more economic value than competitors.
It is possible to classify competitive advantage in two main categories, which are:

- Value advantage (or differentiation)
- Cost advantage

Value advantage (or differentiation) is the ability to create more perceived value for the customer than your rivals, at a similar cost. The more perceived value can be in terms of superior performances.

Cost advantage is the ability to deliver similar perceived value for the customer as your rival, at a lower cost. The work of Porter is mainly based on external factors that he describes in his competitive forces theory, which will be explained later in this report.

Sources of competitive advantage

There are two perspectives concerning the source of competitive advantage. The first perspective is the industry position-focused view (external view). In this perspective the primary determinant of sustainable competitive advantage is the firm's position within its

[24] Porter, M.E. 1985, Competitive advantage: creating and sustaining superior performance, Free Press, New York.

industry. Superior performances can be earned if firms engage in unique activities based on a clear understanding of an industry's structure.

The second perspective is the resource-based view (internal view). In this perspective the primary determinant of a sustainable competitive advantage is the resources within a firm and how they are managed and exploited. Superior performance can be earned if firms have and effectively utilize superior resources protected by isolating mechanisms preventing diffusion.

Combining the two perspectives allow to identify the sources of competitive advantage (cf. figure 3).

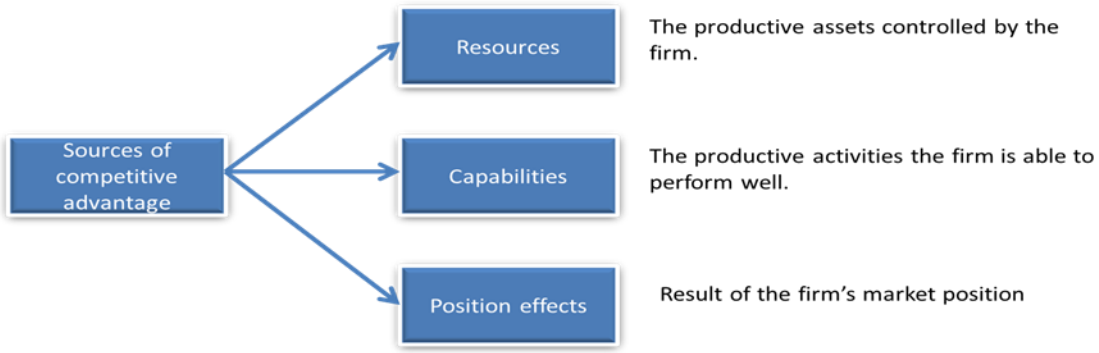

Figure 3: Sources of competitive advantage

3.1 Position effects

The first source of competitive advantage that we will describe is the position effects view. This will be done on the traditional industrial view and on a technological view.

3.1.1 Industrial view

With an industrial view the position effects can be illustrated by the Porter's five forces model[25], the model is illustrated in figure 4. This is a strategic analytical tool of the competitive environment of an industry. The goal of this model is to identify the various forces involved in the competition.

[25] Porter M. (1979) 'How Competitive forces shape strategy', *Harvard Business Review,*52(2), pp. 137-145.

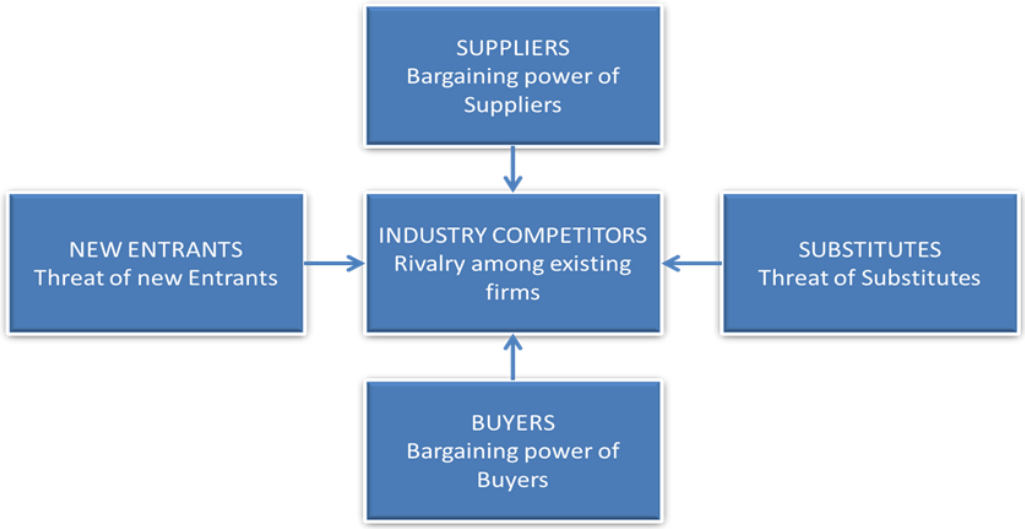

Figure 4: Porter's 5-forces Model

New Entrants

The threat of new entrants is determined by the entry barrier in the industry. In fact markets have many obstacles which make the entry of new companies harder. The main entry barriers are[26]:

- **Capital requirements** needed to get established in some industries because they can be so large that it is enough to discourage all but the largest companies (e.g. aviation or launching commercial rockets)
- **Economies of scale** which constraint new entrants to either act on a large scale or to support a cost disadvantage.
- **Absolute cost advantages** In fact established firms might have cost advantages independently to scale. This advantage is gain through the acquisition of low-cost sources of raw materials and/or through the economies of learning.
- **Product Differentiation** Established firms have the advantage to have a brand recognition and customer loyalty especially in industries where products are differentiated.
- **Access to Channel of Distribution** For many new suppliers of consumer goods the principal barrier is likely to be gaining distribution.

[26] Grant, R. M. (1991) 'The resource-based theory of competitive advantage : implications for strategy formulation', *California Management Review,* 33(3), pp. 114-135.

- **Governmental and Legal Barriers** In some industries the number of companies can be limited by licenses delivered by a public authority. (E.g. taxicabs, banking, telecommunication, broadcasting, etc.)
- **Retaliation** It can takes the form of aggressive price cutting, increased advertising, sales promotion or litigation against new entrants.
- **Technology gap** The market might require proprietary know-how and/or the acquisition of patents in order to enter it.

Industry competitors

The Rivalry between established competitors relates to all the actions which influence profits of industry's actors. The intensity of the competition is the result of the interaction of few factors:

- **Concentration** Seller concentration relates to the number and size distribution of firms competing within a market.
- **Diversity of Competitors** The more different competing companies are higher will be the price competition as they will have different origins, objectives, costs, strategies, and top management.
- **Product Differentiation** The more similar the offerings among rival firms, the more willing customers are to substitute and the greater the incentive for firms to cut prices to increase sales
- **Excess Capacity and Exit Barrier** Significant increases in capacity imposed by economies of scale can sometimes break the balance between demand and supply resulting on an excess of capacity and therefore lower prices. Barriers to exit (e.g. Specialized and durable resources, fixed costs, governmental restrictions, etc.) can lead firms to maintain themselves in an industry even if they have poor financial performance, in that case excess capacity result on low prices.
- **Cost Conditions: Scale Economies and the Ratio of Fixed to Variable Costs** High fixed costs relative to variable costs encourage firms to take on marginal business at any price that covers variable costs resulting on lower prices.

Buyers and Suppliers

The bargaining power of Buyers is due to the fact that Buyers are usually trying to impose lower prices by negotiating better conditions and promoting competition. The strength of Buyers depends on two set of factors which are buyers' price sensitivity and relative bargaining power.

- **Buyers' price sensitivity** The extent to which buyers are sensitive to the prices charged by the firm in an industry depends on four factors:
    - The importance of a product in relation to total cost.
    - The differentiation of the product in relation to other suppliers within the same product.
    - The intensity of competition among buyers
    - How critical is an Industry's product to the quality of the buyer's product.
- **Relative Bargaining Power** Bargaining power rests, ultimately, on refusal to deal with the other party. The balance of power between the two parties to a transaction depends on the credibility and effectiveness with which makes this threat. Several factors influence the bargaining power of buyers relative to that of sellers:
    - Size and concentration of buyers relative to suppliers
    - Buyers' information
    - Ability to integrate vertically

The Bargaining power of suppliers is determined by the same factors which determine the bargaining power of Buyers. The main issues are how easily the company can switch between different suppliers and the relative bargaining power of each party.

Substitutes

The threat of substitute is determined by three factors:

- **Buyer Propensity to substitutes** It refers to the loyalty of the buyer
- **Relative prices and performance of substitutes** It relates to the cost effectiveness of the substitute products.
- **Switching costs** It refers to any cost incurred by switching product.

Firms create value by relating the company to its environment in fact the industry structure strongly influences competitive rules of the game. The forces presented in Porter's theory need to be managed in order to gain business success. The way these forces are managed by companies usually determined their profitability. Competitive advantage is achieved by reacting and managing to factors external to the firm.

3.1.2 Technology view

In this section information has been taken from a lecture given during the master program in Intellectual Capital Management[27]. In order to understand the technology positioning of a company, a technology tree can be used. The goal of the technology tree is to understand the technology market behind a product. Each level of the tree represents the component necessary to build the component on the level above. Technology fields are divided into two types; a first one (illustrated in green in figure 5) which have product/component market logic, and a second one which have a technology market logic (illustrated in red in Figure 5).

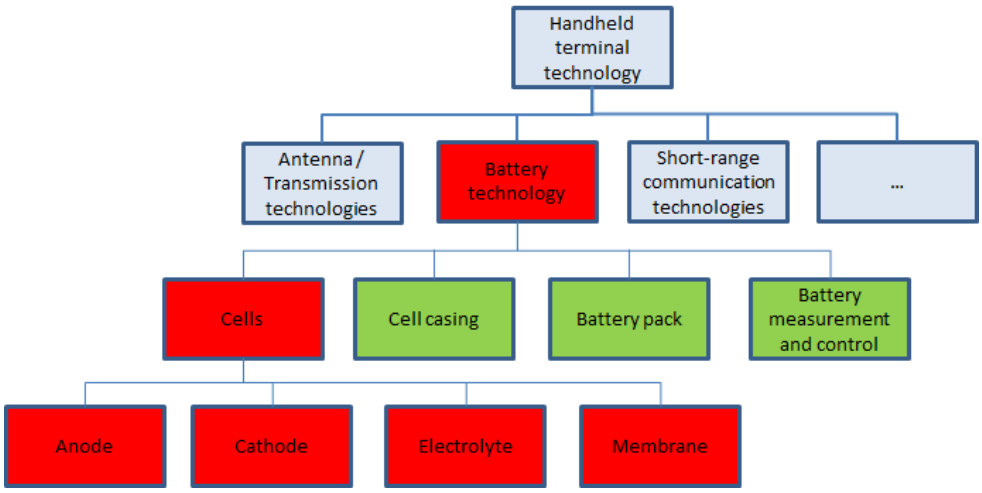

Figure 5: An example of tech tree for a 3G cell phone

In Green technology fields everything is for sale at a market for products. Challenges in that type of technology are:

- To find and purchase the most adequate and best products;

[27] Heiden, B. "Defining Knowledge-Based Business", Advanced ICM course. Chalmers University of Technology. 2013. Lecture

- Identify suitable suppliers;
- To arrange the best deal possible for the acquisition of the product or component;
- To get hold of proper and decent supply;
- Getting service and guarantee.

In Red technology fields, technology is controlled through the constitution of patent portfolios; contract and license networks; and standardization platforms. Transactions take place through :

- Products (mainly selling a products protected by IPRs)
- Licenses (selling the right to a technology)
- R&D collaborations (it can take the form of cross-licensing or joint ventures)
- Combination of Products, Licenses, and R&D collaborations.

In addition in Red technology fields players having a strong control positions may control margins made in the field and coerce other players. The challenge in the red fields is to develop a coherent technology strategy:

- The company must choose either to develop internally or count on a third party.
- The company can either buy a component or producing it
- The company can license a technology or keep it for itself
- The company must think of the opportunity to develop a R&D partnership and/or strategic alliances with third parties.

The strategy can be different depending on the type of technology required or produced by a company.

Arising from the technology tree, it is possible to identify five scenarios occurring for a technology. A first scenario which is an "*open access scenario*" (illustrated in figure 6).
This scenario is characterized by:

- There is not any market participant or cluster which has a significant control position over a winning technology. Another option is that there are multiple technologies available which are as good.
- A high number of producers are able to produce the product based on the technology therefore the product can be seen as a commodity.

- Traditional supply and demand-competition rules are valid in the market.

An example of this is the cell casing market.

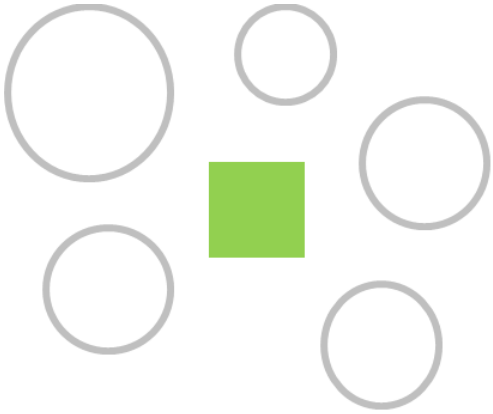

Figure 6: Open access scenario

A second scenario which can be encountered is "*several firms with competing technologies*" (illustrated in figure 7).

This scenario is characterized by:

- Some market participants hold a strong control position over competing technologies, it leads to competitive advantage in the field through a reduced access to the technology from new entrants.
- Competitors with a weak control position doesn't have access to or outperform the technology, and must use inferior technology
- Players with a strong technology position compete on the market with cost advantages or slightly differentiated product based on distinct technical solution.

An example of this scenario is the microprocessor market which is mainly led by Intel and AMD.

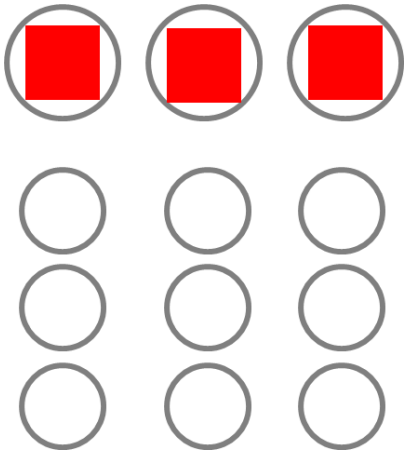

Figure 7: Several firms with competing technologies

The third scenario possible is a "*single cluster control over a winning technology*" (illustrated in figure 8).

This scenario is characterized by:

• A winning technology is controlled by either a market participant or a cluster, it leads to competitive advantage in the field through a reduced access to the technology from new entrants.

• Competitors with a weak control position doesn't have access to or outperform the technology, and must use inferior technology

• If the performance difference is large enough, the player or cluster controlling the winning technology could be able to claim a dominant position in the most lucrative segments of the product market.

An example of this is Windows which is highly dominant in the Operating system market.

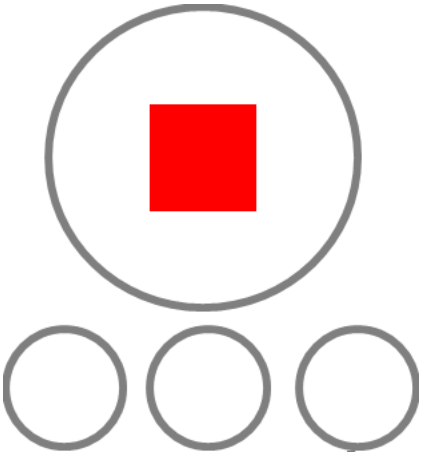

Figure 8: "Single cluster control over a winning technology"

The fourth scenario possible is a "*Standard development around a winning technology*" (illustrated in figure 9).

This scenario is characterized by:

- A privately controlled standard entity or a public standard entity pushes market players to settle for a standard related to a technology.
- The standard will be designed after negotiation between market players and ruled by the clusters/players with the strongest bargaining power. The bargaining power stems from the IPRs owned in the technology standard.
- Market players with a weak or no bargaining power might get a restricted access to the technology. The access of the technology will be associated with a cost in the form of license royalties.

An example of this scenario is the 4G standard in telecommunication.

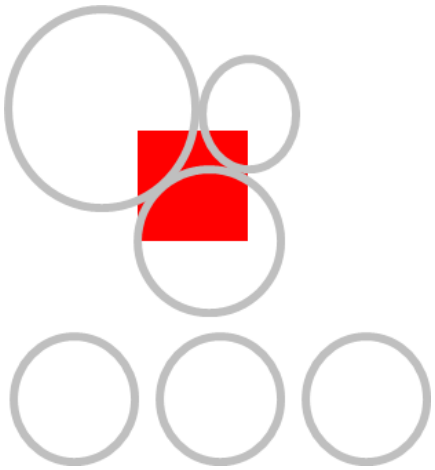

Figure 9: Standard development around a winning technology

The last scenario possible is "*Competing standards*" (illustrated in figure 10).

This scenario is characterized by:

• A battle is made between competing market participants/clusters which are all trying to impose their proprietary technology as the world standard

• Depending on the type of technology, the standard war can take place through negotiation on a governmental and business level.

• In order to strengthen their position competing standards will try to attract as many market players as possible to their respective cluster.

• Access to the technology for market participants with weak or no negotiation positions, will be decided by the result of the war between the competing standards.

An example of this is the wireless charging standard in which Wipower wants to set magnetic resonance charging as standard whereas Qi would like to set magnetic induction charging as standard.

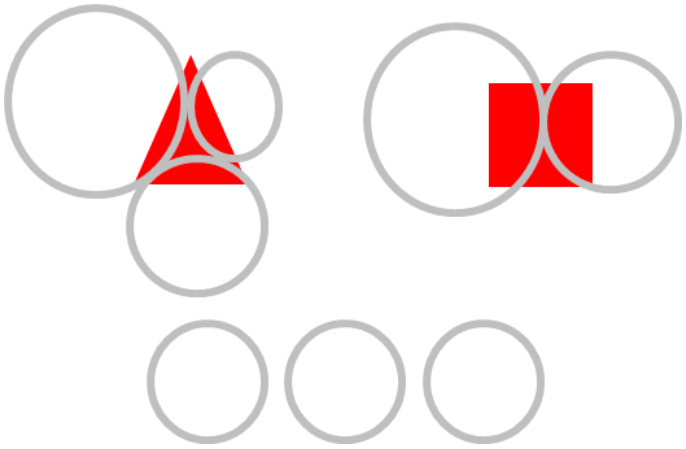

Figure 10: Competing standards

3.2 Resources

The resource-based view explains that the competitive advantage is gain through holding strategic resources[28]. Barney[29] has demonstrated that resources that provide a competitive advantage need to have four characteristics, which are:

- Valuable, meaning that it enables its owner to gain differentiating performance or reduced costs
- Rare, it must not be possessed by many or even by any competitors.
- Imperfectly imitable, meaning that it is unobtainable or only obtainable at higher cost or lower efficiency.
- Non-substitutable, the resource maintains relevance and sustained despite exploitation.
- Organizationally exploitable, the resource have to be exploitable through an entity's organizational process.

It is possible to distinguish two types of resources tangible and intangible resources. (cf. figure 11).

[28] Barney J. (1991) 'Firm Resources and Sustained Competitive Advantage', *Journal of Management,* 17(1), pp. 99-120.
[29] Ibid 18.

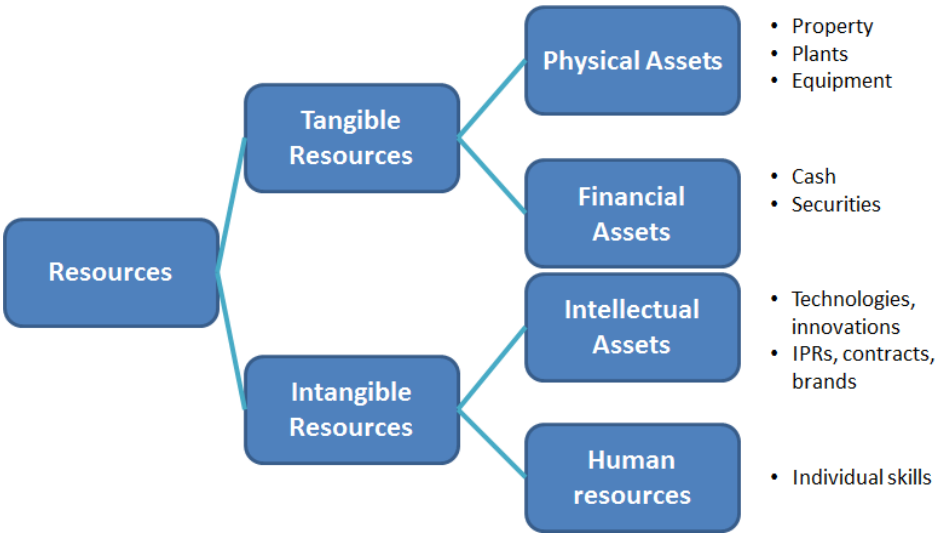

Figure 11: Type of resources

Intellectual assets

In the following section we will describe the different means available to protect an innovation and how innovation can be turn into a strategic resource. In this section a focus will be made in Intellectual Property Rights available and the different benefits patents can provide.

Patents

Patents have been made to rewards the creative efforts of inventors and the financial efforts made to achieve technical progress. The patents criteria are generally novelty, inventive step (Non-obvious in U.S.), and industrial application (Useful in U.S). Patents give an exploitation monopoly for a definite period of time (generally 20 years) in countries in which the patent is valid. The patent owner has the exclusive right to exploit the patented invention[30]. The main disadvantages of patents are the costs (it cost approximately 200,000 euros to maintain a patent for 20 years in all industrialized countries of Europe, America, and Asia) , the obligation to publish (A patent will become public after a

[30] Quinn G. (2015) *The Cost of Obtaining a Patent in the US,* Available at:*http://www.ipwatchdog.com/2015/04/04/the-cost-of-obtaining-a-patent-in-the-us/id=56485/* (Accessed: May 2015).

maximum period of 18 months after filing), and the protection is limited in time (generally 20 years)[31].

Trade secret

Trade secret protection can be used for any type of innovation without any criteria. Trade secret is not limited in time so it can last in theory forever. There is no registration cost to it. The trade secret is kept within the company as it is not necessary to make it public. The protection is international. The disadvantage is that if the industrial secret is present in an innovative product third parties might be able to perform reverse engineering to discover the secret and use it. In addition[32] The protection by secrecy doesn't allow to exclude third parties to exploit commercially an invention. Costs incurred by trade secrets can be potentially high (security, confidential documents, interaction restrictions between employees, etc.). Once an industrial secret becomes public anyone can use it indeed the legal protection provided by Secrecy is low in comparison to patent and vary depending on countries. There is also a risk that an invention protected by secrecy becomes patented by a third party which developed the invention independently and legally[33].

Publication

A third way to protect innovation is through publication. The goal of publication is to put an invention into the public domain. The main advantage of this process it to insure a freedom to operate without patenting. The freedom to operate is valid worldwide with only one publication. It is a very low cost process. The disadvantage is that the disclose invention will not be able to be protected and can be used by any competitor[34].

---

[31] Ibid. 30

[32] French Government (2014) *La stratégie : brevet, secret ou publication?,* Available at:*http://www.ipwatchdog.com/2015/04/04/the-cost-of-obtaining-a-patent-in-the-us/id=56485/* (Accessed: May 2015).

[33] Ibid.30

[34] Colson T.J. (2001) 'Leveraging the Power and Value of Intellectual Property', *Ivey Business Journal,* (July/August 2001)

Patent, trade secret or publication?

Daizadeh et al.[35] (2002) have developed a 6-step approach which allows to determine when to patent, publish, or use trade secret. (Cf. figure 12)

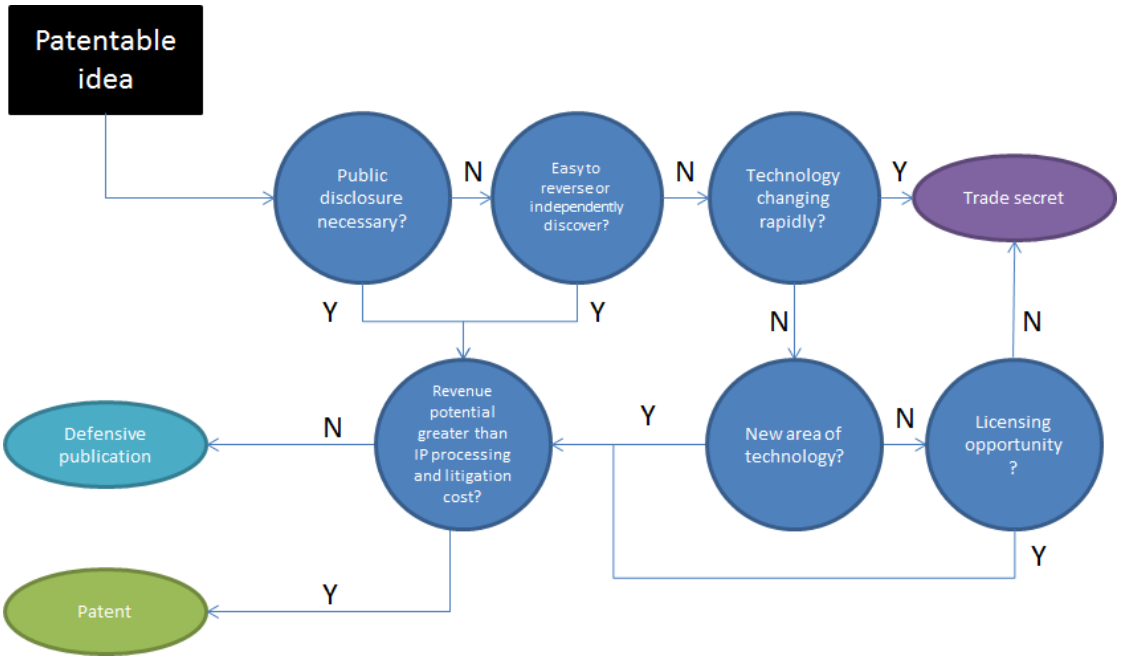

Figure 12: A general approach to determine patent, defensive publication or trade secret protection[36]

The first assumption is that the idea/innovation is patentable as otherwise only trade secret and defensive publication would be the available choices. The first step is to determine whether or not a public disclosure is necessary. In fact in certain industry such as pharmaceutical industry, under FDA regulation, it is necessary to disclose in detail drugs that will be marketed within the American market. In this case the trade secret is excluded. The second step is to determine if the idea is easy to reverse engineer or discover independently. If an independent rediscovery can be performed quickly it would decrease the value of any product as the competition will drive down prices. In this scenario, patenting would be recommended as it would allow a time-restricted monopoly for that particular invention. The third step is to determine if the technological environment is changing fast. If technological improvement is happening fast, it is essential to try to reach the market as fast as possible. If the technology has a fast obsolescence it might not worth it

[35] Daizadeh, I., Miller, D., Glowalla, A., Leamer, M., Nandi, R., Numark, C.I (2002) 'A general approach for determining when to patent, publish, or protect information as a trade secret', *Nature Publishing Group,* 20, pp. 1053-1054.
[36] Ibid. 34

to patent it. The fourth step is to determine if it is a new area of technology. If it is a new area of technology patenting allows to monopolize instantly large pieces of intellectual property through broad claiming. The fifth step is to determine if the inventor is interested in giving access to the invention to third parties. Licensing can provide additional source of revenues to the licensee. There is a risk of unauthorized disclosure to third parties with a trade secret therefore patenting would be more advantageous in this case. The sixth step is to determine if the potential revenue will be higher than IP processing and litigation costs.

Patent strategies

In this section different patent strategies will be defined and the potential benefits that may stem from them in terms of competitive advantage.

Blocking strategy

For Granstand[37] a blocking strategy aims to hinder competitors to valorize their R&D by protecting knowledge which is therefore not patentable by others. At the best this strategy will block competitors and dissuade them to invest R&D in the protected innovation. However there are some points to be made here:

- Competitors can use tactics in order to get over this blockade[38]; by invalidating patents, inventing around, acquiring the technology (in particular through licensing), waiting that the blocking patents expire, ignoring the blockade and infringe.
- The blockade is stronger when a group of patents are blocking a technology field. For this reason different blocking strategies have arisen[39]: the *fencing strategy* means that a group of patent is ordered in a certain way to protect a central innovation and block competitors to perform some research. The *surrounding* strategy is also used, a group of individually less important patents can be used to limit the commercial efficiency of an important patent of a competitor.

[37] Granstrand, O. (1999) *The Economics and Management of Intellectual Property - Towards Intellectual Capitalism*, London: Edward Elgar Publishing Ltd.
[38] Ibid.37
[39] Ibid. 37

Moreover, Blind et al.[40] define two types of blocking strategies defensive and offensive. The defensive blocking strategy has the goal to secure the technological flexibility of the company which means the ability to perform certain research in the future. The offensive blocking strategy aims to hinder technological progress of competitors. We can draw a parallel between Granstrand and Blind, as the *fencing* strategy is an illustration of a defensive strategy while the *surrounding* is an illustration of an offensive one.

Commercialization

There are three ways to use a commercialization strategies, by licensing, by transfer to a third party or through exclusive exploitation[41]. The licensing consist of an agreement between the patentee and the licensee. The patentee authorizes the third party (licensee) to exploit part or fully a patent in exchange of a royalty fee. In the case of an exclusive exploitation, the value of a patent comes from two effects, increased volumes and/or higher profit margin[42]. When the patent aims to protect a method of production and that method allows to produce a technology at a lower cost, the value will come from lower production cost, e.g. higher profit margin. When the patent protect a product, the patent owner can either increase the selling price or increase productivity due to exclusivity[43].

Bargaining chip

Patents can be used as a tool to support and maintain freedom to operate. Grindley and Teece[44] emphasized in their research that companies involve in the electronic industry use their patent portfolio to gain access to competitors' technologies through cross licensing agreements. This particularity has been confirmed by Hall et al.[45] in a qualitative and quantitative empirical study. It explains that major players of the electronic industry, in

[40] Blind, K., Edler, J., Frietsch, R., Schmoch, U. (2006) 'Motives to patent: empirical evidence from Germany', *Research Policy,* 35, pp. 655-672.
[41] Grube, C. (2009) *Measuring the Immeasurable: Valuing Patent Protection of Knowledge-Based Competitive Advantages*, Gabler Edition Wissenschaft edn, Bremen
[42] Ibid. 41
[43] Ibid. 41
[44] Grindley, P.C. and Teece, D.J. (1997) 'Managing Intellectual Capital: Licensing and CrossLicensing in Semiconductors and Electronics', California Management Review,39(2), pp. 8-41.
[45] Hall, B. and Ham Ziedonis, R (2001) 'The Patent Paradox Revisited: an Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995', RAND Journal of Economics, 32(1), pp. 101-128.

which patents have been considered as a not very effective tool to appropriate the benefit from innovation, have gathered big patent portfolio[46].

Lanjouw and Shankerman[47] have statically studied the effect of an important patent portfolio on the probability to get sued for infringement. They find out that companies with an important patent portfolio have been less sued than the ones with small patent portfolios. The risk links to patent infringement is considered by professional as significant and having a substantial patent portfolio is presented as an insurance against this risk in some professional publications[48].

Reputation and Image

Patents can be used in order to establish a reputation and/or image in the market place. A substantial patent portfolio can boost the image of a company as a technology leader, which might provide a competitive advantage on the market place[49]. Patents being public information they can also be used as a tool to measure the performance of a company and therefore increase the reputation of a company[50].

[46] Corbel, P. and Raytcheva, S. « Le brevet comme outil de gestion du risque de subir une attaque en contrefaçon », *in* P. Corbel and C. Le Bas, *Les nouvelles fonctions du brevet – Approches économiques et managériales*, Economica, December 2011, p.101-123

[47] Lanjouw, J.O. and Schankerman, M. (2001) 'Enforcing patent rights', NBER working paper n°8656

[48] Hagel F. (2005) 'Both sides – How Valuable are Patents to Companies', *Patent World*,October(176), pp. 14-17.

[49] Ibid. 41

[50] Ibid. 40

4 TECHNOLOGY IN OCTG

In this part the technology in OCTG products will be presented. This chapter will start with a definition of an OCTG threaded connection. After a technology tree for OCTG products will be depicted and explained. Then the different technologies corresponding to thread, steel and coating will be presented.

4.1 What is an OCTG threaded connection?

Oil Country Tubular Goods (OCTG) is a family of seamless rolled products consisting of drill pipe, casing and tubing subjected to loading conditions according to their specific application.[51]

- Drill pipe is heavy seamless tube that rotates the drill bit and circulates drilling fluid. Pipe segments 30 ft. (9m) long are coupled with tool joints. Drill pipe is simultaneously subjected to high torque by drilling, axial tension by its dead weight, and internal pressure by purging of drilling fluid. Additionally, alternating bending loads due to non-vertical or deflected drilling may be superimposed on these basic loading patterns.
- Casing pipes constitutes the borehole. They are subject to axial tension by their dead weight, internal pressure by fluid purging, and external pressure by surrounding rock formations. Casings pipes are particularly exposed to axial tension and internal pressure by the pumped oil or gas emulsion.
- Tubing is pipe through which the oil or gas is transported from the wellbore. Tubing segments are generally around 30 ft. [9 m] long with a threaded connection on each end.

Within the scope of this thesis we will mainly focus on OCTG threaded connection (also known as seamless pipe). Threaded connection can be defined as a mechanical joint of two

[51] International Molybdenum Association (2014) *Oil Country Tubular Goods (OCTG),* Available at: *http://www.imoa.info/molybdenum-uses/molybdenum-grade-alloy-steels-irons/oil-country-tubular-goods.php*

pipes section. This assembly is composed of exactly one internally threaded member, defined as a box, and at least one externally threaded member, defined as the box. [52]

There are two major classes of threaded connection: *integral* and *threaded and coupled* (T&C) connections. The T&C configuration requires an additional part to connect the pipes, called coupling, while the integral connections have an internally and externally threaded on the pipe[53]. The figure 13 depicts a T&C connection on the left an in integral connection on the right. The purpose of OCTG threaded connection is to provide mechanical stability, to keep water-tightness and gas-tightness, transmit mechanical efforts through the string.

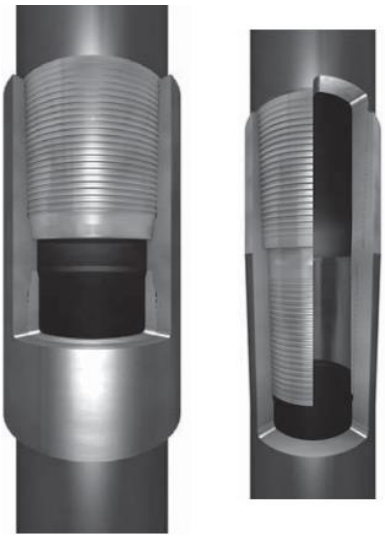

Figure 13: Example of a T&C (on the left) and an integral connection (On the right)

4.2 Technology tree in OCTG

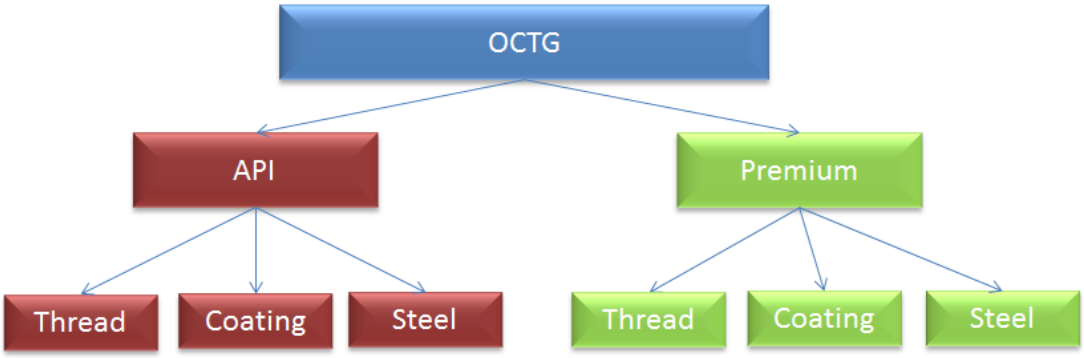

Figure 14: Technology tree for OCTG products

[52] Galle T. and Al. , "Influence of design features on the structural integrity of threaded pipe connections", *Sustainable Construction and Design*, 2011

[53] Ibid.52

As depicted in figure 14, OCTG products can be subdivided into two types of products; API (Standard) and Premium (proprietary). It has been decided to not go through a sub division between T&C products and Integral products as it would have been becomes too technical.

The institute is in charge to control that mills fulfil a certain number of requirements in order to be accredited to produce API products[54]. Standards for coatings are defined in the document API 5a3[55]. Standard for thread and steel are defined in API 5B[56]. API have low mechanical requirements (Reduced mechanical loads, low pressure oil wells, low production rates, optimal use up to 3000 meters). API products don't have any environmental consideration and are easy to cut and run.

API products are however not able to meet all the requirement of the Oil and gas industry especially for extreme conditions applications such as High Temperature High Pressure (HTHP). The development of wells to reach hydrocarbon in HTHP conditions (e.g. Shale Oil/Gas; Deep Sea; etc.) resulted on the enhancement of oil and gas tubular joints[57]. It led to the creation of premium connections, which represent high end markets, each manufacturer has its own design, intellectual property rights, and product exclusivity. Premium products have enhanced performance (with combined loads, the tolerance precision allows controlled stress, galling resistance, clearance availability, improved surface finishes, improved flow characteristics), are proprietary, environmental friendly (in the case of dope free solution) and have a higher costs for the customer[58]. They also need field service supervision for installation on site (Cf. Figure 15).

---

[54] API (2012) *API Overview and Mission,* Available at:*http://www.api.org/GlobalItems/GlobalHeaderPages/About-API/API-Overview*(Accessed: May 2015).

[55] American Petroleum Institute (2009) *Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements, Third Edition (ISO 13678:2009 Identical Adoption)*, 3rd edn., : American Petroleum Institute.

[56] American Petroleum Institute (2008) *Specification for Threading, Gauging and Thread Inspection of Casing, Tubing, and Line Pipe Threads*, 3rd edn., : American Petroleum Institute.

[57] Galle T. and Al. , "Influence of design features on the structural integrity of threaded pipe connections", *Sustainable Construction and Design*, 2011

[58] Flowtech Energy (2014) *OCTG – CASING, TUBING, DRILL PIPE,* Available at:*http://www.flowtechenergy.com/oilfield-services/octg-casing-tubing-drill-pipe/*

API	PREMIUM
• Low mechanical demand • No Environmental consideration • Easy to cut and run	• Enhanced performance • Proprietary design • Environmental friendly (coating) • Higher costs • Need field service supervision

Figure 15: API vs Premium Connections[59]

In order to design a new premium connections, three development steps are needed. A first phase during which the basic geometrical design of the thread with chosen nominal size and material grade is engineered to withstand higher loads[60]. The second step is to extrapolate to a variety of sizes and grades to create a new family of connections. In the final step the new connections are tested following standards described in API 5C5 or ISO 13679, in addition customer might require additional tests.

4.3 Thread

The Thread is an essential feature of the threaded connection, it can have different forms such as triangular, square, round, etc. Figure 16 and 17 present two type of standard threads. The threads are designed in order to be able to stand specific conditions. Every slight change in the design of one feature of a thread can result on unforeseen effects in the overall performance of the connection and need to be carefully evaluated. Proprietary thread are designed to raise the tensile efficiency, compression, sealability or a combination of features[61].

[59] Markets and Markets (2014) *Oil Country Tubular Goods Market by Grade (API, Premium), by Product (Seamless, ERW), & by Geography (North America, South America, Europe, Asia-Pacific, Africa, and Middle East) - Global Trends & Forecast to 2019*, : marketsandmarkets.com.
[60] Ibid 57
[61] Patent EP2325435

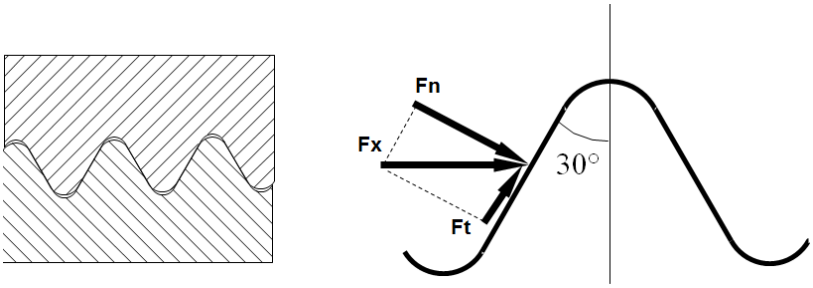

Figure 16: API connection – round[62]

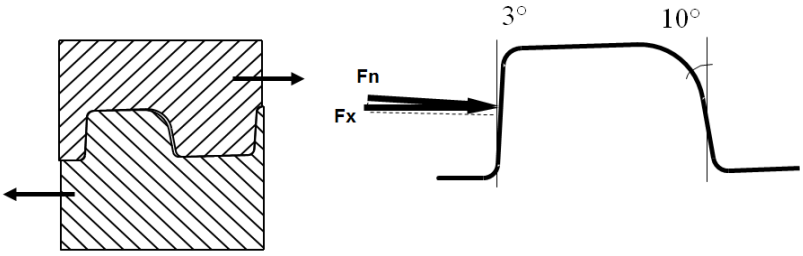

Figure 17: API Connection – Buttress[63]

4.4 Coating

Traditionally, in order to protect the threaded zones against galling during makeup-breakout operations, they are stripped of grease which protects against corrosion and coated with special makeup grease such as grease in accordance with American Petroleum Institute standards API 5A2 or 5A3. However, in addition to the disadvantage of requiring a supplementary coating operation to be carried out on-site, the use of such greases, loaded with heavy and/or toxic metals such as lead, suffers from the disadvantage of causing pollution of the wells and of the environment, since excess grease is ejected from the threads during makeup. Further advances which satisfy more environmental standards have consisted in designing a product known as a "dry" lubrication product, which solves most of the problems linked to the use of API type greases. Thus, lubricants of the dry thermosetting sliding varnish type have provided a high performance and ecologically viable solution[64].

[62] American Petroleum Institute (2009) Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements, Third Edition (ISO 13678:2009 Identical Adoption), 3rd edn., : American Petroleum Institute.

[63] Ibid 62

[64] Patent EP2516910

4.5 Steel composition

The traditional steel grade used in the OCTG industry are defined in the norm API 5CT. Producers have developed new proprietary steel in order to be able to withstand harsh environment such as Sour environment; High pressure; High temperature; Low temperature; highly corrosive environment.

5 COMPETITIVE ADVANTAGE IN API OCTG MANUFACTURING

In this chapter, the source of competitive advantage in the API OCTG manufacturing industry will be described and analysed followed by the determination of the role patent plays in the competitive advantage.

5.1 Market shares

In the API market , the competition is high with producers having different origins and aiming for similar market. The worldwide market share is depicted in figure 18.

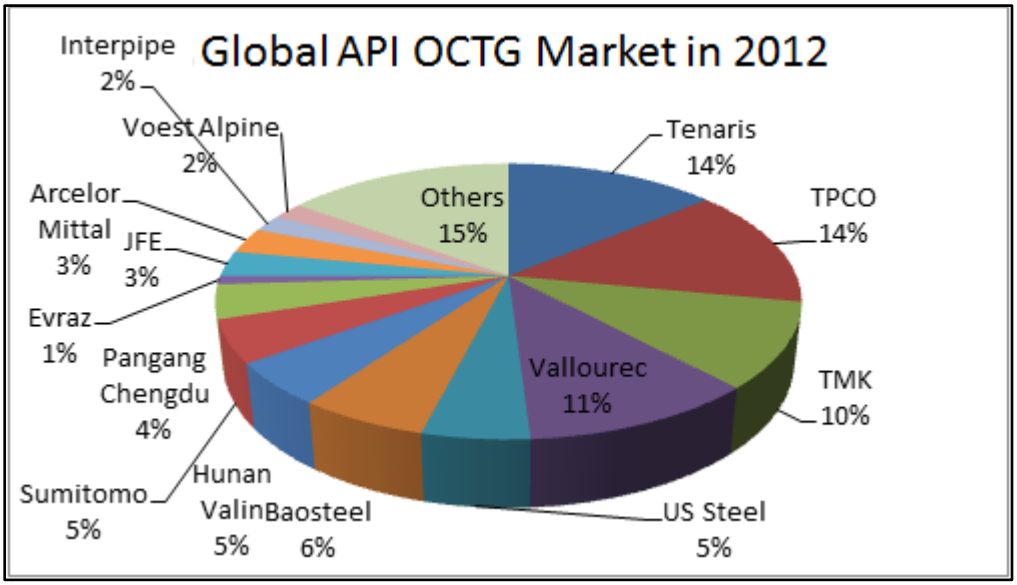

Figure 18: Global API OCTG market shares in 2012[65]

In the API market the product differentiation is impossible as products are fully standardized. Tenaris, Vallourec, Sumitomo, TPCO, and TMK are the only players which possess the capacity to produce the full range of size and deliver globally. Other companies are companies focus on a specific market with specific products related to the market they target (e.g. Hunan Valin, Pengan Chengdu in China; US Steel in U.S; Evraz in Commonwealth of independent states (CIS); Voest Alpine in Western Europe). In addition to these producers there is a long tail of small manufacturers (other 15%) focusing on specific products of certain size. There is a high number of competitors thus the price competition

[65] Metal Bulletin Research, "Review of the OCTG Market and Outlook to 2016", 2013

is higher as competitors of the market have different origins, objectives, costs, strategies, and top management.

5.2 Resources

In this part we will analyse the key resources companies need to control in order to be able to be successful in the API market. The main resources possess by successful companies in the API market are financial assets and physical assets namely plants and equipment.

5.2.1 Financials

In order to be able to compete in the OCTG market, it is needed to have strong financial assets as the construction of a plant is very costly (e.g. TPCO announced the construction of a plant in the US for more than one billion dollars in 2009). Financial assets are key in order to increase the production capacity of a company. In addition, it can be key in order to enter certain markets which have anti-dumping ruling through the acquisition of a local company (e.g. Acquisition of IPSCO in 2008 by TMK which allows TMK to enter the US market) or building a local facility like TPCO did in 2009.

5.2.2 Plants and equipment

Only few companies have plants which are located all around the world and which can supply OCTG products and are able to product the whole range of size which are needed in wells (e.g. Tenaris, Vallourec, and Sumitomo are the only global players proposing seamless tube having a diameter superior to 16 inches in US) . Tenaris, Vallourec, Sumitomo, TPCO, and TMK are the only players which possess the capacity to produce the full range of size and deliver globally, being able to provide the whole range of products has the advantage to reduce costs, logistics and potential quality-control issues for the final customer[66].

Having global capacity and proposing the whole range of size allows companies to propose a worldwide supply of OCTG products to Oil companies which can lead to global supply deal (e.g. Vallourec signed a global supply deal with the major Total SA in 2015). This type

[66] USITC, "Hearing in the Matter of: Oil Country Tubular goods from Argentina, Italy, Japan, Korea, and Mexico", 2007 Available through → http://www.usitc.gov/trade_remedy/731_ad_701_cvd/investigations/2006/Oil%20Country%20Tubular%20Goods%20From%20Argentina,%20Italy,%20Japan,%20Korea,%20and%20Mexico/Second%20Review%20(Full)/octg_hearing.pdf

of deal insure the OCTG supplier to be insured to have orders and the oil company will be provided with lower prices.

5.2.3 Type of competitive advantage

The type of competitive advantage encounter in API market is mainly a competitive advantage based on a cost advantage as products sold are identical. It follows traditional supply and demand-competition rules are valid.

5.3 Competitive environment – Porter's five forces

To analyse the source of competitive advantage in the API manufacturing industry, the 5-forces framework developed by Porter has been used.

5.3.1 Threat of New Entrants

The main barrier of entry in the API OCTG business is that high capitals are necessary in order to create a facility which is able to produce steel tubular products. For example, in 2007 TPCO has invested one billion U.S. dollars to build a seamless steel pipe manufacturing facility in Texas[67].

Another barrier exists, it is the protectionism that some states employs to protect their home market such as anti-dumping legislation. In US for example there is an anti-dumping duties against South Korean, Indian, Philippian, Saudi Arabians, Taiwanese, Thai, Turkish, Ukrainian, and Vietnamese OCTG producers[68]. Anti-dumping laws allows to have protected market and results usually on higher price for the end customer.

The technology needed in order to enter the market is well known as the design and production procedure are described in API norms.

[67] TPCO America (2014) *Project Introduction,* Available at:*http://www.tpcoamerica.com/about.cfm* (Accessed: May 2015).

[68] International Trade Administration, "Commerce Finds Dumping of Imports of Certain Oil Country Tubular Goods (OCTG) from India, Korea, the Philippines, Saudi Arabia, Taiwan, Thailand, Turkey, Ukraine, and Vietnam, and Countervailable Subsidization of Imports of Certain OCTG from India and Turkey", 2014

5.3.2 Industry competition

The concentration of competitors in the market of API tubular products is very high and diverse. API tubular producers are located all around the world and compete for similar markets. The price competition is therefore higher as competitors of the market have different origins, objectives, costs, strategies, and top management. In the API market the product differentiation is impossible as products are fully standardized.

In period of crisis the industry competition raises as an excess of capacity as the balance between demand and supply is broken resulting in lower prices. The high fixed costs relative to variable costs encourage firms to take on marginal business at any price that would covers variable costs in crisis period. The threat of industry competition is enhanced also by the fact that Barriers to exit are high as OCTG products are specialized and durable resources.

5.3.3 Bargaining power of Suppliers

The only suppliers for the OCTG industry are steel scrap producers. There is not any substitute to steel scraps and the ability of it is limited[69]. OCTG manufacturer are highly dependent to the steel scrap however the price of it is marginal in relation to the total manufacturing costs.

5.3.4 Bargaining power of Customers

The number of buyers is limited, buyers are International oil companies and National oil companies. They are few buyers for a high numbers of possible suppliers which allow allows the Oil companies to have a strong bargaining power over API producers, this bargaining power is even stronger in crisis period.

For some projects however in which the timeframe is key, an oil company might chose an OCTG provider depending on its ability to deliver quickly products on site.

[69] Sedliacikova M, "Analysis of competitiveness of the chosen company", *Forestry and Wood Technology no 76*, 2011

5.3.5 Threat of Substitute Products or Services

In the API OCTG industry products are similar as they follow the same norms. However some manufacturers who also plays on the premium market started to propose API standardized threaded OCTG products with a dope free coating in order to get a differentiation.

5.3.6 Competitive forces and profit potential in the API OCTG industry

According to Porter, the sum of competitive forces within an industry defines its profit potential. His allegation is that the stronger the forces within an industry are the lower the potential for profits. As shown above most forces in the API OCTG industry are high, making the industry less attractive in term of profits. The API OCTG market is a commodity market in which the main competitive advantage is made through low prices and time to deliver.

5.4 Position effect in terms of technology

API OCTG products are standardized by the American Petroleum institute therefore there is not any player or cluster which has a controlling position of the technology. Products which are sold on the API market are manufactured by a range of alternative supplier and are purchase as a commodity. Traditional supply and demand-competition rules are valid on this market. It is therefore possible to consider the API market as an *open access* technology market (figure 19).

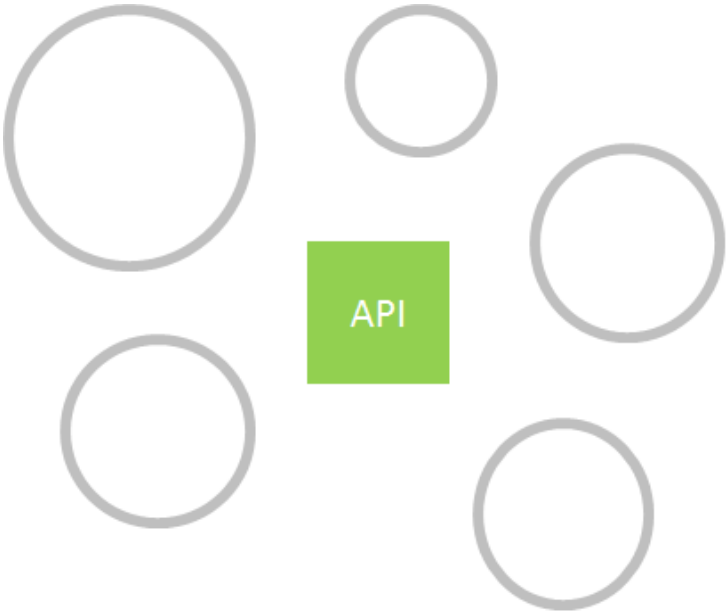

Figure 19: Open access technology positioning in API OCTG

According to Grube[70], a patent related to a method of production can reduce production costs (through reduction of rejects, speed of production, etc.) and therefore increase profit margin, here it might help a producer to win call for tenders by proposing lower prices than competitors. Method patents have not been investigated in this thesis as it is difficult to get information showing the effect of method patent on production costs. This type of information is usually classified as secret. In addition methods are not necessary patented but rather kept as trade secret as they are not easy to reverse engineer and in case of an infringement it is difficult to prove it.

[70] Ibid. 41

6 COMPETITIVE ADVANTAGE IN PREMIUM OCTG MANUFACTURING

In this chapter, the source of competitive advantage in the premium OCTG manufacturing industry will be described and analysed followed by the determination of the role patents play in the competitive advantage.

6.1 Market share

The number of competitors is limited in the Premium OCTG industry. There are about 15 competitors on the market. Tenaris, Vallourec/Sumitomo (Vallourec and Sumitomo are put together as they have several joint ventures and use the same premium connection design) are leading the market as they have been on the business premium connections for the longest time and have the highest number of connections qualified. The sum of Tenaris and Vallourec/Sumitomo market shares represented more than 60% of the total premium market in 2012 (cf. figure 20).

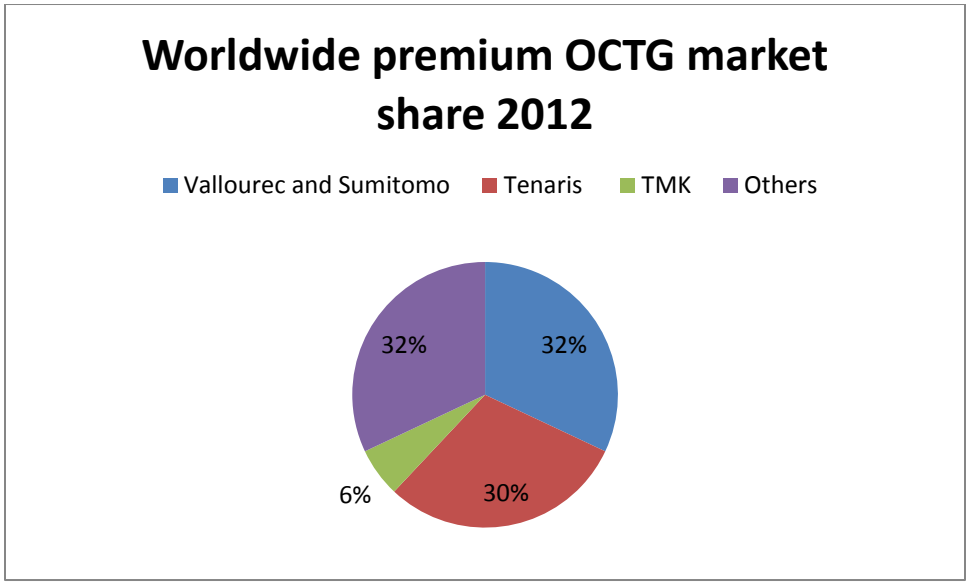

Figure 20: Worldwide premium OCTG Market share 2012

In comparison in the API market, Tenaris and Vallourec/Sumitomo have roughly 16% of the market share.

6.2 Resources

In the premium market resources are similar to the one described in the API market with the exception of an additional resource which is the proprietary technology. In this part we will discuss the Intellectual assets related to proprietary technology and how successful companies in the premium market turn their innovation into intellectual property rights.

6.2.1 Type of intellectual property rights used to protect innovation

For this thesis the patent portfolio of Baosteel's, JFE's, Tenaris', TMK's, and Vallourec's have been studied as they are considered as leaders in the Premium OCTG technology market. Patents studied were related to the design of thread, composition of steel, and coating composition.

Thread design

Patents concerning thread design are always constructed the same way. In this part we will illustrated it with an example, the Patent US8220844. Figure 21 illustrate the thread design presented in the patent US8220844.

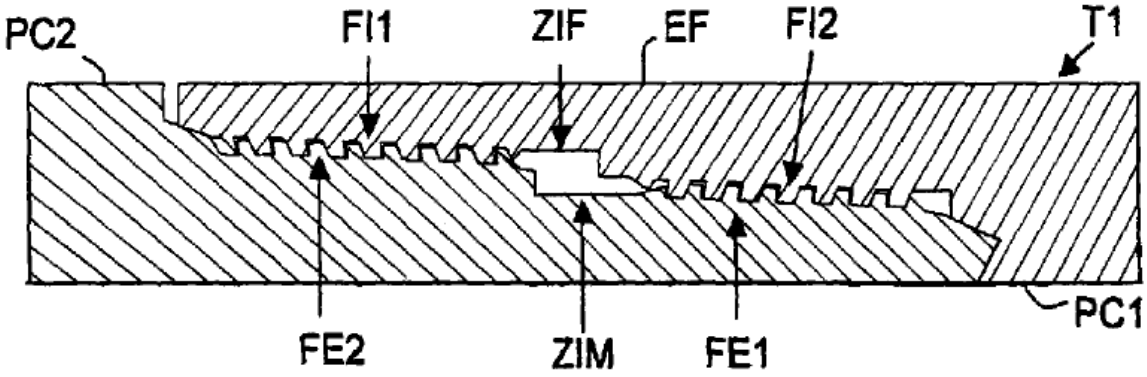

Figure 21: Drawing illustrating US8220844

The independent claim of this patent describes:

"*Claim 1: A threaded element of a component, comprising:*

a free end and at least first and second threading portions each comprising threads each comprising a stabbing flank and a loading flank, said first threading portion being closest to said free end and said second threading portion being closest to a central non-threaded portion of said component,

Wherein the stabbing flanks and the loading flanks of the threads of said first threading portion and the threads of said second threading portion are inclined in an opposed manner with respect to a radial direction, in a cross section along a longitudinal axis of the said element."

The interesting part here is to understand whether if information disclosed in patents is enough to be able to copy a product. As explained in 4.2 the development of a new premium connection is made following different phases which are:

1. To create a Geometrical design and Select a Steel Grade
2. Extrapolate the results to a variety of sizes and grades to create a new family
3. Tests to comply with norms and customer requirement

The independent claim describes the geometrical design of the thread as a change in the design of one feature of the thread can result on unforeseen effects in the overall performance of the connection and need to be carefully evaluated. To describe the geometrical design is enough to fulfil the requirement of novelty, inventive step, and industrial application.

Thread design patents never mention the tolerance needed to manufacture the thread which is a key parameter in the manufacture of an OCTG product to insure properties such as sealability and mechanical properties. The extrapolation of the results to create a new family of tubular is a long process too. According to specialists in Tenaris having the geometrical design is a small part of the development with this information the remaining development in order to have an entire family ready for the market would require 5 to 6 years of development at the minimum. It wouldn't necessarily worth it to copy a premium connection and it might be more interesting to develop a new proprietary design instead as by the time a company will be able to copy it could have maybe created a new connection instead. According to a Director of Tenaris in a hearing at the United States International Trade Commission[71] (USITC), developing a new premium connection is a long process and it takes approximately seven to eight years to take it to the market.

[71] USITC, "Hearing in the Matter of: Oil Country Tubular goods from Argentina, Italy, Japan, Korea, and Mexico", 2007 Available through → http://www.usitc.gov/trade_remedy/731_ad_701_cvd/investigations/2006/Oil%20Country%20Tubular%20Goods%20From%20Argentina,%20Italy,%20Japan,%20Korea,%20and%20Mexico/Second%20Review%20(Full)/octg_hearing.pdf

In thread design technology a mix of trade secrets and patents is used to protect innovation.

Coating

Patents concerning coatings are always constructed the same way. In this part we will illustrated it with an example, the Patent US8420581. The independent claim of the patent describes:

"*Claim 1: A threaded joint for pipes used in the excavation of oil wells and gas wells without using a lubricating grease constituted by a pin and a box each having a contact surface comprising a threaded portion and an unthreaded metal contact portion, characterized in that the contact surface of at least one of the pin and the box has a lubricating coating formed using a composition which comprises a total of 1-30 percent of one or both of a rosin and calcium fluoride, 2-30 percent of metal soap, 2-30 percent of wax, and 10-70 percent of a basic metal salt of an aromatic organic acid as expressed in mass percent based on the total amount of non-volatile components in the composition and further contains substantially no harmful heavy metals, wherein a relative value of DELTAT is 90 or more when DELTAT in control is 100, wherein DELTAT=Ty-Ts, and Ts represents torque at a beginning of shoulder interference when the threaded joint is formed by turns of the pipe, and Ty represents torque when plastic deformation of the shoulder of the threaded joint begins during rotation, and DELTAT in control is a value obtained with a compound grease.*"

If we look at patents concerning coatings such as a patent described above we can see that the description of the composition of the coating is very vague which is made deliberately to make it hard for third party to copy. In addition the manner the coatings is applied on the surface of the threaded connection is not described neither which results on another challenge for the competition to overcome. In coating technology a mix of patent and trade secret is also used to protect innovation.

Steel

Patents concerning steel are always constructed the same way. In this part we will illustrated it with an example, the Patent EP2403970. The independent claim of the patent describes:

"*Claim 1: A low alloy steel with high yield strength and excellent resistance to sulphide stress cracking, characterized in that it contains, by weight: C: 0.3% to 0.5% Si: 0.1% to 0.5% Mn: 0.1 % to 1% P: 0.03% or less S: 0.005% or less Cr: 0.3% to 1.5% Mo: 1.0% to 1.5% Al: 0.01% to 0.1% V: 0.03% to 0.06% Nb: 0.04% to 0.15% Ti: 0 to 0.015% N: 0.01% or less the remainder of the chemical composition of said steel being constituted by Fe and impurities or residuals resulting from or necessary to steel production and casting processes*."

The composition of the steel as in the claim described above is vague with not the exact composition of the steel but rather different range of components composing the steel. The exact composition of the steel and the method of production are trade secrets and therefore if a company wants to create a similar steel it will have to make some research to find the right mix and a method of production in order to be able to copy the steel. As in Coating and thread design, the technology of steel is protected by a mix of patent and trade secret.

6.2.2 Type of competitive advantage

The type of competitive advantage encounter in the premium market is a competitive advantage based on differentiation as products sold are based on proprietary technologies protected by IPRs.

6.3 Competitive environment – Porter's five forces

To analyse the source of competitive advantage in the premium manufacturing industry, the 5-forces framework developed by Porter has been used.

6.3.1 Threat of New Entrants

The capital requirement for a new entrant will be high as a new entrant will have to develop new Premium connection designs in order to enter the market. Established players have absolute cost advantages which have been gained through the economies of learning.
The difficulty for new entrants is that established players have their reputation with their track records, their core and add-on offering and scale of operation with technicalities and their contacts with both NOC and IOC. If a new entrant wants to be successful it must

propose a revolutionary technology or technique for the exploration and exploration of oil and gas and therefore have skilled labour which is difficult to find in the industry[72]. In addition each new products have to go through a process of qualification (it is aim to determine if a product can fulfil the requirement needed by the customer) which is unique for each IOC or NOC and a relatively long process (up to 6 months) and costly process as it is fully performed and paid by the OCTG producer. The qualification has to be made to all different Outside Diameters (called "OD" in the industry) and all Wall Thickness (called "WT" in the industry) of each type of pipe. The process is so costly that it is mainly perform under request from a client.

Technology expertise and patents available within established firms are also high barriers for new entrants.

6.3.2 Industry competition

The number of competitors is limited in the Premium OCTG industry. There are mainly about 15 competitors on the market. Tenaris, Vallourec and Sumitomo which are the most established players as they have been on the business of premium connections for the longest time. We find then JFE and Hunting which use the same type of connection as they developed their joint connections in a joint venture. The latest actors which are on the raise are TMK, TPCO, Grant Prideco, Baosteel, Vetco Gray, US Steel, Jesco. Vallourec, Sumitomo, Tenaris, and JFE are the companies which have the highest number of connections and tubes qualified to be used by Oil companies however the competition is getting higher with other competitors starting to get their premium connection qualified to be used by Oil companies too[73].

The rivalry amongst firm in Premium OCTG business is high as offers are similar, the difference is made through the technological offers and the efficiency (time delivery and price) they can propose to their customers. It is in particular the case between Vallourec Sumitomo and Tenaris which have similar track records and products which are used

[72] Sahu, S., & Parekh, K. ,"*Determinants of Economies of Scale and their Influence on the Oil & Gas Services: A Discussion, Review of Integrative Business and Economics Research*", 2012, 246-259.

[73] Metal Bulletin Research, "The five year Outlook for the Global OCTG Market", *Metal Bulletin Research, 2014*

especially in terms of premium connections with for example the “Blue®” Series of Tenaris which achieved similar performance as the “VAM TOP®”, both have become standards for the OCTG premium threads and have the largest field record in the Oil and Gas industry.
In Premium OCTG manufacturing fixed costs and exit barriers are high. It can be difficult for Oilfield services to divest their assets if they leave the market which result on higher rivalry.

6.3.3 Bargaining power of Suppliers

The only suppliers for the OCTG industry are steel scrap producers. There is not any substitute to steel scraps and the ability of it is limited[74]. OCTG manufacturer are highly dependent to the steel scrap however the price of it is marginal in relation to the total manufacturing costs.

6.3.4 Bargaining power of Buyers

The number of buyers is limited, buyers are International oil companies and National oil companies. However the premium products are essential in High pressure and high temperature projects (HPHT) and also in shale projects as these products are specifically designed to withstand extreme conditions. API products would not be able to withstand extreme conditions or there would be a high risk of failure.
The cost of production and services offered is a small portion of the total capital investment of oil companies. The products and services are quite unique in a small industry of specialists. Once a premium product is chosen by an Oil company for a project a lock-in effect is created as there will be a problem of compatibility with competitor’s products due to patented features (Threads design mainly). For all after sale service needed the Oil company will have to go through either the producer or one of its licensee who is allowed to provide after sale services.

[74] Sedliacikova M, “Analysis of competitiveness of the chosen company”, *Forestry and Wood Technology no 76*, 2011

6.3.5 Threat of Substitute Products or Services

In the premium OCTG industry, products tend to be fairly similar between established players. The oil and gas industry is a very conservative industry, in which technological advances and emerging alternative technologies have difficulties to enter the market and get market acceptance[75]. In addition the new technology will have to go through the process of qualification.

6.3.6 Competitive forces and profit potential in the premium OCTG industry

According to Porter, the sum of competitive forces within an industry defines its profit potential. His allegation is that the stronger the forces within an industry are the lower the potential for profits. As shown above most forces in the premium OCTG industry are lower than in API market, making the industry more attractive in term of profits. The premium OCTG market is a differentiated product market in which the main competitive advantage seems to be made through technology.

6.4 Position effect in terms of technology

In this part, we will investigate the position effect in terms of technology in the premium industry. It will start with an analysis of the patent portfolio of leading actors in the premium industry which will lead to an understanding of how the technology is controlled.

6.4.1 Patent portfolio

In this section the patent portfolio of the companies studied will be presented. Only patents concerning features (Thread, coating, steel composition) of OCTG products have been taken into account.

In the period studied (1994-2013) Tenaris has 97 patents (granted or applications) related to premium connections. The portfolio in premium connections is distributed as follow:

- 54 patents related to threads
- 29 patents related to steel composition
- 19 patents related to coatings

[75] Triepke J. (2015) *Understand Oilfield Technology Lifecycles [OCTG Case Study]*,Available at: *http://oilpro.com/post/3662/understand-oilfield-technology-lifecycles-octg-case-study* (Accessed: May 2015).

In the period studied (1994-2013) Vallourec has 179 patents (granted or applications) related to premium connections. The portfolio in premium connections is distributed as follow:

- 131 patents related to threads
- 16 patents related to steel composition
- 32 patents related to coatings

In the period studied (1994-2013) JFE has 35 patents (granted or applications) related to premium connections. The portfolio in premium connections is distributed as follow:

- 25 patents related to threads
- 6 patents related to steel composition
- 4 patents related to coatings

- TPCO's patent portfolio

In the period studied (1994-2013) TPCO has 26 patents (granted or applications) related to premium connections. The portfolio in premium connections is distributed as follow:

- 11 patents related to threads
- 18 patents related to steel composition

- Baosteel's patent portfolio

In the period studied (1994-2013) TPCO has 42 patents (granted or applications) related to premium connections. The portfolio in premium connections is distributed as follow:

- 6 patent related to threads
- 36 patents related to steel composition

- TMK's patent portfolio

In the period studied (1994-2013) TMK has 7 patents (granted or applications) related to premium connections. The portfolio in premium connections is distributed as follow:

- 7 patents related to threads

6.4.2 Patent as a mean to appropriate value in the premium OCTG Industry

According to Grube[76], 4 strategies can be used to create value in a business setting. In the following section each strategy will be analysed, with the aim of investigating whether they can be identified within the case study. In the end of the section, a summary of which functions have been identified will be presented.

Blockade

The main benefit of patents is that it gives the right to the patentee to exclude any third party from profiting from an invention[77]. In the case study which has been conducted blockade has been identified towards competitors. Hints towards actors trying to go over blockade have been identified.

It seems that the technology barrier created by actors in the premium market allowed them to limit the number of competitor playing in the market space. If we compare the number of competitors in the API market and the Premium market, there are mainly 15 companies playing on the Premium market against hundreds of companies playing on the commodity market. A good example to illustrate it is the premium coating technology. It is not surprising to see that only Tenaris, Vallourec, and JFE have patents related to coating (Cf. Part 6.2.2). They are indeed the only producers which propose on the market dope free solution with the Dopeless® from Tenaris, Cleanwell® from Vallourec, and ClearRun® from JFE. OCTG used to be connected together by using a layer of petroleum-based lubricant (also known as "Dope") to the threads by hands before the connection gets connected. Dope free solutions are coating which replace the Dope and are applied at the mills. Dope free solutions standardize and clean up the lubrication process by taking it off the rig and into the factory where quality can be monitored and assured. Dope free solution is a key product especially in certain region of the world in which environmental regulations are in place (especially in the North Sea) and will become more and more important in the other regions as there is a push towards reducing environmental impact. Tenaris and Vallourec have however a competitive advantage over JFE as both solution are dry while JFE solution is semi-dry. A dry solutions have several advantage:

[76] Ibid. 41
[77] Ibid. 41

- Better in term of safety for operator as no Dope are used so the surface around the rig is not slippery
- Better in term of running performance, there is not any extra work needed on the rig therefore the efficiency in the drilling process.
- In extreme condition, the dope used as lubricant was not the optimal solution as it froze at 0 degree, flow down at high temperature, and sand can stick on it. All this problem are solved with a dry coating.
- Dry Dopeless solution are more reliable as the right amount of lubricant is put and insure a perfect make-up.

Dry Dope free technology is a key technology which is controlled by Tenaris and Vallourec/Sumitomo. It is however difficult to determine exactly the influence of patents in this effect as mentioned previously companies in the premium OCTG market use a mix of trade secrets and patents in order to protect their innovation.

There are also signs of a fencing strategy in the industry. The patent portfolio of Vallourec in term of thread design has been studied carefully however this part has been classified as confidential. It has been found that patents related to thread designs owned by Vallourec are not all used in all of their product on the market. The majority of patents related to thread design is not used which is a clear sign of a fencing strategy of the premium market.

In addition, there is a sign that companies are trying to get over the blockade that patents can create as more and more oppositions in front of the European Patent Office (EPO) occur between premium OCTG producers. It is possible for a third party to file an opposition to an European granted patent up to nine month after publication of the granted patent. The outcome of an opposition can be that the patent is maintain as published; maintain but with a reduced scope of protection; or revoked. By looking at archives of the EPO it can be found that 47 oppositions have been filed opposing Tenaris to Vallourec.

Commercialization

In the case study, royalty-based licenses and exclusive exploitation of patents rights have been identified. There is no elements indicating either transfer of patents rights or cross-licensing activity in the premium OCTG industry.

The royalty-based licenses in the OCTG industry is a complex matter. OCTG companies involve in the premium market sell license to repair shops all around the world. For example Vallourec has more than 100 qualified repair shops in 37 countries[78]and Tenaris has 175 licensees in 49 countries[79]. OCTG producers are licensing the rights to thread patented thread profile and give access to know-how in order to be able to thread premium products. The know-how includes:

- Access to technical drawing of thread
- Being able to purchase proprietary tools which are necessary to thread premium pipes, these tools are manufactured by selected producers.
- Access to gauge rentals which are essential to insure the tolerance of threaded pipes

The licensees have to pay a fee on each pipes that they thread however the fees paid by licensees and revenues generated through royalties are confidential information. In addition to the royalty fees, the advantage for OCTG producers is that repair shops are available close to every locations in which there are oilfield or gas field which is very convenient for oil companies.

The use of patents to block third parties from entering the market can create a temporary monopoly in the market[80]. When a temporary monopolistic position is achieved, Premium OCTG producers can increase their market share and profit margin at the same time. For example Tenaris has 14% of the global API OCTG (Cf. Figure 18) Market but 30% of the premium OCTG market (Cf. figure 20). On Figure 20, we can see that the premium market

[78] Vallourec (2014) *Licensee Network,* Available at:*http://www.vallourec.com/DRILLINGPRODUCTS/EN/Solutions/Pages/Licensee-Network.aspx* (Accessed: September 2015).
[79] Tenaris (2015) *Threading & Repair Shops,* Available at:*http://www.tenaris.com/en/products/premiumconnections/threadingandrepairshops.aspx*(Accessed: September 2015).
[80] Ibid 41

is highly dominated by Vallourec and Tenaris as these two companies represent 62% of the premium market. It can be explained by the fact that Vallourec and Tenaris have the highest number of premium connections and tubes qualified to be used by Oil companies.

Premium OCTG products allow producers to get higher margin on this type of tubular[81]. Once a premium product is chosen by an Oil company for a project a lock-in effect is created as there will be a problem of compatibility with competitor's products due to patented features (Threads design mainly). For all after sale service needed the Oil company will have to go through either the producer or one of its licensee who is allowed to provide after sale services. In addition premium products need field supervision and therefore it allows producers to gain extra revenue by selling this service.

Bargaining chip

Patent portfolios, whether actively enforced through attacking others or not, can in some industries be used as protection from lawsuits brought by other industry actors, and hence create a freedom to operate. Nonetheless there was not any lawsuit in the OCTG industry which have been made yet therefore it is difficult to determine whether or not patent can be used as a bargaining chip in the OCTG industry.

Reputation & Image

Patent portfolios of premium OCTG producers is a tool to keep the reputation to be a technological leader. The reputation and image of producers is however mainly based on track records built by a company. The Oil and Gas industry is highly conservative which makes it reluctant to new players and/or new technology as oil companies are not willing to take any risk of failure in a multi-billion dollars project that a new well represents.

6.4.3 Scenario which occurs in term of technology

In the premium OCTG industry we have several players who are building a competitive advantage by restricting access to technologies (threading, coating, steel compositions)

[81] USITC, "Hearing in the Matter of: Oil Country Tubular goods from Argentina, Italy, Japan, Korea, and Mexico", 2007

from new entrants. Other actors will have either to settle with inferior technology (it is typically the case for coating in which JFE has a semi-dry coating which doesn't have all the benefit of a dry coating). Firms are competing on product market with slightly differentiated offerings or cost advantages based on different technical solutions.

We have the typical scenario of *several firms with competing technologies*. (figure 22)

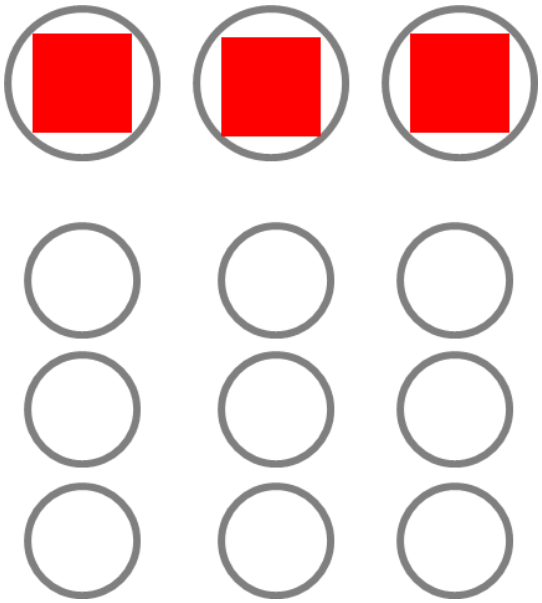

Figure 22: Scenario of Several firm with competing technologies

This setting allows established actors (mainly Vallourec/Sumitomo and Tenaris) to have a higher market share in the premium market than in API. Premium OCTG companies are investing in the premium market as it is also a more profitable market with margin which are three to five times higher than with API products[82].

In addition having a proprietary technology allows to have additional revenues through licensing the right and know-how to thread to repair shops all around the world.

[82] Interview with a Director of Tenaris

7 CONCLUSION

Oil Country Tubular Goods (OCTG) are pipe and tube products used in the exploration and production of oil and gas. OCTG products can be subdivided into two types of products; API (Standard) and Premium (proprietary). Premium products have been created to withstand extreme conditions which can be found in HPHT well reservoirs. Three features have been identified in OCTG products namely the thread profile, the coating of the thread and the steel composition.

The first case section concerned the competitive advantage in the API OCTG market. The market is composed of several players which acts on either a local market or a more globalized market. The key resources to be successful in the API market are physical assets, namely plants and equipment, and Financial assets. It is an *open access* technology meaning that API OCTG market is a commodity market in which traditional supply and demand-competition rules applicable. Nonetheless patents related to method might play a role indeed a patent related to a method of production can reduce production costs (through reduction of rejects, speed of production, etc.) and therefore increase profit margin or help a producer to win call for tenders by proposing lower prices than competitors.

For the second case study, the competitive advantage in the premium OCTG market has been studied. The number of competitors is reduced with a competition of 15 companies. The resources needed to be successful in the premium markets are the same as in the API OCTG market with the addition of the intellectual assets which are mainly IPRs. The innovation in the OCTG industry is protected with a mix of patents and trade secrets. The patent protections benefits that have been identified in the premium OCTG industry are mainly as blockade and commercialization. Patents are used to build a technological entry barrier to the premium market, it is made by the use of a fencing strategy. Another sign of blocking patents is the number of oppositions in front of the EPO. This market is based on differentiation, the scenario which occurs in this market is that *several firms with competing technologies* are fighting for market shares. Patents enables main actors to gain market

shares, getting higher margins, generate royalties and to create a lock-in effect on customers.

8 SUGGESTION FOR FURTHER RESEARCH

One area which would be interesting to investigate would be the role of method patents and trade secret in the API OCTG industry, it would be interesting to see their effects on the cost of the final products and the consequence in terms of market shares.

In addition the competitive advantage in this thesis has focus mainly on the resources and position effect as a source of competitive advantage, therefore it is possible also to study the competitive advantage of OCTG companies in API and premium markets in term of capabilities. It would be interesting to find a way to weight the effect of each of the sources of each competitive advantage in terms of market shares.

9 REFERENCES

American Petroleum Institute (2009) Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements, Third Edition (ISO 13678:2009 Identical Adoption), 3rd edn., : American Petroleum Institute.

API (2012) *API Overview and Mission,* Available at:*http://www.api.org/GlobalItems/GlobalHeaderPages/About-API/API-Overview* (Accessed: May 2015).

American Petroleum Institute (2008) Specification for Threading, Gauging and Thread Inspection of Casing, Tubing, and Line Pipe Threads, 3rd edn., : American Petroleum Institute

Ball, J., Davies, H. (2015) Where there is oil and gas there is Schlumberger, Available at: *http://www.theguardian.com/environment/2015/may/18/where-there-is-oil-and-gas-there-is-schlumberger* (Accessed: 2nd September 2014).

Barney J. (1991) 'Firm Resources and Sustained Competitive Advantage', *Journal of Management,* 17(1), pp. 99-120.

Blind, K., Edler, J., Frietsch, R., Schmoch, U. (2006) 'Motives to patent: empirical evidence from Germany', *Research Policy,* 35(), pp. 655-672.

Brusoni, S., Prencipe, A., Pavitt, K.L., "Knowledge specialization and the boundaries of the firm: why do firms know more than they make?", 2011, *Administrative Science Quarterly 46, 597–621*

Bryman A. and Bell E., "Business Research Method", *Oxford University Press*, 2011.

Burr, W., Stephan, M., Soppe, B., Weisheit, S. (2007) *Patentmanagement, Strategischer Einsatz und ökonomische Bewertung von technischen Schutzrechten*, Stuttgart: Schaffer-Poeschl.

Canadian Association World Petroleum Council (2014), *Upstream midstream downstream* Available at: http://wpccanada.com/yc/industry-info/about-the-industry/upstream-midstream-downstream.html

Cohen, W.M., Goto, A., Nagata, A., Nelson, R.R., Walsh, J.P. (2002) 'R&D spillovers, patents and the incentives to innovate in Japan and the United States', *Research Policy,* 31, pp. 1349-1367.

Corbel, P. and Raytcheva, S. « Le brevet comme outil de gestion du risque de subir une attaque en contrefaçon », *in* P. Corbel and C. Le Bas, *Les nouvelles fonctions du brevet – Approches économiques et managériales*, Economica, December 2011, p.101-123

Credit Suisse, "The Shale Revolution II", *Credit Suisse Research & Analytics,* 2013 Available through → https://doc.research-and-analytics.csfb.com/docView?language=ENG&source=emfromsendlink&format=PDF&document_id=1023125461&extdocid=1023125461_1_eng_pdf&serialid=9EIFh5wGMbrXUOFyyhvTsJLi%2fxb2aKN9Saj95oKCxko%3d

Daizadeh, I., Miller, D., Glowalla, A., Leamer, M., Nandi, R., Numark, C.I (2002) 'A general approach for determining when to patent, publish, or protect information as a trade secret', *Nature Publishing Group,* 20, pp. 1053-1054.

Ernst, H. (1995) ' Patenting Strategies in the German Mechanical Engineering Industry and their Relationship to Company Performance', *Technovation,* 15(4), pp. 225-240.

Flowtech Energy (2014) OCTG – CASING, TUBING, DRILL PIPE, Available at: http://www.flowtechenergy.com/oilfield-services/octg-casing-tubing-drill-pipe/

Fritzsche A. & Geiger R., "The strategies and tactics of patent management and their importance for competitive advantage", The third conference on intellectual capital Available through → https://books.google.nl/books?id=L6guNg_TeAcC&pg=PA157&lpg=PA157&dq=The+strategies+and+tactics+of+patent+management+and+their+importance+for+competitive+advantage&source=bl&ots=tucl4gT4Av&sig=8LZbrEsKEn9ooLslLm4HFvLKclo&hl=fr&sa=X&ved=0ahUKEwif4PKD1KbJAhXGThQKHdDcBP0Q6AEIKzAB#v=onepage&q=The%20strategies%20and%20tactics%20of%20patent%20management%20and%20their%20importance%20for%20competitive%20advantage&f=false

Galle T. and Al. , "Influence of design features on the structural integrity of threaded pipe connections", *Sustainable Construction and Design*, 2011

Gallié E-P, Legros D., "French firms' strategies for protecting their intellectual property", *Research Policy*, 2012.

Granstrand, O. (1999) *The Economics and Management of Intellectual Property - Towards Intellectual Capitalism*, London: Edward Elgar Publishing Ltd.

Grant, R. M. (1991) 'The resource-based theory of competitive advantage : implications for strategy formulation', *California Management Review,* 33(3), pp. 114-135.

Grindley, P.C. and Teece, D.J. (1997) 'Managing Intellectual Capital: Licensing and CrossLicensing in Semiconductors and Electronics', *California Management Review,*39(2), pp. 8-41.

Grube, C. (2009) *Measuring the Immeasurable: Valuing Patent Protection of Knowledge-Based Competitive Advantages*, Gabler Edition Wissenschaft edn, Bremen

Hagel F. (2005) 'Both sides – How Valuable are Patents to Companies', *Patent World*,October(176), pp. 14-17.

Heiden, B. "Defining Knowledge-Based Business", Advanced ICM course. Chalmers University of Technology. 2013. Lecture

International Molybdenum Association (2014) *Oil Country Tubular Goods (OCTG),* Available at: *http://www.imoa.info/molybdenum-uses/molybdenum-grade-alloy-steels-irons/oil-country-tubular-goods.php*

International Trade Administration, "Commerce Finds Dumping of Imports of Certain Oil Country Tubular Goods (OCTG) from India, Korea, the Philippines, Saudi Arabia, Taiwan, Thailand, Turkey, Ukraine, and Vietnam, and Countervailable Subsidization of Imports of Certain OCTG from India and Turkey", 2014 Available through → http://enforcement.trade.gov/download/factsheets/factsheet-multiple-OCTG-ad-cvd-final-071114.pdf

TPCO America (2014) *Project Introduction,* Available at:*http://www.tpcoamerica.com/about.cfm* (Accessed: May 2015).

Triepke J. (2015) *Understand Oilfield Technology Lifecycles [OCTG Case Study],*Available at: *http://oilpro.com/post/3662/understand-oilfield-technology-lifecycles-octg-case-study* (Accessed: May 2015).

Lanjouw, J.O. and Schankerman, M. (2001) 'Enforcing patent rights', *NBER working paper n°8656*

Lincoln YS. and Guba EG. , "Naturalistic Inquiry", *Sage Publications*, 1985.

Lloyd M. (2014) How does the Halliburton/Baker Hughes merger change the fracking patent landscape?, Available at: http://www.ambercite.com/index.php/amberblog/entry/how-does-the-halliburton-baker-hughes-merger-change-the-patent-landscape-of-fracking (Accessed: 2nd September 2014).

Markets and Markets (2014) Oil Country Tubular Goods Market by Grade (API, Premium), by Product (Seamless, ERW), & by Geography (North America, South America, Europe, Asia-Pacific, Africa, and Middle East) - Global Trends & Forecast to 2019, : marketsandmarkets.com

Metal Bulletin Research, "Review of the OCTG Market and Outlook to 2016", 2012

Metal Bulletin Research, "The five year Outlook for the Global OCTG Market", *Metal Bulletin Research, 2014*

Neal W.H. et Al. (2007) *Oil and gas technology development*, : NPC Global Oil & Gas Study, Available through → http://www.npc.org/study_topic_papers/26-ttg-ogtechdevelopment.pdf

Nippon Steel & Sumitomo Metal, OCTG Connections , Available through → http://www.tubular.nssmc.com/product-services/octg/connection/map

Patent EP2325435

Patent EP2516910

PetroStrategies, Inc (2015) Industry Players, Available at: *http://www.petrostrategies.org/Learning_Center/industry_players.htm#Fully Integrated*

Porter M. (1979) 'How Competitive forces shape strategy', *Harvard Business Review,*52(2), pp. 137-145.

Porter, M.E. 1985, Competitive advantage: creating and sustaining superior performance, Free Press, New York.

Planete energies (2015) Different Types of Oil and Gas Company, Available at:http://www.planete-energies.com/en/medias/explanations/different-types-oil-and-gas-company (Accessed: 11th January 2016).

Porter M., "What is strategy?", Harvard Business Review, Nov-Dec 1996, Vol.74, p.61-79

Rahn, G. (1994) 'Patenstrategien japanischer Unternehmen', *Gewerblicher Rechtsschutz und Urheberrecht (International),* 5

Sahu, S., & Parekh, K. ,"Determinants of Economies of Scale and their Influence on the Oil & Gas Services: A Discussion, Review of Integrative Business and Economics Research", 2012, 246-259.

Sedliacikova M, "Analysis of competitiveness of the chosen company", *Forestry and Wood Technology no 76*, 2011

Shapiro, C. (2001) 'Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting', *Innovation Policy and the Economy,* 1, pp. 119-150.

Slind-Flor, V. (2013) Nike, Schlumberger, ABA, Wiley: Intellectual Property, Available at: *http://www.bloomberg.com/news/articles/2013-09-03/nike-schlumberger-aba-wiley-intellectual-property* (Accessed: 2nd September 2014).

Statista (2015) World oil and gas industry revenue from 2009 to 2013 (in million U.S. dollars), Available at: http://www.statista.com/statistics/215892/revenues-of-the-world-gas-and-oil-industry/(Accessed: 2nd September 2014).

Teece D, Pisano G., and Amy Shuen, "Dynamic capabilities and strategic management", *Strategic Management Journal,* August 1997, Vol.18, Issue 7, p.509-533

Thomas D., "A General Inductive Approach for Analyzing Qualitative Evaluation Data", *American Journal of Evaluation* ,June 2006 vol. 27 no. 2 237-246

U.S. International Trade Commission, "Oil Country Tubular Goods from Austria, Brazil, China, France, Germany, India, Indonesia, Romania, South Africa, Spain, Turkey, Ukraine, and Venezuela", Publication 3511, May 2002.

USITC, "Hearing in the Matter of: Oil Country Tubular goods from Argentina, Italy, Japan, Korea, and Mexico", 2007 Available through → http://www.usitc.gov/trade_remedy/731_ad_701_cvd/investigations/2006/Oil%20Country%20Tubular%20Goods%20From%20Argentina,%20Italy,%20Japan,%20Korea,%20and%20Mexico/Second%20Review%20(Full)/octg_hearing.pdf

Tenaris (2015) *Threading & Repair Shops,* Available at:*http://www.tenaris.com/en/products/premiumconnections/threadingandrepairshops.aspx*(Accessed: September 2015).

Vallourec, A propos de Vallourec, Available through → http://www.vallourec.com/FR/GROUP/ABOUTUS/Pages/default.aspx

Vallourec, China, Avalaible through → http://www.vallourec.com/EN/LANDS/CHINA/Pages/CHINA.aspx

Vallourec, Historique, Available through → http://www.vallourec.com/FR/GROUP/ABOUTUS/HISTORY/Pages/default.aspx

Vallourec, "Investor day Presentation 2013", Available through → http://www.vallourec.com/EN/GROUP/MEDIA/Presentations/Lists/Publications/20130926-Vallourec-Investor-Day-2013-Presentation-EN.pdf

Vallourec Licensee Network By Area, Available through→ http://www.vamservices.com/network/by_area.aspx

Vallourec (2014) *Licensee Network,* Available at:*http://www.vallourec.com/DRILLINGPRODUCTS/EN/Solutions/Pages/Licensee-Network.aspx* (Accessed: September 2015).

Vallourec, Our locations, Available through → http://www.vallourec.com/OCTG/EN/Solutions/field-service/Pages/Global-local-vamfieldservices.aspx

Vallourec, "Rapport D'activite 2014", Available Through → http://www.vallourec.com/FR/GROUP/MEDIA/Publications/Lists/Publications/VALLOREC_RA_2014_FR.PDF

Vallourec, "Vallourec et les Pays Emergents", 2014, Available through → http://www.melchior.fr/fileadmin/fichiers/Ellg/2014/A10_Presentation_Vallourec.pdf

Veron P. and Romet I., "On the way to Fair Balance, The French Approach to patent Litigation", *Who's Who Legal*, 2011 Available through → http://whoswholegal.com/news/features/article/28961/on-fair-balance-french-approach-patent-litigation

Wesley M. Cohen, Richard Nelson, and Walsh John P. (2000) 'Protecting their intellectual assets : Appropriability conditions and why u.s. manufacturing firms patent (or not).', *National Bureau of Economic Research*