

**Louvain School of Management**

# **The race to 5G in China and the European Union: an analysis of Huawei and Nokia's innovation policies**

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*As my time at university is coming to an end, I would like to express my gratitude to all the people who helped and supported me during those enriching years.*

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# Table of Content

<b>Introduction .....</b>	<b>1</b>
<b>Part A – Literature Review .....</b>	<b>4</b>
<b>Chapter 1: The EU-China relation .....</b>	<b>5</b>
<b>1.1 Economics.....</b>	<b>5</b>
1.1.1 China’s economic transition.....	5
1.1.2 EU’s economic integration .....	6
1.1.3 Trade .....	7
1.1.4 Foreign Direct Investment.....	8
<b>1.2 Politics .....</b>	<b>10</b>
1.2.1 China’s foreign policy in the EU.....	11
1.2.2 EU member states divergences.....	13
<b>1.3 Social .....</b>	<b>14</b>
1.3.1 People-to-People Dialogue .....	14
1.3.2 Movement of people .....	14
1.3.3 Education .....	15
<b>1.4 Security.....</b>	<b>15</b>
1.4.1 Climate change.....	16
1.4.2 Nuclear non-proliferation .....	17
1.4.3 Cyber-security .....	18
<b>Chapter 2: China’s innovation strategy.....</b>	<b>18</b>
<b>2.1 Medium-to-Long-Term Plan for the Development of Science and Technology .....</b>	<b>19</b>
<b>2.2 Made in China 2025 .....</b>	<b>20</b>
<b>2.3 Current state of innovation in China.....</b>	<b>23</b>
<b>Chapter 3: EU’s digital strategy.....</b>	<b>24</b>
<b>3.1 The Lisbon Strategy and Europe 2020.....</b>	<b>24</b>
<b>3.2 The von der Leyen Commission .....</b>	<b>26</b>
3.2.1 A European Green Deal.....	26
3.2.2 A Europe fit for the digital age .....	26
<b>Chapter 4: The case of 5G.....</b>	<b>27</b>
<b>4.1 What is 5G? .....</b>	<b>27</b>
4.1.1 Definition.....	27
4.1.2 5G architecture and ecosystem .....	27
4.1.3 Benefits of 5G.....	28
4.1.4 From 4G to 5G .....	30
<b>4.2 EU 5G strategy and implementation.....</b>	<b>30</b>
4.2.1 The 5G Infrastructure Public Private Partnership .....	30
4.2.2 5G Action Plan for Europe.....	31
4.2.3 European 5G Observatory.....	32
<b>4.3 The politics of 5G .....</b>	<b>33</b>
4.3.1 US-China Trade War .....	33
4.3.2 ZTE & Huawei US ban.....	35
4.3.3 US lobbying in the EU.....	36

<b>Chapter 5: China catching up.....</b>	<b>38</b>
<b>Part B – Practical part .....</b>	<b>41</b>
<b>Chapter 1: Research question .....</b>	<b>42</b>
<b>Chapter 2: Methodology .....</b>	<b>43</b>
<b>2.1 Research method .....</b>	<b>43</b>
<b>2.2 Data collection .....</b>	<b>44</b>
<b>Chapter 3: Nokia and Huawei in the global 5G market .....</b>	<b>44</b>
<b>3.1 5G in Europe .....</b>	<b>44</b>
3.1.1 Finland.....	47
3.1.2 Croatia.....	47
3.1.3 Germany.....	47
3.1.4 Belgium .....	47
<b>3.2 5G outside Europe .....</b>	<b>48</b>
3.2.1 United States.....	48
3.2.2 China .....	49
3.2.3 South Korea.....	49
<b>3.3 Nokia .....</b>	<b>50</b>
3.3.1 Company profile.....	50
3.3.2 Market share .....	51
<b>3.4 Huawei .....</b>	<b>52</b>
3.4.1 Company profile.....	52
3.4.2 Market share .....	54
<b>Chapter 4: Innovation policy .....</b>	<b>55</b>
<b>4.1 Nokia .....</b>	<b>55</b>
4.1.1 Research and Development .....	55
4.1.2 Patents .....	57
4.1.3 Mergers and Acquisitions.....	58
<b>4.2 Huawei .....</b>	<b>61</b>
4.2.1 Research and Development .....	61
4.2.2 Patents .....	63
4.2.3 Mergers and Acquisitions.....	65
<b>4.3 What are the differentiating factors in both companies’ innovation policies? .....</b>	<b>66</b>
<b>Chapter 5: The role of state intervention .....</b>	<b>69</b>
<b>5.1 Nokia .....</b>	<b>69</b>
<b>5.2 Huawei .....</b>	<b>71</b>
<b>Chapter 6: Discussion .....</b>	<b>74</b>
<b>6.1 Analysis .....</b>	<b>74</b>
<b>6.2 The future of Nokia and Huawei.....</b>	<b>77</b>
<b>Conclusion .....</b>	<b>78</b>
<b>References .....</b>	<b>81</b>
<b>Appendices .....</b>	<b>88</b>

## Abbreviations

5G PPP	5G Infrastructure Public Private Partnership
BRI	Belt and Road Initiative
CCP	Chinese Communist Party
EEAS	European External Action Service
EU	European Union
FDI	Foreign direct investment
ICT	Information and communications technologies
JV	Joint venture
M&A	Mergers and acquisitions
MLP	Medium-to-Long Term Plan for the Development of Science and Technology
ODI	Outward direct investment
PLA	People's Liberation Army
PRC	People's Republic of China
R&D	Research and development
RAN	Radio access network
SEP	Standard essential patent
SOE	State-owned enterprise
UK	United Kingdom
US	United States

## **Introduction**

Since the end of World War 2, liberalism and the Washington Consensus have driven the economic order of the world. Indeed, free market and the reduction of state intervention has been at the centre of Western countries' economic policies. The international expansion of high-income countries' companies as well as the internationalization of their value chains have created significant wealth for those and has become the norm for any country willing to develop. Through the intervention of global institutions like the International Monetary Fund and the World Bank, emerging countries had the ability to develop their economies by implementing liberal and open-market policies.

In the 1970s, when China opened up to the world after decades of an isolationist policy, many Western analysts and experts expected the country to engage in liberal reforms and slowly turn into a democratic country. The failures of Mao, such as the Great Leap Forward and the Cultural Revolution, brought a new and reformist party leadership that aimed to open the country to the world and reclaim the country's position as a global power, following the century of humiliation where China was subjected to Western colonies and authority.

Forty years after its opening up, the expectations of Western countries have been smashed as the Chinese Communist Party (CCP) is still governing the People's Republic of China (PRC) with an iron fist. Even though the party has allowed for a controlled opening of its economy, strategic sectors are still highly protected from multinational competition. On a political level, the hope that China would become a democracy never even brushed the CCP's mind and the accession to power of Xi Jinping has only reinforced the strong hold that the party has on the country.

After the lying low policy instigated by Deng Xiaoping where the CCP encouraged a peaceful and quiet rise of the country, China is now becoming more assertive on the international stage and Xi Jinping is starting to show signs that China is now ready to take on a bigger role in foreign affairs, challenging the United States (US) hegemony. The recent Belt and Road Initiative (BRI), a massive regional infrastructure plan, has become an important topic for international observers with voices in the West claiming that it would allow China to grow its influence over emerging nations in Asia, Europe and Africa. Moreover, the CCP has become more assertive regarding its autonomous regions like Hong Kong, Taiwan and more. The recent protests in Hong Kong have been largely covered by the international press and have bring the spotlight on the growing Chinese influence there. Also, allegations of human rights violations

of the Uighur Muslims in the autonomous region of Xinjiang have attracted foreign attention and have brought a negative image to the CCP.

In response to the rise of China, Western countries have recalibrated their policies regarding the country. In the US, the Trump Administration have strengthened its position on China, calling it a threat to national security. In the European Union (EU), the Commission has described the country as a systemic rival.

In the middle of the growing rivalry between Western liberal democracies and the autocratic China, the deployment of 5G has become a strategic race to technological leadership. World powers are racing to deploy this technology in order to get a first-mover advantage in the fourth industrial revolution and be able to dictate international standards that will govern the digital world.

For that reason, telecommunications equipment providers like Huawei and Nokia have been at the centre of this race and have attracted a lot of attention. Indeed, Huawei's growing market share in high-income countries have raised many concerns in the national security community as the company has been accused of working hand in hand with the CCP. The fast rise of the Chinese company has let many people in the West to question its ability to deliver safe and independent products and services as it is rumoured that the Chinese government has played a significant role in the development of the firm's innovative capabilities.

In this thesis, we will explore the rise of Huawei and how its innovation policies allowed the firm to become the leader of the telecommunications equipment sector. Moreover, we will explore China's industrial policy and describe how it helped the Chinese firm to develop its innovation capabilities.

The thesis will be divided into two parts. Part A will be a literature review that will allow the reader to have a better understanding of the subject. The first chapter will describe the ongoing EU-China relationship and how it has evolved through the years since the first reforms in the 1970s. In the second and third chapters, we will describe the EU and China's innovation strategies to see how both powers approach state interventions into the development of their domestic companies. The fourth chapter will be about 5G. We will explain why 5G is so important in the technological race and the benefits that this innovation will bring. At the end of the literature review, we will explain the catching-up strategy of China and show why the country is still far from reaching the level of high-income countries.

In the second part of this thesis, we will go deeper into the 5G race and explore the different innovation strategies of two rival firms, Nokia and Huawei, through a comparative analysis. The first and second chapters will present our research questions and our methodology to

answer them. The third chapter will detail the state of 5G deployment in the EU as well as in other important regions of the world. We will also present both Nokia and Huawei's current position in the market. In the fourth chapter, we will analyse both firms' innovations strategies in depth. After that, we will analyse the degree of state intervention in both firms' strategies to see how the EU and China support their domestic companies. We will finish the second part with a discussion chapter that will go through the analysis and answer our research questions. The purpose of this thesis is to explore the effects of China's industrial policy on Huawei's innovation capabilities. As tensions are growing between China and the West, the thesis will bring a better understanding of the CCP's strategy to expand their national champions abroad. It will shed some light on their objectives and allow a path for further research on a coherent response from Western countries.

# **Part A – Literature Review**

## Chapter 1: The EU-China relation

### 1.1 Economics

#### 1.1.1 China's economic transition

In 2021, China will celebrate the 100<sup>th</sup> anniversary of the CCP. Since 1948 and the Maoist revolution, the party have had total control over the country. However, modern China is, in many ways, very different compared to 1948 due to significant changes in its economic system in the late 1970s.

Under Mao, the Chinese economy was isolated from the outside world. According to the World Bank (2019), the value of China's inward foreign direct investment (FDI) in 1979 was at \$80,000 or close to 0% of its gross domestic product (GDP). In the same year, export of goods and services accounted for only 5.16% of GDP and imports accounted for less than 6% of GDP. In 1978, China was the 32<sup>nd</sup> exporting country in the world, far away from the number one spot it occupies today (Lardy, 1992). Lardy (1992) describes the Chinese trade policy under Mao as an import substitution regime. The philosophy behind this regime was that exports were meant to finance useful imports. By overvaluing the local currency, imports were made cheaper and purchased with the foreign exchanges earned via the exports. China fully embraced this system as described in 1955 by the Minister of Foreign Trade: "*Export is for import and import is for the country's socialist industrialization*" (Lardy, 1992). During Mao's tenure, six foreign trade corporations had the responsibility to implement the foreign trade plan and meet the requirements of the domestic market (Lardy, 1992). Most of the imported goods were producer goods as the goal of the CCP was to quickly industrialize the country and to catch up with other Asian countries. Even though, this period brought a few successes to the country such as the fast development of its industry, it also brought massive failures such as the Great Leap Forward and the Cultural Revolution.

The 70s was a pivotal decade for China. With the intensity of the Cold War increasing, the Nixon Administration decided to operate a complete policy change vis a vis China in order to isolate the USSR. In 1972, Nixon's visit officially started the rehabilitation process of China as a global actor. With the death of Mao Zedong in 1976 and the push for reformists to change China's import substitution regime, Deng Xiaoping, a reformist, became the leader of the CCP in 1978. Following the century of humiliation and the failures of Mao, Deng Xiaoping started its reforms with the goal to establish China as an economic power and reaffirmed a sense of national self-confidence (Nolan, 1995). By opening its country to FDI and welcoming new

trade partners, he allowed China to take full advantage of its comparative advantage. In 1998, the net inflows of FDI jumped to \$45 billion and exports of goods and services accounted for 18% of the country's GDP. This significant increase was made possible by the liberalization of the domestic market, however, the reforms undertaken by the CCP were not part of a comprehensive plan but were incremental. Feedbacks and analyses helped the central power to adjust them if needed. Major reforms included: the decentralisation of trading corporations, going from planned trade to licensed trade, devaluation of the yuan and reform of the pricing of traded goods (Lardy, 1992).

Today, the Chinese economy is facing a new challenge. As Kroeber (2016) described in his book, the CCP has, since the first reforms, worked towards the goals of mobilizing resources, meaning the development of its economy and its industry. Now that China has developed a powerful industry, it needs to work on making its economy efficient by deleveraging its economy, re-energize productivity growth and lower its excess capacity in some industries. According to Magnus (2018), Xi Jinping is facing four traps that he needs to solve in the near future: debt, renminbi, demographic and middle-income traps. This implies that after opening its economy to the world, China must now reform its domestic economy in order to sustain its rapid growth. The Chinese economy is highly leveraged, especially through the massive amount of corporate loans that state-owned banks have given to Chinese firms since the first reforms. Moody's chief economist, Mark Zandi, recently called China's corporate debt the biggest threat for the global economy (Tan, 2019). The response from the CCP and its new leader since 2013, Xi Jinping, can be found in the 13<sup>th</sup> Five-Year Plan, a shift towards an export-led economy to more investment in innovation and cutting-edge technology will allow China to move up the global value chain and define new standards on the global level (Defraigne, 2014).

### *1.1.2 EU's economic integration*

Contrary to its member states that cumulatively have hundreds of years of history, the EU is a relatively newcomer in the global economic order (Christiansen, Kirchner, & Wissenbach, 2019). Starting as the European Coal and Steel Community a few years after the end of World War 2 with the purpose of creating peace on the continent, the EU has become the most complexed and integrated supranational organization in the world. Today, the Union is governed by the Treaty of Lisbon, which came into force in 2009 and established the current EU's institutions and organization. According to the World Bank (2019), the EU has a GDP of \$18.7 trillion (current US dollar) for a population of 513 million people. Those numbers make

the EU one the biggest economies in the world next to the US and China. However, the EU is not a state. The hybrid nature of the EU where supranational institutions and member states work around interests defined by the latter makes it a complex entity to understand but should not be seen as a super state such as the US or China (Christiansen, Kirchner, & Wissenbach, 2019).

The EU, which gathers 27 member states (excluding the UK), is governed by many institutions which all have an influence on the decision-making process. Unlike China, where the power is concentrated at the top of the CCP's bureaucracy, the EU's decision-making is shared between the Parliament, the Council of Europe, the European Council, the Commission and other institutions. This complexed apparatus of institutions makes it hard for the EU to speak with a common voice. Furthermore, as the EU shares competences with its member states, divergences sometimes occur between them.

In the last decades, the EU has enlarged its border from 6 founding countries to the current 27 member states. One of its biggest economic successes is probably the establishment of the single market that provides the free movement of goods, services, capital and labour. Thus, the creation of a +500 million people single market looking for quality goods and services has made the EU very attractive in the eyes of foreign countries. For that reason, the EU has become one of the biggest trading blocs and is the top trading partner for more than 80 countries (European Commission, 2020).

### *1.1.3 Trade*

Historically, Europe and China have traded for centuries (Christiansen, Kirchner, & Wissenbach, 2019). Under Mao, trade between the two have been close to zero due to his isolationist policy. As explained above, trade was only a mean to pursue domestic objectives and was kept to a minimum. However, after the first reforms and the opening of the Chinese market, trade between the two partners boomed. Indeed, trade quickly became the central element in the EU-China relation. As an example, in 2014, 18% of EU imports were coming from China which made China the first source of imports for the EU, even before the US (Christiansen, Kirchner, & Wissenbach, 2019). In 2019, the EU exported for \$198 billion and imported \$362 billion worth of goods to China which created a trade in goods balance of \$164 billion between the two (Eurostat, 2019). Those figures highlight a growing economic interdependency which, according to Christiansen et al. (2019), has been reinforced after the

2008 crisis during which China became a safe haven for EU's goods when its internal demand was facing a massive decrease.

From 2002 to 2015, the EU has gradually decreased its tariffs to follow its liberalisation policy and develop free trade. This is a consequence of the increase in bilateral trade agreements that the EU has made with its trading partners (Eurostat, 2017). According to Eurostat (2017), 70% of EU imports faced a zero or a preferred tariff in 2015, following the liberalization and openness trend of the EU trade policy, a core principle of its institutions. As trade is the exclusive competence of the EU, the Commission has negotiated many trade deals in order to follow the objective. However, member states still have a say in the EU institutions' decisions through the European Council where heads of states meet to discuss EU strategy. Even though trade with China can be detailed through EU level figures, the situation can be very different from a member state to another. As an example, Germany is by far the largest exporter of EU goods in China, and, in 2014, it accounted for 45% of EU trade with China (Christiansen, Kirchner, & Wissenbach, 2019). Also, Germany is usually the only EU countries to run a positive trade balance with China. On the opposite, France has had a trade deficit with China for years. These differences between member states create divergences in how to see China in terms of trade.

In recent years, trade with China has become a very hot topic for EU politicians. The election of Trump and his strong stance on the country has only reaffirmed the necessity to be cautious when dealing with them but this tougher approach on China started even earlier with the Obama administration. Indeed, they initiated negotiations with many Pacific countries to establish a Trans-Pacific Treaty that would have covered many subjects such as trade between those nations. China was excluded from the negotiations as the treaty was part of the "rebalance Asia" strategy of the Obama administration to strengthen its relations with the US's pacific allies.

#### *1.1.4 Foreign Direct Investment*

Along with trade, FDI represent a significant aspect of the economic relations between the EU and China. Even though, Chinese investments in the EU were relatively small in the beginning of the 21<sup>st</sup> century, this situation changed around 2010 when the EU experienced a massive increase of FDI coming from China (Le Corre & Sepulchre, 2016). According to Kratz, Huotari, Hanemann and Arcesati (2020), Chinese FDI in the EU were at €2.1 billion in 2010 and increased to €37.3 billion in 2016. However, the same source acknowledges a sharp decrease since 2016 with a value of €11.7 billion in 2019, in accordance with the global decrease of

China's outward direct investment. According to Le Corre and Sepulchre (2016), this surge of Chinese investments follows the "going out" policy of Beijing with the purpose to internationalize Chinese companies. They explain this late start, in comparison with trade, to the fact that the European market always seemed very complex and overregulated in the eyes of Chinese investors. But the increase in intercultural knowledge between the two finally created a better understanding of each other and created this surge in FDI. According to Defraigne (2014), the increase of Chinese ODI is part of China's industrial policy. The main purpose of Chinese ODI in developed countries or regions such as the EU is to gain access to strategic assets. As Chinese firms look to go global, they invest in the EU in order to gain experience in intangible assets such as branding, innovation capabilities and management know-how. The recent decrease in Chinese FDI in Europe can be explained by two factors. First, Beijing is slowly starting to tighten its control over capital and domestic credit. Second, some EU member states have implemented stricter investment screening procedures which makes it harder for foreign investors to invest in some sectors (Dadush, Dominguez-Jimenez, & Gao, 2019).

In the early 1990s, European ODI in China took off, mostly due to the expansion of European firms in China. Indeed, companies like Volkswagen invested massively in China in order to benefit from the rapid growth in the country and globalize their supply chains (Christiansen, Kirchner, & Wissenbach, 2019). Nolan (2012) explains in his book "Is China buying the world?" that Western firms have been investing in China since the first reforms. From 2000 to 2009, Nolan shows us that the balance between inward and outward stocks of FDI have increased in China due to the expansion of Western firms in the country.

Since the 2010s and its increase of ODI in Europe, China has faced some criticisms from some European Union member states. Massive acquisitions such as Syngenta in Switzerland and the port of Piraeus in Greece have increased the pressure on the country and put the spotlight on their offensive acquisition strategy. In that regard, debates within the EU have emerged to discuss the issue and a common solution. In 2014, the EU Commission initiated talks with China to sign an investment agreement that would govern FDI between the two. As of today, this agreement is still negotiated by both parties. The goal of the agreement is to rebalance the relationship between the EU and China and create common practices around investments. In the Joint Press Communiqué of the 14<sup>th</sup> EU-China Summit, both parties agreed to negotiate an agreement that will increase market access for companies, transparency and eliminate barriers to investments (Council of the European Union, 2012). At the 21<sup>th</sup> EU-China Summit in 2019, both parties reaffirmed their willingness to conclude the investment agreement for 2020

(Council of the European Union, 2019). However, Sabine Weyand, the EU director-general for trade, recently said that the deal probably won't be signed in 2020 citing low political commitment from Beijing (Financial Times, 2019). The slow pace of development in EU-China investment relations can also be found, like trade, in the divergences within the EU. Indeed, EU member states have very different relations with China in terms of FDI. Between 2009 and 2017, the majority of Chinese FDI in the EU have been concentrated in France, Germany and the UK (Hanemann & Huotari, 2018). Due to the 2008 financial crisis and the need for investments in Europe, EU member states have competed against each other to attract FDI. This situation created tensions and a great opportunity for Chinese firms to invest in the old continent which can explain the surge that happened between 2010 and 2016 (Meunier, 2014). The divergence within the EU can also be shown with the different investment screening policies in place in member states. Meunier (2014) tells us that the majority of EU countries does not have an investment screening mechanism. Some countries like France and Germany have since a long time adopted those mechanisms that allow them to monitor foreign investments, especially in sectors that affect the countries' national security.

In 2019, the EU foreign investment screening regulation came into force, two years after the Commission proposed it. The goal of this regulation is to create a framework where the EU institutions and members states can raise their concerns over specific foreign investments where it poses national security threats. However, the member states keep their decisional power in terms of foreign investment on their territory (European Commission, 2019).

## **1.2 Politics**

Formal diplomatic ties between the EU and China were established in 1975 following the policy change of the Nixon Administration regarding China. Since then, the relations have grown further but suffered a few setbacks along the way.

As Christiansen et al. (2019) describe it, the economic interdependence between the EU and China is high but their political interdependence is low in comparison. The significant aspect of the relation is based on the economic realities between the two such as trade and investment as described in the previous section. Christiansen et al. (2019) also explain that the political relation between the two partners significantly increased in the mid 1990s for three reasons. First, the end of the Cold War created new global challenges that needed to be faced by bigger international cooperation. Second, China saw the opportunity to engage with the EU in order to better deal domestically with their political issues, mostly the One Country Two Systems.

Third, the EU has always wanted to push its normative power outside of its border and saw China as the perfect recipient of its values.

Following the evolution in political relations between both powers, the EU and China signed in 2003 a strategic partnership, confirming their willingness to increase the scope of the relationship. For the EU, the partnership's goal was to increase interdependence and thus trust between the two and push for its normative policy in China. From the Chinese standpoint, the partnership's goal was to advance its multipolarity agenda and challenge US hegemony in the world (Casarini, 2013). Men (2007) explains that this partnership was essentially driven by the economic developments between the two powers. According to her, the EU-China relation experienced a honeymoon situation directly after the partnership but suffered setbacks after 2005 when both partners realized that they were still far away from a complete understanding of each other. The relation is not static and is evolving with the economic and political developments in the world.

For that reason, the strategic partnership was updated in 2016 to reflect the new reality of the evolving EU-China relation. On the EU side, the 2016 Strategy on China is now the basis of the EU policy on China. This shift in policy came at a time when China became more assertive under Xi Jinping's leadership and had the goal to adapt the EU's policy to the new reality of a strong China (European Commission, 2019).

More recently in 2020, the European Union and China signed the "EU-China 2020 Strategic Agenda for Cooperation" with the aim to update their strategic partnership and define new goals and guidelines for their relation (European Commission, 2020). The relation is structured through 3 pillars: The Political Dialogue, The Economic and Sectorial Dialogue and The People-to-People Dialogue. Those pillars take place through the form of an annual summit, regular ministerial meetings and over 60 sectorial dialogues (European Commission, 2020). You can see the architecture of the EU-China relation in appendix 1.

### *1.2.1 China's foreign policy in the EU*

Since the reforms, China's foreign policy has followed the five principles of peaceful coexistence: mutual respect of each other; non-aggression rule; no interference in other states; equality and mutual benefit; and peaceful co-existence (Christiansen, Kirchner, & Wissenbach, 2019). This can be illustrated by the "lying low" policy initiated by Deng Xiaoping. However, international observers have warned that China's foreign policy have become much more aggressive since the accession to power of Xi Jinping (Rühlig, 2018). Blackwill & Campbell

(2016) explains that even though Xi's foreign policy is more assertive than of its predecessors, the break is not as big as described. What is new is that Xi Jinping uses all the available state instruments to push for his policy on the global scene and that makes him, in the eyes of observers, more assertive. According to Yinhong (2015), China's foreign policy has suffered major contradictions in recent years. On one hand, elements like modernizing the People's Liberation Army (PLA), the increase of military presence in the South China Sea and the establishment in 2013 of the East China Sea Air Defence Identification Zone (ADIZ) have suggested that the country is taking a more assertive position. On the other hand, political statements talk more and more about "peaceful development". The increase in cooperation between the US and China on military issues and the emphasis of the "good neighbourhood policy" have shown a different facet of China's foreign policy. The changes and evolutions in the global context over the next few years will have an impact on Xi's foreign policy.

Regarding the EU, China released its first policy paper on the EU on 13 October 2003, the same year as the strategic partnership between both powers. At that time, China highlighted three foreign policy objectives in regard to the EU: the promotion of EU-China relations following mutual respect and trust; the deepening of their economic cooperation; and the expansion of social and cultural exchanges (Mission of the People's Republic of China to the European Union, 2003). Those 3 objectives follow the strategic partnership objectives and are illustrated by the 3 pillars of the EU-China relation (political dialogue, economic dialogue and people-to-people dialogue).

In 2014, China released its second policy paper on the EU, this time in the Xi Jinping era. In general, the paper encourages both partners to deepen their already existing relationship. China reaffirmed its vision of a multipolar world and confirmed the EU as a partner to advance this vision, in opposition with the US hegemony (Mission of the People's Republic of China to the European Union, 2014).

Even though China's policy papers emphasize the need for cooperation and mutual trust with the EU, some observers have qualified China's strategy in Europe as "divide and conquer". In 2012, China created the "16+1" group which gathered China and Central and Eastern European Countries (CEEC) with 11 EU member states among them. This gave China a better leverage as they played with the internal divisions of the EU (Gaspers, 2018). Another issue is the privileged relation that Germany has with China (mostly due to economic reasons). In an interview in 2015, Wang Yi, China's Foreign Minister, said: "*China-Germany practical cooperation continues to take the lead in China-Europe relations and is being constantly deepened*" (Mission of the People's Republic of China to the European Union, 2016). That is

also a cause of internal divisions within the EU. We will explore further the internal EU divergences in the following section.

### *1.2.2 EU member states divergences*

Since the 2009 Lisbon Treaty, the EU developed its diplomatic branch called the European External Action Service (EEAS). In 2016, under the supervision of Frederica Mogherini, the former head of the EEAS, the EU launched its global strategy. The ambition around that paper is to formally describe the EU's security and foreign policy. The main objectives are the preservation of peace, the strengthening of international security, the promotion of international cooperation and development of democratic values, the rule of law and human rights (European Union, 2018). Nevertheless, EU foreign policy is also influenced by its member states through the European Council. This situation makes it complicated to understand the foreign policy and also to speak with a common voice on global issues.

To understand the divergences of EU member states regarding China, Fox and Godement (2009) classify them into 4 different categories: Assertive Industrialists, Ideological Free traders, Accommodating Mercantilists and European Followers (see appendix 2).

The Assertive Industrialists stand up to China on both economic and political issues. The Ideological Free traders will oppose any form of trade restrictions but will be tough on China regarding political issues. The Accommodating Mercantilists are soft on China on political issues as they think it will bring more economic benefits. The European Followers don't have any particular stance on China and prefer to follow the EU policy.

Dennison et al. (2015) go even further by calling the EU foreign policy a fantasy. For them, national foreign policy and concerns still trump the supra governmental action. It is clear that this situation creates a very complex environment when dealing with China.

Due to those divergences, China has been frequently accused of playing a double game with the EU (Christiansen, Kirchner, & Wissenbach, 2019). Indeed, the hybrid foreign policy apparatus, both national and supra governmental, means that China also deals with both national governments and EU institutions.

A major accelerator of this situation was the 2008 financial crisis. From the crisis have emerged significant economic, technological and political differences between EU countries. Some countries have found themselves in terrible economic shapes and in desperate need of money. The austerity programs in the EU that followed the financial crisis have created an opportunity for Chinese firms to buy public-owned assets in some EU countries. This has created tensions

between member states as to how the EU should deal with China and its growing influence in the world.

### **1.3 Social**

The social component of the EU-China relation should not be underestimated or avoided. Indeed, “people-to-people” relation is the third pillar of the strategic partnership which implies that it is a significant aspect of the relationship for both the EU and China. As Christiansen et al. (2019) describe it, social relations between both powers have increased exponentially in the last decades. Thus, this section will analyse the latest social development in the relation. Topics like education, cultural exchange, sport, migration and tourism are a strong part of the social interactions and are influenced by non-state actors, such as NGO’s, universities, think tanks, lobbying groups and more. According to Josselin and Wallace (2001), non-state actors have the ability to play a significant role in international politics and their power should not be doubted.

#### *1.3.1 People-to-People Dialogue*

On 18 April 2012, the EU and China introduced the High-Level People-to-People Dialogue as a part of the third pillar of the EU-China strategic partnership and with the aim to deepen educational and cultural relations between both powers. In a speech on the same day, then Commissioner Vassiliou said that this new dialogue had 3 main objectives: contribute to the knowledge and understanding between China and the EU; encourage concrete actions based on the exchange of information; and support the evolution of our societies with respect to our highly valued diversity (Vassiliou, 2012).

#### *1.3.2 Movement of people*

Migration from China to Europe started in the mid-19<sup>th</sup> century with the arrival of European countries within China, mainly from Hong Kong to Western Europe. After the reforms of Deng Xiaoping, the migration flows started again with the opening of the country’s border and the trends have accelerated in the 21<sup>st</sup> century. According to Wu and Latham (2014), the recent increase of migration from China to the EU is due to the following factors: state-owned enterprises (SOE) reforms in China, increase in trade between China and the EU, rising inequality in China and the internationalisation of higher education. Today, the largest communities of Chinese migrants in Europe are in the UK, France, Italy, Spain and Germany (Christiansen, Kirchner, & Wissenbach, 2019).

In 2010, 825,511 Schengen visa applications were made from China and in 2018, it rose to 2.9 million which represents an annual increase of more than 12%. In 2017, 6 million Chinese tourists visited Europe making the continent the second place that the Chinese visit, only behind Asia. Moreover, EU-China tourism is valued at €10 billion with Chinese tourists spending around €7 billion in Europe in 2016 and the European tourists spending around €3 billion in China.

Those numbers imply a strong and growing people-to-people relation due to the growing number of touristic and business trips between both powers.

### *1.3.3 Education*

Education is an important aspect of the EU-China relation. Educational exchanges between both powers started at the beginning of the 1990s, pushed by the developments of higher education exchanges. From 2000 to 2010, it was estimated that the number of Chinese students in the EU increased by 6 times from 20,000 to 120,000 students. This number represents the largest number of non-EU students studying on the old continent. With a growing middle class in China, families are now able to send their children studying abroad and it is the reason for the significant increase of Chinese students in the EU, but also in other regions of the world (Wu & Latham, 2014). EU students also go to China, in a lesser number, and in 2011 around 47,000 EU students studied there.

In the last three decades, many joint educational programmes have been set up between European and Chinese universities which have increased the cultural knowledge of each other in both places. With education being a key aspect of the relation, educational exchanges are supposed to increase in the years to come.

As we have seen with the growing number of immigrants and students between the EU and China, we can expect the social links to increase further between the two. As the people-to-people dialogue is now considered as strategic, both powers will want to develop cultural exchanges in order to increase their knowledge of each other.

## **1.4 Security**

Security-related questions and issues are today at the core of political relations. The EU-China relation has historically been centred around economic and political issues. However, given the growing number of global security challenges that the world is facing, both partners have

recently developed their dialogues on security issues such as climate change, nuclear proliferation, terrorism and migrations.

The security challenges can be split in traditional security issues (focused on military questions) and the non-traditional security issues (climate change, energy). According to Christiansen et al. (2019), the EU-China security dialogue is mostly based on non-traditional security issues such as climate change and nuclear proliferation. This is due to the fact that, in terms of military, the EU still cannot talk with a single voice to global partners and that China see the EU as too close to the US position and lacking independence. Kirchner, Christiansen and Dorussen (2015) explain that even if the EU and China don't consider the other as a threat or an enemy, the security cooperation between the two are mainly based on the non-traditional security aspects for two reasons. First, the lack of an EU military presence in Asia and divergences between member states diminish the credibility of the EU. Second, as the EU is part of NATO, it is seen by China as a follower of the US policy and thus lacks the independence to be consider credible in solving traditional security issues.

#### *1.4.1 Climate change*

In 2020, the World Economic Forum (2020) listed long term risks that the world will face in the future. The top 5 risks with the highest likelihood to happen are all related to the environment and climate change. This historic report emphasizes the need for countries to cooperate regarding climate change. The EU and China being two of the biggest economies and polluters in the world, their cooperation in this field is highly relevant and important in their relation.

EU-China official talks about climate change started in 2005 after the 8<sup>th</sup> EU-China Summit. In a joint statement, both powers agreed to start a partnership on climate change in order to strengthen their cooperation and dialogue in that field. The objectives of the dialogue were for both powers to work together to reduce greenhouse gas emissions, develop new clean energy sources and promote clean energy technologies (European Commission, 2005). Even though the partnership showed a lot of ambitions to fight climate change, the EU was not capable of acting as the leader they wanted to be due to a lack of leadership and internal divisions within the union (Romano, Giulia C, 2010).

In 2010, 2015 and 2018, both the EU and China reaffirmed their confidence in the 2005 partnership on climate change via joint statements (European Commission, 2020). In 2018, they both reaffirmed their commitments to the historic 2015 Paris Agreement after the withdrawal

of the US in 2017 and a growing number of climate change deniers in the world (European Commission, 2018). In that 2018 joint statement, both powers also reaffirmed their willingness to intensify their cooperation in fighting climate change and the development of clean energy. Even though the EU and China have the opportunity to become great partners to fight climate change, it is important to say that both powers have nevertheless different approaches to solve the question. According to Ujvari (2017), the EU and China have different methods because of their diverging interests in the matter. The same author enumerates three significant subjects where their solutions diverge: sharing of responsibilities, emission reduction targets and views about green finance. The author advocates for both powers to adjust their approaches in order to find common ground and be able to move forward.

At the same time, the growing dialogue around climate change and environmental issues have allowed the EU and China to develop their relation from an economic standpoint to a more strategic one (De Matteis, 2010). It also allowed both actors to gain international exposure by standing as leaders in the fight against climate change. The interdependency between both economies and the necessity to fight global warming are the reasons for such developments between them.

#### *1.4.2 Nuclear non-proliferation*

According to Christiansen et al. (2019), both the EU and China have made it a priority to fight against nuclear proliferation. Nuclear non-proliferation is a strategic issue for both countries and a dialogue have been set up back in 1998 between the two to reinforce cooperation in that topic. In recent years, Iran and North Korea have been at the centre of the nuclear arms debate due to their willingness to develop their nuclear capacity.

Prior to 2015 and the signing of the Iran deal, China regularly blocked and delayed resolution against Iran at the United Nations Security Council. Even though they enforced the sanctions, China was a strong energy importer from Iran and was not keen to strong arm them (Maher, 2016). However, in 2015, China co-signed the EU-led Iran deal with the aim to restrict Iran's military nuclear use. Cronberg (2017) calls the deal a European success story of multilateralism as 3 EU member states initiated this deal. Even after the withdrawal of the US under the Trump Administration, China stated that they will fulfil their part of the deal.

The situation with North Korea is different compared to Iran. China shares not only a border with the country but also strong historical and economic ties. In the opposite, the EU has close to zero economic ties with North Korea. Strategically, both the EU and China shares the will

for a nuclear free and peaceful region (Su & Saalman, 2017). Since the new tough US policy on North Korea, the situation has become more sensitive than ever before. The 3 main nations in that situation, the US, China and North Korea are in a dangerous status quo and thus the EU could help the situation by mediating it by bringing a neutral and peaceful agenda of de-escalation (Duchâtel, 2017).

### *1.4.3 Cyber-security*

With the digitalization of the world and the development of 5G, AI and IoTs, cyber-security issues are becoming a very important subject of non-traditional security issues between countries. Recently, China has been accused of more and more state-sponsored cyber-security attacks in Western democracies (Forbes, 2020). Even though the Chinese government has always denied such allegations, the topic is becoming more important in the EU-China relation. As part of their strategic partnership, the EU and China have held talks about the cyber-security issue and developed a joint task force with the aim to address the problem. However, those talks have been highly politicized and the lack of a common vision between the two means that the cyber-security relation is not as developed as the trade and FDI topics (Sliwinski, 2014).

## **Chapter 2: China's innovation strategy**

Innovation is at the centre of China's industrial policy. According to Shi-Kupfer and Ohlberg (2019), China's innovation strategy is driven by both economic and political goals. Indeed, the credibility of the CCP relies heavily on strong economic results and a fast development of Chinese digital capabilities will allow the country to upgrade in the value chain, from the workshop of the world to one of the most innovative countries.

As Defraigne (2014) explained, the political goal of China's industrial policy is to reach both domestic cohesion and strategic autonomy. In order to fulfil those objectives, China has, since the late 70s reforms, decided to develop its domestic science and technology capabilities. The end-goal of those developments are to create national champions that will be able to innovate and create new international standards but also compete on foreign markets with other international companies. In the beginning of the reform era, science and technology policies were mostly handled and written by one government ministry, the Ministry of Science & Technology (MOST). Because MOST was not the most important ministry and due to the fact that other ministries and local governments had other priorities than innovation, those policies were not very efficient. This situation started to change with the 2006 Medium to Long Term

Program for Science and Technology Development (MLP) as ministries began to work together in a comprehensive manner and create much more efficient policies that were not only based on science and technology but also on taxes, incentives, R&D investments and more (Liu, Simon, Sun, & Cao, 2011). In 2016, the Chinese authorities launched the innovation-driven development strategy (IDDS) that highlights 3 stages in the next decades that China will have to reach: becoming an innovative country by 2020, joining the leading edge of advanced innovation countries by 2030 and becoming a strong global innovation power by 2050 (Cheung, et al., 2016). In the next section, 2 key innovation plans will be presented and detailed to understand and highlight the ambitions of the Chinese authorities to develop innovation in the country.

## **2.1 Medium-to-Long-Term Plan for the Development of Science and Technology**

In 2003, the Chinese leadership began to think about a way to boost the country's science and technology capabilities as it was lagging behind developed economies. The planning of the MLP took 3 years and in 2006, the MLP was conceived with the help of thousands of engineers, experts, economists and focused on key areas where China needed to become more competitive (Cheung, et al., 2016). As it was the second long-term plan of China since the accession to power of the CCP, it had a significant importance for the country and was confronted with major internal debates. At the end of the day, the MLP was focused on developing indigenous technology to foster domestic innovation. Cheung, et al. (2016) define the MLP as follow: *“the notion of indigenous or independent innovation, which seeks to promote the country's S&T capabilities through improving the absorption and re-innovation of foreign technology as well as investing in the building of a national innovation system to nurture development of original, homegrown innovation”*.

The MLP is a 15-year plan that started in 2006 until 2020. In those 15 years, multiple objectives and goals were set up in order to measure and analyse the actual development of S&T capabilities in the country. The deployment of the plan was focused around 11 key areas where the country was looking to make significant progress: energy; water and mineral resources; the environment; agriculture; manufacturing industry; transportation sector; information industry and modern service industry; population and health; urbanization and city development; public security; and national defence. Also, 16 special major projects were chosen in order to lead the development in key areas. Next to the S&T capabilities development, the plan also outlined strategic policies related to education, investments and taxes in order to create a viable

environment for the innovation to happen (The State Council of the People's Republic of China, 2006). The MLP also provided a few quantitative objectives for 2020 such as China's gross expenditures on R&D must reach 2.5% or more of GDP, the S&T contribution to the economy should account for 60% or above, the dependence of China to foreign technology must be reduced to 30% or less and China must be in the top 5 countries in terms of invention patents and international citations of scientific papers (The State Council of the People's Republic of China, 2006).

According to Cao, et al. (2006), many experts and observers described the MLP as a grand experiment for China as it grouped state-directed programs with decentralized, market-responsive methods. Cao, et al. (2006) describe four critical issues in Chinese science and technology capabilities that the MLP planned to fix. First, China was still dependent on foreign innovations and had a weak record in terms of domestic commercial technologies. Second, China's growing demand in energy, water and environmental protection needed to be met by technological progress. The rising demand for those social needs could not be matched by an increase in supply but by more innovation which would allow more efficiency. Third, the Chinese military capabilities were not enough strong and powerful. The country imported a lot of technologies from foreign nations, mainly the US. As today's military technologies can have a dual purpose (civilian and military), innovation in that sector can only help China to develop a more reliable national security arsenal. Fourth, Chinese science was not at its best level, they suffered a massive brain drain with a lot of scientists leaving the country for Western countries. The experts that decided to stay were sometimes highly remunerated without any checks and balances which created an inefficient allocation of resources in the scientific community. The MLP helped to create a strong and efficient scientific and research tradition in the country and thus triggered an innovation cycle.

A few years after the implementation of the MLP, Liu, et al. (2011) found out that there seemed to be an improvement in the collaboration of the different institutions and government agencies which used to be traditionally not the case in China. They also stated that there seemed to be an institutionalization of the Chinese system of innovation which created a more coherent portfolio of policies between the various government agencies.

## **2.2 Made in China 2025**

In May 2015, the State Council unveiled Made in China 2025, a national plan to improve the manufacturing capabilities of the country thanks to the new technologies of the 4<sup>th</sup> industrial

revolution. In many regards, this plan is similar with the German plan “Industry 4.0” as it has the goal to use innovative information technology tools in production facilities and thus upgrade the manufacturing capabilities to Western standards and even further (Kennedy, 2015).

Even though the plan has a 10-year length ending in 2025, it sets longer term objectives with 3 deadlines that have increasingly higher expectations. In 2025, China seeks to become a leading manufacturing power by improving the quality of its manufacturing, boost innovation and develop domestic multinationals. In 2035, the country wants to become a global leader in some key industries and in 2049, for the 100<sup>th</sup> anniversary of the PRC, China seeks to become the global leader in manufacturing and innovation (Morrison, 2019).

According to the China-Britain Business Council (2015), the implementation of the Made in China 2025 plan focuses on the following nine strategic tasks: to encourage innovation; to promote the use of integrated, digital, technology-focused manufacturing; to strengthen the overall industrial base; to improve product quality and build global Chinese brand names; to focus on enforcing green manufacturing methods; to make innovative technological breakthroughs in the 10 key sectors; to restructure industries to improve efficiency and output; to improve service-oriented manufacturing-service industries; and to globalise Chinese manufacturing industries. Those strategic tasks will be concentrated around ten strategic sectors of the Chinese economy: advanced marine equipment and high-tech vessels; advanced rail and equipment; agricultural machinery and technology; aviation and aerospace equipment; biopharmaceuticals and high-end medical equipment; integrated circuits and new generation information technology; power equipment and technology; high-end manufacturing control machinery and robotics; low and new-energy vehicles; and new materials.

As stated above, the Made in China 2025 plan shares similar objectives and goals with the German plan Industry 4.0. However, differences in the methods and implementation exist which make both plans relatively different. Like Germany, other EU member states launched plans which aim to transform their manufacturing capabilities. According to the European Union Chamber of Commerce in China (2017), Industry 4.0 is mostly a bottom-up approach where the German authorities create a favourable innovative environment where private actors have the liberty to innovate as they wish. Indeed, the plan doesn’t offer massive state funding or subsidies but rather develop strong institutions, IP protection and support for R&D centres and universities. Furthermore, the German plan is open to collaboration with international partners, such as China, to work on joint research projects. By heavily supporting basic research in strategic sectors where significant scientific breakthroughs can happen, Germany hope to transform its manufacturing capabilities into a more integrated and innovative sector.

In opposition with the German plan Industry 4.0, Made in China 2025 has a top-down approach where the Chinese leadership dictates the path to follow. Indeed, the plan is driven by political forces and not much business support for two main reasons (Wübbeke, Meissner, Zenglein, Ives, & Conrad, 2016). First, many Chinese entrepreneurs do not feel the need to massively invest in costly new technologies for their manufactories. As they are not exposed to a free market environment and a strong competition, they lack the incentives to upgrade their capabilities, and improve their market position by delivering more efficient, less expensive products. Second, labour costs in China are still relatively low. For many Chinese entrepreneurs, it is still cheaper to hire many low skilled workers than investing money in new technologies.

The political push for the Made in China 2025 was also to solve the middle-income trap that China is facing in the coming years. According to Magnus (2018), the term “middle-income trap” was established in 2005 and describes an economy that is blocked between poor economies and developed countries. After years of high GDP growth, China has now reached a point where there is a need for policy changes in order to unlock its path to becoming a high-income country and avoid a structural growth slowdown. The country has, for years, developed its industry by organizing physical labour, developing low-cost products and acquiring its technology from foreign help. If China wants to avoid staying a middle-income country, it needs to focus on developing innovation, boost higher education enrolments, arrange its institutions and work on advanced infrastructure. China faces a double pressure coming from both developing low-wage economies and developed high-wage economies. The Chinese leadership is worried about being stuck between those and is thus looking to upgrade the manufacturing capabilities of the country. On one hand, they seek to challenge the market dominance of developed countries, and on the other hand, they are facing strong competition from emerging countries like Brazil, Vietnam and others that will challenge their status of “factory of the world” thanks to their low-wage low-skilled population (Wübbeke, Meissner, Zenglein, Ives, & Conrad, 2016).

In 2019, Zenglein and Holzmann (2019) delivered an analysis on the implementation of the Made in China 2025 plan, 4 years after its launch. First, the Chinese leadership decided to tone down the strong rhetoric of the plan by removing words such as “indigenous innovation” or “self-sufficiency” as they attracted negative comments abroad. Second, due to a fast-changing business and economic environment, many readjustments in the strategy have been made. However, the end goals of the plan are still the same. After 4 years, China achieved to become a leader in some key industries such as telecoms equipment or high-speed trains and is rapidly

catching up with advanced economies in other areas like AI or connected vehicles. The report also acknowledged the fact that China is still dependent on foreign technologies, especially semiconductors or in basic research. However, the rising position of China in the tech industry have mainly been pushed by the private sector which showed that China positively created a strong environment for companies to grow and innovate.

### **2.3 Current state of innovation in China**

The Chinese leadership has made innovation the driving factor of development in the country. Many plans, policies and initiatives have been launched in last decades in order to upgrade the science and technology capabilities of China. The recent S&T fast developments have let observers to describe the situation as a “real leap forward” in comparison with the catastrophic Great Leap Forward of Mao (Fabre & Grumbach, 2012). The Chinese leadership has now fully emboldened the concept of innovation in its national industrial policy in order to strengthen its economy but also its political power over the country. As Chinese companies continue to grow in the local market, with the strategic help of the state, they will be able to compete on international markets against established multinational companies (Shi-Kupfer & Ohlberg, 2019). Even though the latest innovation plans showed very ambitious targets, some might be difficult to reach in such short deadlines. As we have seen, China is still highly dependent on foreign technologies with the example of the US ban on some Chinese companies that blocked their capacity to import vital semiconductors. However, China’s policy pushed by meticulous planning and quantitative targets have had successes. Indeed, many observers in 1978 saw in China a country ready to enter the international economic order and to open its border to foreign companies. After forty years, China is still ruled by the CCP and has shown a high level of resilience. In 2019, China was ranked 14<sup>th</sup> in the Global Innovation Index and 22<sup>nd</sup> in the Bloomberg Innovation Index (Cornell University, INSEAD, and WIPO, 2019) (Bloomberg, 2015). As liberal democracies have based their innovation policies around free market and competition, the Chinese innovation approach of top-down, techno-nationalism and state-driven characteristics will, without a doubt, pose a great challenge to advanced countries (Heilmann, 2018). It remains to be seen if China will be able to attract the best researchers in the world and also decrease the brain drain that the country has been witnessing for decades. Indeed, the increase of the country’s innovation capabilities will have to be met with an increase in the productivity of its scientific community. However, the majority of international Chinese students tend to not go back to China after their studies and the ones who do are attracted by

high salaries from companies like Huawei (Defraigne, 2014). Even though China has, in the last few years, attracted hundreds of thousands of international students, the vast majority of them are not willing to stay in the country citing low quality of life, low salaries and internet censorship as reasons (Zwetsloot, 2020). Thus, China will have to push for reforms when it comes to attracting and retaining the best talents in the country.

## **Chapter 3: EU's digital strategy**

### **3.1 The Lisbon Strategy and Europe 2020**

By the end of the 20<sup>th</sup> century, the EU experienced an economic and technological stagnation compared to its competitors such as the US and Japan but also to emerging countries. In order to remedy the situation and avoid a wider gap with those countries, the EU leadership launched, in March 2000, the Lisbon Strategy (Gaillard, 2018). The 10-year plan had for the EU the ambition: *“to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”* (European Council, 2000). The plan offered a major strategic framework for the EU in the 2000s decade. It was based around 3 pillars: economic, social and environmental while promoting research, entrepreneurship, fiscal consolidation and sound public finances. However, due to poor results, the plan was relaunched in 2005 with a stronger focus on growth creation and employment (Ivan-Ungureanu & Marcu, 2006). Five priority areas were selected to ensure the feasibility of achieving the targets: investing in knowledge and innovation; internal market reforms; unlocking business potential; increasing employment and social cohesion; and working on climate change.

Even though the Lisbon Strategy did not meet its expectations and many targets were never reached, the majority of EU actors agreed that those kinds of plan are useful policy instruments to dictate and implement social, economic and environmental reforms (Butkovic & Samardzija, 2010). According to Defraigne (2016), the lack of internal coordination and the competition between member states were to blame for the failures of the plan. The high level of heterogeneity within the EU also posed problems. Whereas Nordic countries have the same technological levels as Japan and the US, some Eastern countries have a smaller level of technological developments than China or Brazil.

Following the 2000 Lisbon Strategy and the mixed results the plan achieved, the EU Commission launched, in March 2010, a follow-up plan called Europe 2020 (Butkovic & Samardzija, 2010). Like the Lisbon Strategy, Europe 2020 is a 10-year plan with a strategy to

increase the competitiveness of the EU in the world economy. The strategy is centred around three priorities: smart growth (focus on innovation and knowledge), sustainable growth (focus on greener and more efficient economy) and inclusive growth (focus on employment and cohesion). The Commission also proposed a few quantitative targets to reach by the end of the plan: employment rate at 75%; R&D spending must be at 3% of GDP; 20% greenhouse gas emissions diminution, the share of renewable energy at 20% and 20% increase in energy efficiency; 20 million less EU citizens in poverty; and decrease the education dropout rate at 10% and increase people with tertiary education at 40% (European Commission, 2010). The plan also launched 7 flagship initiatives in order to achieve the different priorities.

Due to the lack of strong results of the Lisbon Strategy, observers are pessimistic regarding the result of the Europe 2020 agenda. The strategy mainly focuses on competences that does not belong to the EU institutions but to member states which might foreshadow a probable failure (Erixon, 2010). According to Butkovic & Samardzija (2010), member states will have to play an active role in the strategy and engage with the EU institutions to enforce Europe 2020 and see positive results.

Among the seven flagship initiatives of Europe 2020, Innovation Union is probably one the most ambitious. As innovation is at the core of Europe 2020, this initiative hopes to answer the most pressing global issues that the EU will face such as economic growth, climate change and energy security (European Commission, 2011). With the goal to develop the most innovative and impactful ideas in the EU, Innovation Union aims to develop and increase the funding of scientific research and innovation. The initiative also acknowledges the fast innovative-friendly environment developing in China but also the widening of the technological gap of the EU with the US and Japan. In 2015, a mid-plan review was presented by the EU. According to a report of the European Commission (2015), the initiative created a strong momentum for innovation topics and allowed many national and regional policies to be drafted. However, the implementation has been uneven within the EU where some countries performed much better than others. One of the main achievements of the initiative was the creation of the European research area and the Horizon 2020 plan.

Horizon 2020 is the funding vehicle of the Innovation Union. Launched in 2014 until 2020, the plan will fund innovation projects for a total amount of €80 billion (European Commission, 2014). With an emphasis on excellent science, industrial leadership and tackling societal challenges, Horizon 2020 aims to reach the goals of Innovation Europe for smart, inclusive and sustainable jobs.

### **3.2 The von der Leyen Commission**

In 2019, the newly-elected von der Leyen Commission launched 6 ambitious priorities to create “a Union that strives for more” with the aim to lead the green transition and develop a new digital era (Von der Leyen, 2019). Among those priorities, two will be detailed in this section.

#### *3.2.1 A European Green Deal*

The European Green Deal is an ambitious plan looking to make Europe the first climate-neutral continent in 2050. It is a roadmap to make Europe a sustainable economy in the long run. The plan aims to: boost the efficient use of resource by moving to a clean, circular economy; and restore biodiversity and cut pollution (European Commission, 2019). The European Green Deal is backed by the promise of a €1 trillion mobilization in order to finance this green transition over the next decade. It is also supported by very ambitious targets such as the requirement for the EU to have cut carbon emissions by 55% in 2030. The high ambition of the plan will test the resistance of the European Union and obviously create strong tensions between member states. Countries with a high carbon emissions economy will have to take tough policies to reach the targets (Buras, 2020).

#### *3.2.2 A Europe fit for the digital age*

In order to transform the EU society into the new digital era, the Commission made the digital transformation one of its priority for the next years. The digital strategy is focused around 3 pillars: technology that works for the people; a fair and competitive digital economy; and open, democratic and sustainable economy. With this plan the EU aims to become a global role model in the digital transformation and promote that model to emerging economies (European Commission, 2020).

Reflecting on the two priorities described above, the EU Commission in 2020 launched a new industrial policy for Europe. The New Industrial Strategy for Europe combines the ideas that Europe needs a green transformation to address the environmental challenges of the future and that the world is rapidly evolving towards a global digital society. Facing this new reality, the new strategy lays out the foundations for the industry of tomorrow: sustainable and digital (European Commission, 2020). The strategy is focused towards three drivers: green transition, global competitiveness and digital transition.

According to Bjerkem and Pilati (2020), the new strategy is a great attempt to bring more coherence into the Commission's vision and goals. However, the lack of targeted measures and equality between the different member states might be a big obstacle in the success of the new policy.

## **Chapter 4: The case of 5G**

### **4.1 What is 5G?**

#### *4.1.1 Definition*

5G is the fifth and next generation of wireless cellular technology or mobile internet connectivity. This new technology follows decades of evolution regarding telecommunications. In the beginning of the 80s, the first generation, 1G, was launched with the voice call innovation. Since then, a new generation has been implemented roughly every 10 years with better features and improvements than its predecessor (Fendelman, 2020). Thus, 5G will be the most advanced technology in terms of mobile internet connectivity and is supposed to deliver impressive new business applications. The main innovation of 5G will reside in its capacity to deliver a faster internet, more data and a lower latency.

In order to set a global framework for 5G, the International Telecommunication Union which is the United Nations Agency responsible for information and communication technologies (ICT), delivered a plan with minimum requirements for 5G in the world. With this plan, the 3<sup>rd</sup> Generation Partnership Project (3GPP), a collaboration of telecommunications standards organizations (Japan, USA, China, EU, India, South Korea), set standards for 5G in order to have a global network (de Looper, 2020).

#### *4.1.2 5G architecture and ecosystem*

Basically, the architecture of 5G is composed of 3 main components: Radio Access Network (RAN), Evolved Packet Core and IP Multimedia Subsystem.

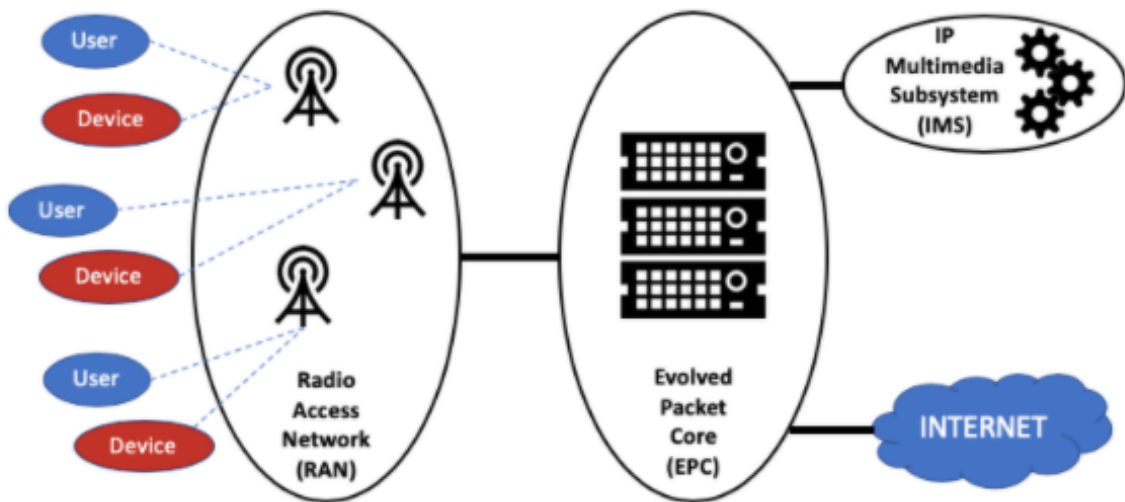


Figure 1: 5G generalized physical architecture

Regarding the RAN component, 5G will introduce many new technologies that will allow the end user to have a better experience than previous generations. It will take much more spectrum bands and thus allow more data to transit. Three different spectrum bands will be used: low-band (same ones as 4G, will allow big coverage), mid-band (faster internet but less coverage), high-band (also known as the millimetre waves, it will allow massive speed but short coverage). The three spectrum bands will be working together to allow the most consistent connectivity (Schwaderer, 2019).

The ecosystem of 5G is broad and many companies are involved in the process of deploying this new technology. Three big categories can be identified: chipsets manufacturers, equipment providers and phone carriers. The equipment providers are responsible for the development of the RAN component but can also deliver end-to-end solutions. The major equipment manufacturers are Huawei, Ericsson, Nokia, ZTE and Samsung. In the last year, this segment of the 5G industry has attracted a lot of attention as it has been put in the spotlight by the Trump Administration following the trade war between the US and China. Indeed, Huawei has become a recurrent target of the US President to argue in favour of a tougher stance against China and the race of 5G.

#### 4.1.3 Benefits of 5G

The deployment of 5G in the world will bring great benefits to consumers and businesses. As a direct consequence of this new generation of mobile connectivity, three key benefits are to be expected. First, the data rates will be higher which will enable users to download at a much

faster rate. Second, there will be a much lower latency which will result in less delay when using the internet. Third, the capacity will grow as the network expands (IEEE, 2019).

Besides the positive impacts of 5G for its consumers, it will also have benefits in the economy and create new business opportunities. According to PSB (2016), 5G full economic benefits could produce up to \$12.3 trillion worth of goods and services enabled by 5G by 2035. The report highlights the possibility for 5G to create around 22 million jobs by 2035 and generate a value chain worth \$3.5 trillion. The report also surveyed business managers and opinion leaders and found out that those people are more likely to say that 5G will have a greater deal of impact on their businesses than 4G, 5G's predecessor.

The widespread development of 5G will create strong economic and social progresses. A World Economic Forum report (2020) emphasizes the benefits of 5G in key areas. First, 5G will create industrial advances and support those advances in three different ways: faster and effective inspections with predictive intelligence; improvement of work safety; increase operational effectiveness. 5G will also create social benefits in the world and advance the cause of 11 out of 17 of the UN's Sustainable Development Goals (SDG). As the full deployment of 5G will take time, some business benefits could be grasp sooner than others.

Some industries are expected to enjoy significant benefits from 5G. Those industries will see massive changes in their sector and will have to adapt quickly to those. The healthcare industry might be disrupted by the 5G technology. The low latency of 5G will allow surgeons to perform remote surgeries on patients. Manufacturing will also be highly impacted as automation will develop faster and more efficiently with 5G. Smart manufacturing and internet of things will allow massive gains of productivity and cost cutting. However, those gains might come at the price of a rising unemployment rate. The transport industry and more specifically car manufacturers will have the possibility to create self-driving autonomous cars. In parallel, smart cities will enable those cars to become better and safer with intelligent traffic lights and other technological advancements. Vehicle-to-vehicle communications will become possible and some manufacturers like Tesla are already well advanced in their production. The retail industry will also see big changes as shops will totally change the shopping experience for customers with the help of advanced reality. 5G will allow to create more connectivity with local shops in a new technological environment (Wray, 2020).

The benefits of 5G could also help emerging economies to tackle some of their challenges. The combination of AI and 5G could help in the development of sectors like agribusiness, healthcare and education (Mockel & Baloko, 2019).

4.1.4 From 4G to 5G

As we have explained above, 5G will give the opportunity for businesses to develop significant innovation in the future. The main reason comes from the fact that 5G brings many improvements compared to 4G, the current generation of mobile connectivity. Three areas will be impacted by the upgrade to 5G: speed, capacity and latency (CNN, 2020). Speed is expected to increase massively compared to current standards. As 5G will be using millimetre waves or higher frequencies waves, up to 30 GHz, 5G speed is expected to be 20 times faster than 4G. However, those new waves are much more impacted by the general environment and have thus a shorter reach. So, in order to experience an internet 20 times faster, cities will have to be fully equipped with a lot of new antennas. Because of the very high investments of those, it is likely that consumers will not experience this in the beginning of the 5G deployment. Capacity will also massively increase with 5G. Indeed, as 5G will use a much broader spectrum of frequencies, bandwidth will also increase and thus the amount of data that will be able to circulate in the network. As an analogy, adding new and better lanes on a highway will allow more cars to circulate. With 5G, bandwidth is added and thus allow more data to circulate. Latency will likely decrease massively. This won't affect normal end-users as the latency is already relatively low with 4G. However, a latency close to zero will open the door for new business innovations such as remote surgeries and self-driving cars which all need a very low latency to work properly (Fisher, 2020).





		3G	4G	5G
	Deployment	2004-05	2006-10	2020
	Bandwidth	2mbps	200mbps	>1gbps
	Latency	100-500 milliseconds	20-30 milliseconds	<10 milliseconds
	Average Speed	144 kbps	25 mbps	200-400 mbps

Figure 2: Technical characteristics of 3G, 4G and 5G

4.2 EU 5G strategy and implementation

4.2.1 The 5G Infrastructure Public Private Partnership

Since 2013, the EU has established many plans to prepare the continent for the deployment of 5G. The first significant milestone happened that year when the Commission created the 5G Infrastructure Public Private Partnership (5G PPP), a joint initiative between the EU

Commission and the European ICT industry that aims to deliver solutions, architectures, technologies and standards for 5G. Its goal is to secure EU's leadership in certain areas where 5G will massively impact innovations, such as smart cities and healthcare. In its 2015 vision paper, the 5G PPP (2015) reaffirmed the impact that 5G will have in the society. The report highlights the necessity for the EU ICT industry to be ready and seize this new opportunity and also details the objectives of the 5G PPP initiative. The main objectives are to conduct research and innovation on 5G; reinforce the European industrial capabilities in communication networks; serve as a platform for collaboration between academics, industry, research and SMEs; support global standards; and provide a reliable and trustworthy communications infrastructure. In a nutshell, the 5G PPP is the research and innovation vehicle of the EU, in collaboration with the industry, to structure the EU research capabilities in the domain. The 5G PPP has launched and supported 3 phases of projects with around 20 projects per phases. All of those projects follow the missions and goals of the 5G PPP. In order to finance those projects, the initiative has been allocated a budget of €700 million from the Horizon 2020 program. This will also trigger private investments which are estimated to be around 5 times that amount. The three phases cover different period of time and different objectives. Phase 1 occurred from 2015 to 2017 and financed 19 research projects about the core infrastructure of 5G and its network architecture. Phase 2 occurred from 2017 to 2019 with 21 projects and expanded the phase 1 research but also established relations between 5G and industries. The last phase of the initiative is separated into 4 different waves of projects that cover end to end platforms, connected and automated mobility, trials across industrial and long term 5G evolution (European Commission, 2020).

#### *4.2.2 5G Action Plan for Europe*

In parallel of research and innovation that was structured with the 5G PPP, the EU Commission launched in September 2016, the 5G Action Plan for Europe. It is a strategic initiative gathering all 5G stakeholders with the goal to make 5G a reality for citizens and businesses in the EU by 2020. In other words, the 5G Action Plan for Europe is the implementation plan of the EU to insure a collaborative 5G deployment in the continent. This plan follows the 2014-2019 Digital Single Market strategy of the EU that aims to develop the online world to citizens and businesses.

Considering some of the failures of the 4G deployment in Europe (in 2015, 75% of the US population had access to 4G/LTE compared to 28% in the EU), the Commission acknowledged

the need for a coordinated approach in the deployment of 5G. The full advantages of the technology could only be fostered if member states are able to share the same standards, spectrum and regulations. As the investments needed will likely be massive, mobile network operators will not engage in the 5G if they are not able to see a European compatibility in the region. Some innovations, as autonomous cars, will also need some sort of compatibility within the EU to see their full benefits. Thus, the 5G Action Plan for Europe seeks to deliver on those questions and challenges. It identified the following elements (European Commission, 2016):

- Align 5G roadmaps and priorities for a coordinated deployment within the EU;
- Make provisional spectrum bands available and recommend a plan to authorise above 6GHz bands;
- Promote early deployment in cities and along transportation infrastructure;
- Promote Pan-European trials;
- Facilitate industry-led environment to support 5G innovation;
- Unite actors to ensure the promotion of global standards.

The plan also detailed 8 actions to take in order to fulfil the objectives of the Digital Single Market strategy.

As the EU strategy calls for the creation of a 5G environment, the Commission launched, along the 5G Action Plan for Europe, the European Electronic Communications Code which is a set of new rules and regulations that applied to internet providers. The Code updates the existing EU laws in light of technological development and defines how national regulators can regulate internet and services providers.

#### *4.2.3 European 5G Observatory*

In 2018, the European 5G Observatory was set up to monitor market developments of 5G in Europe and abroad. It will track the progress made by the EU in the context of the 5G Action Plan for Europe and analyse the actions taken by the member states. The Observatory will publish quarterly reports on the evolution of 5G to give lawmakers a brief summary of the global situation regarding this topic. It will also publish the national strategies of the different member states as well as national and European trials.

Thus, the Observatory is a useful tool to monitor and assess the evolution and deployment of 5G in the EU and to compare it with global developments such as in China and in the US. On their website, the Observatory details the elements they will monitor: main 5G market developments; new developments regarding key 5G products and components; 5G pre-

commercial trials; national strategies of EU member states; preparation and execution of spectrum assignments (European 5G Observatory, 2020).

### **4.3 The politics of 5G**

As we have presented in the previous sections, 5G will significantly transform societies and allow businesses to come up with new innovations and business models. Many companies will appear, and even though we already expect some products such as remote surgery or connected vehicles, other unknown products and services will be invented thanks to a faster internet and very low latency. Billions of new devices will be able to go digital in what experts call the Internet of Things. Thus, 5G is considered as a backbone for this digital revolution and countries are now racing to deploy it and enjoy a first mover advantage.

This race for 5G started a few years ago with superpowers like the US, China and the EU all elaborating plans and strategies to develop it the fastest. The deployment of 5G calls for a complex supply chains as it needs new infrastructure and cannot only work with 4G installations. In that regard, telecom equipment manufacturers have been recently put into the spotlight as they assume a significant role in the 5G network.

#### *4.3.1 US-China Trade War*

During the 2016 US Presidential Election, Donald Trump displayed an aggressive and strong rhetoric regarding China and accused them of unfair trade practices. After the election, the Trump Administration launched a plethora of tariffs on Chinese imports which triggers a response from China. The escalation created growing tensions between the two countries which soon translated into a full trade war.

Despite the media covering the growing tensions as a trade war and mainly focusing on the establishment of tariffs between the two countries, other outlets pointed out that the key driver of the growing tensions might be the race to the new 5G technology (Kharpal, 2018). In parallel, think tanks started to write about the necessity for the US to develop 5G in the country and described the technology as a question of national security.

According to Weitz (2020), the race to 5G should be considered as important and challenging as the space race during the Cold War between the US and the USSR. The author argues that the 5G technology will have significant long-term impacts on the world economy and that the US should not let China win the battle. China has implemented very aggressive strategies in order to develop 5G the fastest, using predatory pricing and subsidies. Thus, the US should

push for the development of 5G not only for its economic benefits but also for its national security.

In 2019, the Heritage Foundation, a conservative US think tank, issued a brief where they call for the US to treat China (and Chinese companies) as a security threat in regard to the deployment of 5G (Kitchen, 2019). The author of the brief argues that the US cannot trust China on 5G as Chinese companies will use, extract and store valuable data which will then be available for China's national security apparatus. Moreover, the author calls for the US to be vigilant as China will use its telecommunications companies to engage in state espionage and use the 5G networks to increase its growing global influence.

In a blog post on the American Enterprise Institute website, Barfield and Baird (2019) argues that allowing Chinese 5G equipment companies might create a way for China to penetrate and infiltrate the US 5G networks and they could have access to the country's most precious data. The author emphasizes that the cost of allowing Chinese companies in the network are not only based on economics but also on security.

With the growing concerns of the Chinese 5G entering the US market, the trade war quickly turned into a technological war with the objective for both countries to win the technological leadership of the next decade. In March 2020, the Trump Administration released the US National Strategy to Secure 5G. The strategy outlines how the US government will secure the deployment of the 5G network via 4 lines of effort: facilitate domestic 5G rollout, assess the risks and identify core security principles for 5G infrastructure, manage the risks to the economic and national security during the development and deployment of 5G, promote responsible global development and deployment of 5G (The White House, 2020).

As the US started to increase the pressure on Chinese telecom companies, other western allies started to join them and publicly highlighted the security risks of allowing Chinese technologies in the 5G network. However, even if those countries acknowledged the fact that security risks exist, the approach to mitigate them varies massively from one country to another (Lewis, 2019).

With the increased pressure coming from the US, China is responding and there have been talks among the expert's community about how to manage the shift in the relation between the two countries. Even though, the tensions rose with the Trump Administration, many Chinese analysts anticipated the changing relationship after the 2008 financial crisis and more specifically in 2011 with the "Pivot to Asia" from the Obama Administration. More recently, the US-China trade war instigated by the Trump Administration has started many discussions in China. For many Chinese experts, the trade war is hiding a technology war between the two

with the aim to be the global technological leader. Indeed, China has embarked in a technological quest and the US is trying to stop their progress by inflicting punitive tariffs and restrictive measures, mainly to stop US businesses to sell significant components to Chinese firms (Zhao, 2019).

We have seen previously that technological leadership is an important aspect of the Chinese development strategy, with plans like Made in China 2025. At the same time, the long-standing US technological leadership have allowed the country to grow massively and are thus likely to try and keep it that way. In a 2019 report, ING (2019) is expecting an aggressive response from China to the US-China tech war as the US continues to impose punitive measures on Chinese tech companies.

#### *4.3.2 ZTE & Huawei US ban*

In March 2017, ZTE, a Chinese telecom manufacturer, pled guilty for violating US sanctions on Iran and North Korea by selling them their products which contained US components. ZTE is a partially state-owned Chinese telecom manufacturing company and is one of the largest telecom equipment suppliers in China with presence in foreign markets. Following the 2017 guilty verdict, the company accepted a deal with the US government which contained a three-year probation period. In March 2018, the US Department of Commerce found out that ZTE was not complying with the agreement which resulted in a complete ban from US technology until 2025. As ZTE needs US technology such as microprocessors and chips to make their products, the ban took the company to a near-death experience. This consequence could be seen as a success for the US at first, however, a much more accurate analysis can highlight the negative impacts of such a policy on US businesses and national security. According to Lewis (2018), banning ZTE from US components with the aim to bankrupt the company could never work as the Chinese authorities would never let a Chinese national champion fail, especially if that occurred through foreign involvement. Indeed, China would use any instruments available, zero interest loans, subsidies or else to keep a company like ZTE afloat. Moreover, China is looking more into decreasing their dependence from US strategic components. The ban on ZTE would only increase the development of Chinese competitors and decrease US market share in that strategic industry.

Another very similar case happened in 2019 with Huawei. Huawei, a Chinese private company, is the biggest supplier of 5G telecom equipment and one of the biggest phone manufacturers in the world. Citing national security concerns, the US government imposed a ban on Huawei

from buying US components which means that US companies must have a governmental authorization to do business with the Chinese firm. This highly publicised ban came after months of increasing pressure on the company. Indeed, Huawei has long been scrutinized for its alleged close links to the Chinese government and its security apparatus. As for ZTE, Huawei was put on the US Department of Commerce's Entity List which means that US companies will need licensing to do business with the company. However, the US quickly ease the ban on Huawei for the same reasons as with ZTE: US suppliers were significantly impacted, and Huawei started to look for other suppliers and develop their own components.

The ban on Huawei also brought an interesting question for the US government which is the choice between economic and security arguments. Indeed, the positive impacts of 5G has been shown numerous times however the risks for national security to use Chinese products are difficult to quantify (Savini Zangrandi, 2019).

Both bans on ZTE and Huawei came at a complicated moment in the US-China relationship. It added to the already tough trade war between the two and put the spotlight on the race to technological leadership that they both engaged a few years ago.

#### *4.3.3 US lobbying in the EU*

After both bans on ZTE and Huawei, the US started to lobby their allies to impose equivalent restrictions in their 5G networks in order to diminish the reach of Chinese companies within the technological infrastructure of countries close to them. Some countries like Australia, New Zealand, Japan and Taiwan effectively followed US advice and banned completely or partially Chinese telecom firms from their networks. Recently, the US have strongly advised the EU and its member states to follow their advice by reiterating their claims that allowing Chinese firms in the 5G networks is a significant national security risk.

In a 2019 op-ed for Politico, the US Secretary of State Mike Pompeo laid out its arguments to convince EU countries to remove Chinese firms, naming Huawei and ZTE, from their 5G plans. According to Pompeo (2019), given the critical and strategic aspect of 5G, the EU should not consider Chinese firms as they cannot be trusted to install and maintain a secured network. He cited cases where Huawei was found guilty or accused of espionage in various countries around the world. The US Secretary of State also argues that the recent new Chinese National Intelligence Law would allow the Chinese government to have access to private information and proprietary data coming from the EU 5G networks. In the worst case, they could use the Huawei or ZTE installations to “kill switch” the electrical grid or other critical industries.

Indeed, China passed, in 2017, a national intelligence law that obliges citizens or companies to work alongside and help the Chinese government in their intelligence work. In other words, Chinese individuals and companies will have the legal obligations to help the Chinese government to spy on domestic or foreign entities. Even though Chinese analysts call this law a defensive one, western experts emphasize the offensive nature of the law (Girard, 2019). To finish its op-ed, Pompeo urges the EU not to take the risk of choosing Chinese products by letting EU firms, Ericsson and Nokia, and Japanese firm, Samsung, install the future 5G network of the continent.

Even though Mike Pompeo delivered a pretty compelling security argument to avoid using Chinese tech in the 5G networks, the EU is also focus on the economic argument that a company like Huawei can bring. Indeed, Huawei is able to provide a great technology at a very low cost, mostly due to the help of the Chinese government (Lewis, 2019). The economic argument is based on two facts: Huawei technology is cheap and Huawei technology could be installed very quickly.

The issue in the EU comes from the failure of its leaders to create a real single digital market (The Economist, 2020). Indeed, China and the US both have 3 to 4 network operators in their countries whereas the EU has more than a hundred and all are different from country to country. This situation has had the positive impact of massively decreasing the price of data and phone subscriptions within the EU. However, it also reduced significantly the profit margin of the operators and thus their ability to invest in new technology such as 5G. The price argument of Huawei is thus very important for operators in the EU.

In the beginning of 2020, the EU Commission unveiled a toolbox that will help member states to assess the risks of telecom companies in the 5G architecture. It takes into accounts companies' headquarters locations, if the companies can challenge their governments or if they can counter request for espionage. Even though, the toolbox did not name any countries or companies, Thierry Breton, the European Internal Markets Commissioner, acknowledged that it would be more complicated for certain companies (Cerulus, 2020). Thus, this new measure will probably limit the importance of Huawei or ZTE in the EU 5G networks but won't completely ban them, as demanded by the US. It could be seen as a long-term win for the US and the Trump Administration because the EU is, by this toolbox, restraining accesses of Chinese telecoms firms in the EU markets.

The toolbox offers a strategy for member states but the final decision of working with foreign telecom companies still belong to them. For that reason, the US announced after the unveiling of this plan that they will continue to press allies to consider the national security risks.

In July of 2020, the UK announced that they will completely ban Huawei from their 5G networks and that all of their equipment already installed should be removed by 2027. This came months after the first decision to accept Huawei in non-core infrastructure and was seen as a great diplomatic victory for the Trump Administration. Indeed, the pressure and the close relationship of the US and the UK, but also a faction in the UK Conservative Party, won to persuade Boris Johnson of the security risks of allowing the Chinese firm in the UK. Also, in July, the French cyber security agency communicated that restrictions on Huawei will be adopted and that licenses from 3 to 8 years will have to be delivered by the agency. Even though, a full ban has been ruled out by the country, the new rules will clearly slow down the development of the Chinese firm in the hexagon. Another important decision will be the one coming from Germany. Even though, the Germans are not comfortable with letting Huawei in their 5G networks, the strong economic relationship between Germany and China will probably play an important role in the decision. Also, DT, the country's largest mobile provider, is lobbying with the Ministry of Economic Affairs to allow Huawei in the German 5G networks. At the end of the day, the country will probably impose some restrictions on the company (The Economist, 2020).

After many months of lobbying the EU, the US might claim a small victory as most countries will probably impose partial bans on Chinese telecom companies. However, the EU is not fully confident in letting the US dictate its way to approach China. The challenge for the European Union and its deployment of 5G in the coming months will be to balance its relations with China and the US and at the same time find a balance between technological sovereignty and the fast deployment of the 5G technology.

## **Chapter 5: China catching up**

Since the reform era of Deng Xiaoping, China has rapidly grown into one of the biggest economies in the world, outperforming many experts' predictions. In forty years, China's GDP, trade and FDI have all grown massively to the level of high-income countries. The country's industrial policy, which have remained unchanged since the beginning of the reforms, have helped China to turn from an economically and politically isolated country to a global power, capable of stretching its influence on the global stage.

In the beginning of the 1980s, Western companies started to expand their operations worldwide and create global value chains in order to benefit from good economic conditions in low-income countries. At the same time, China successfully opened its economy to global companies which

resulted in a surge in its inward FDI. In a few years, China was able to benefit from its comparative advantage and develop its manufacturing capabilities in light and labour-intensive industries.

By opening its economy to multinationals while keeping the control of its domestic market in certain strategic sectors, China was able to develop its private sector via joint ventures that resulted in technological spillovers. The newly created private sector, as well as the state-owned enterprises, benefited from the protection of its domestic market and had thus the ability to grow without facing the strong competition of the high-income countries' companies.

With the rapid growth of its economy as well as the development of its national champions abroad like Huawei or Lenovo, there has been a growing number of criticisms regarding the global development of China and the threat that the situation could cause. Since the accession to power of Xi Jinping, China has become more assertive and has taken a bigger role on the global stage. Recently, the Belt and Road Initiative, Xi Jinping's flagship initiative, has attracted the attention of foreign analysts and raised a lot of criticisms from the US and its allies. The ambitious initiative, announced in 2013, aims at resurrecting the old Silk Road by connecting the Eurasian region through the sea and the land. China's goals behind this \$1 trillion infrastructure initiative are both economic and geopolitical. First, Chinese companies will be best positioned to win the massive infrastructure contracts that the BRI will create in the whole region, thus following the "go global" strategy of the Chinese government. It will also allow Chinese companies to develop trade relations with emerging countries in the region and decrease its overcapacity issue that the country is facing at home. On the geopolitical side, China will be able to significantly grow its influence in the region by offering loans, grants and subsidies to the countries willing to take part in BRI's projects. According to Chatzky and McBride (2020), the BRI is also a way for China to push back against the US's pivot to Asia strategy.

The growing size of the Chinese economy, the announcement of the Belt and Road Initiative and the recent US-China trade war have all put the spotlight on China's rise in the West and has brought to light the necessity for high-income countries to react. Some observers have even gone further by stating that China was starting to rise and will end up buying the world. However, Nolan (2012) explains that, even though the rise of China in the last forty years has been very impressive and has defied a lot of experts' predictions, the country is still far away from high-income countries like the US, Germany or Japan. In the last thirty years, high-income countries' firms have entered in a massive cycle of M&A deals with the aim to reinforce their market's positions and decrease the competition in their sector. It had the consequences to

create a lot of oligopolistic markets where a few firms would control the majority of the market. At the same time, those new massive global companies started to expand to new markets, like China, in order to grab a share of the emerging countries' massive population and create new growth channels. Thus, high-income countries' firms occupy today a strong position within the Chinese market, whereas Chinese national champions are still struggling to expand internationally. Relatively speaking, we can see that in the last thirty years, Western firms have bought the world due to their significant presence around the globe whereas Chinese firms have mostly focus on their internal market.

China has still a long way to go to completely catch up with developed nations. Looking back at economic numbers, it is true that the size of its economy is rapidly growing to the levels of the EU and the US. However, when taking the GDP per capita into consideration, China is still far away from those nations. In this theoretical part, we have seen that China must avoid falling into the middle-income trap if it wants to, one day, catch-up with advanced economies. Moreover, China is facing other domestic issues such as the high levels of corporate debts in the country. Chinese companies are highly leveraged due to generous loans given by state-owned banks in order to develop its domestic industry. China's population is also ageing very fast as a consequence of the one-child policy (Magnus, 2018).

After a prosperous economic rise in the last decades, China must now act and reform its domestic economy. Its ageing economy and highly leveraged corporations will need to be met with answers in order to avoid falling into the middle-income trap. Thus, it is too soon to say that China has caught up with advanced economies. However, it has proved to the international community that a one-party state country was able to significantly develop its economy without following the Washington Consensus policies and entering into liberal reforms.

We have seen that China's industrial policy focuses on the development of domestic innovative capabilities in order to gain some technological leadership. In this plan, the telecommunications equipment sector is at the forefront and has been considered as strategic for years. It is one of the few sectors where China can claim some kind of leadership thanks to the development of national champions like Huawei and ZTE, with the former considered as the leader of this sector. In the next part of the thesis, we will analyse the innovation policy of Huawei as well as the influence that the Chinese industrial policy had on the company's development. We will see that the development of Huawei in the last decades have, in a certain way, followed its country's industrial policy and is a good illustration of the catching-up strategy of China.

## **Part B – Practical part**

## Chapter 1: Research question

In the theoretical part, we have seen that China is slowly catching up with advanced economies such as the US, the EU and Japan. Since its reforms in the late 1970s, the country has implemented many S&T measures with the aim to upgrade China's innovative capabilities and go up in the global value chains. Indeed, China wants to become a significant country in the world order and technological development is part of that strategy. In the technological industry, one sector has become more and more important for the Chinese government and it is the telecommunications equipment one. Indeed, the Chinese government sees the deployment of 5G as strategic and as a way for the country to establish new standards by leading the industry thanks to its national champions.

We have seen in the theoretical part that 5G is expected to bring great benefits and improvements in the world economies. Indeed, 5G is a disruptive technology and should not be seen as a simple evolution of 4G as it will bring much more than just an increase in internet speed. The deployment of 5G and its low latency characteristic will allow the creation of new business models like autonomous cars, remote surgeries and connected devices. Thus, it will bring significant innovation and countries with a first-mover advantage will have the ability to dictate the standards of those new businesses.

In that area, the EU and China occupy an important place as both powers host the four major telecommunications equipment providers, Huawei, ZTE, Nokia and Ericsson.

In recent years, Huawei has become a massive multinational with great market share, not only in China as expected for a Chinese company, but also in other markets, especially the EU. Today, the Chinese firm is considered by many as the leader of that sector followed by Nokia and Ericsson. In order to understand how a Chinese firm has succeeded to overtake two historical EU multinationals, we will try to answer the following question: *“How did Huawei's innovation policies allow the company to become a global market leader?”*.

We have seen in the theoretical part that China and the EU both implemented plans and initiatives in order to develop innovation domestically. Indeed, the leaders of both powers see innovation as a key feature in their industrial policy's development. In that regard, China and the EU has set up key strategic plans in order to develop 5G as fast as possible. Being the hosts of companies like Huawei and Nokia, they are playing a role in those companies' developments. In order to understand the impact of governments on the 5G deployment we will also try to answer the question: *“How did state interventions help to boost Huawei's innovation capabilities?”*.

## **Chapter 2: Methodology**

### **2.1 Research method**

In order to answer both questions stated above, we will analyse Huawei's innovation policies as well as its competitor, Nokia's innovation policies. Furthermore, we will analyse China and EU' roles into the innovative developments of both firms to highlight the intervention of governments in the 5G global race.

As we have said in a previous section, there are two European competitors for Huawei. Indeed, both Nokia and Ericsson are closely following Huawei at the top spots of the telecommunications equipment providers ranking. Thus, we had to choose between one of them and the choice was finally to go with Nokia. On paper, both companies share a lot of similarities. Market valuation, market position, operating profit, commercial deals are all very similar and it would be hard to decide a winner by looking at those numbers. However, a few differences make the choice of Nokia easy to understand. Like Huawei, Nokia is able to provide an end-to-end solution whereas Ericsson is more specialized in RANs. Moreover, Nokia's research and development (R&D) spending are slightly higher than its European rival and its mergers and acquisitions (M&A) history makes it a more interesting company to analyse in terms of innovative capabilities. Also, Nokia maintains a strong history with its domestic country, the Finnish government, which will be interesting to compare with Huawei's links with the CCP. All in all, Nokia allows for a more interesting comparison with Huawei as it shares some similarities with the Chinese firm.

A qualitative method will be put in place through the comparison of Huawei and Nokia. According to Yilmaz (2013), a qualitative research looks at the larger picture of a concept in order to understand it as a whole. Also, qualitative methods are best suited for "how" questions as well as context-dependent and unique cases that we can analyse in depth. Thus, a qualitative method seems to fit well the comparison between both companies' innovation policies.

More precisely, a comparative research will be undertaken to understand how a relatively new Chinese firm was able to lead in a technological sector and overtake an experienced European firm. The goal of a comparative analysis is to look for similitude and variance (Mills, Bunt, & Bruijn, 2006). So, we will look for similarities and differences in both companies' innovation policies in order to understand how Huawei reached a leader position.

## **2.2 Data collection**

The data for this paper came from multiple sources. First, Huawei and Nokia's own resources were a valuable source of primary information that could be used as raw data. The annual reports allowed us to have a significant number of information regarding both companies. In those, we could find information regarding the financial health of the company but also business-related information that could help us to understand the state of both companies in comparison with their strategy. By retrieving annual reports from previous years, we were able to analyse the evolution of some factors like the patent numbers and R&D spending, essential to analyse the state of innovation in a firm. Also, other company official sources such as their websites provided great additional information to understand both firms' innovation policies thanks to company blogs and press releases.

Second, research papers and studies about both firms helped to understand more precisely the raw data and contextualize them in our topic. In that regard, think tanks were specifically helpful and many sources were retrieved from those as they offer an accurate source of free information. Sources from the US, the EU and also from Chinese researchers were use in the paper in order to have a global non-biased approach about both firms.

## **Chapter 3: Nokia and Huawei in the global 5G market**

### **3.1 5G in Europe**

As we have seen in the literature review, the EU launched various initiatives, plans and strategies in order to effectively deploy 5G on the continent. Different targets have been set along the way to ensure the homogeneous deployment within the Union and avoid significant gaps between member states. In April 2019, an EU parliamentary document highlighted the state of the 5G deployment in the EU and also its position against global competitors. As a conclusion, the report emphasized that the EU is relatively well positioned against other important global actors like the US, China and South Korea (Policy Department for Economic, Scientific and Quality of Life Policies, 2019). Indeed, the EU hosts two major telecom equipment manufacturers, Nokia and Ericsson, and also hosts a key 5G standard organization, ETSI/3GPP, which could be seen as an important advantage in the race to 5G. Furthermore, the EU has developed strong pilots' programs, city testing and efficient spectrum allocation in accordance to its Action Plan of 2016. As of April 2019, 138 trials in the 28 member states have

been recorded. However, at the same period, only 7% of the 5G spectrum band had been assigned.

In June 2020, the European 5G Observatory (2020) published its 8<sup>th</sup> quarterly report on the 5G deployment in Europe. Those reports aim at informing EU institutions on the progress of the 5G on the continent and also measure that progress in regard to the targets set in the 2016 Action Plan. Thus, those reports constitute a great source of information to analyse 5G in Europe. As of June 2020, 192 5G trials have been recorded in the EU (including the UK) corresponding to an increase of 54 trials in a year and a half. 20.7% of the 5G spectrum has been assigned which is also an increase compared to the 7% in early 2019. These numbers show an effective deployment in Europe that is due to a strong commitment of member states to quickly develop this new generation of mobile connectivity. The 192 trials can also be analysed as a vertical development meaning trials linked to business cases and industries. Among those, a significant number has been dedicated to the media, transport and automotive industries. Indeed, those 3 areas accounted for 89 trials out of 235 (192 trials in the EU plus trials from Russia, San Marino, Norway, Turkey and Switzerland). Other industries taking part in those trials were the smart manufacturing, healthcare industry, smart cities and more.

All of the EU trials took place in various cities of the EU. One of the objectives of the 2016 Action Plan was to develop 5G in at least one city per member states by 2020. Thus, a few trial cities were announced in 2017 in order to reach the objectives. Years after years, more cities decided to join the process and in June 2020, it was estimated that around 248 5G enabled cities had either start a trial or a pilot in order to develop the technology.

By June 2020, the 27 member states plus the UK had all finalized their public consultations regarding the 5G spectrum and strategy, however, only 12 (Austria, Czechia, Denmark, Estonia, Finland, France, Germany, Luxembourg, Spain, Sweden, The Netherlands and the UK) have published a complete 5G roadmap while the other countries are in the process of finalizing theirs.

Next to the member states' trials, the EU also launched 11 cross-border 5G corridors from 2017 to 2019 with the aim to increase interconnectivity between neighbouring member states and develop uninterrupted mobile connectivity, specifically along roads, railways and maritime routes. Along three corridors, three large scale projects, partially funded by the 5G-PPP, have been launched to test business applications on them. "5GCroCo" on the Metz-Merzig-Luxembourg corridor, "5G-Mobix" on the Porto-Vigo corridor and "5G-CARMEN" on the Bologna-Munich corridor.

Commercial launches, which will enabled end-users to have access to 5G, have started in early 2019 and have since significantly increased. As of June 2020, 14 EU member states launched, via at least one mobile operator, 5G for their customers. In some of those countries, multiple operators have already launched their 5G services such as the UK where the four major operators (EE, Vodafone, O2 and Three) already sell 5G subscriptions for their customers.

Another important aspect to take into consideration when analysing the deployment of 5G is the allocation of spectrum. Indeed, the phone operators have to buy governmental licences to use the spectrum and thus, the faster those licences are delivered, the faster 5G can be deployed. The 5G frequency bands are split between the low-band (700MHz), the mid-band (3.4-3.8GHz) and the high-band (24.25-27.5 GHz). The usability of those bands is key in the 5G race and will strongly contribute to the global position of the EU. The assignment of those bands is solely managed by member states which is why countries have different calendars and are at different levels of development. The first allocations by EU member states started in 2015 with new auctions planned every year until 2023. As of June 2020, seven member states (Denmark, Finland, France, Germany, Hungary, Italy and Sweden) have assigned the low-band spectrum. 12 countries (Austria, Czech Republic, Finland, Germany, Hungary, Ireland, Italy, Latvia, Romania, Slovakia, Spain and the UK) have assigned some spectrum within the mid-band. Only two countries, Italy and Finland, have assigned spectrum within the high-band. As stated above, those assignments account for 20.7% of the available spectrum and will grow in the next few years as more auctions are scheduled by member states.

The deployment of 5G is mostly driven by member states. Even if EU institutions offer recommendations and plans, the member states are responsible for the spectrum auctions and are responsible for that competence. Thus, disparities exist between them and we can already witness a gap between certain countries and regions in their advancement of 5G. In order to calculate those differences, Incites Consulting (2020) has created a “Europe 5G Readiness Index” which ranked European countries based on their progress in the development of 5G. The index is based on 6 key areas that help the firm to establish an accurate ranking. The 6 areas that are analysed are: infrastructure and technology; regulation and policy; innovation landscape; human capital; country profile; and demand. The final ranking displays a high level of disparities not only between European countries but also between European Union member states. Indeed, the three first EU countries, Finland, Germany and Denmark (respectively scoring 70.95, 66.68 and 65.93) are far away from the three last EU countries, Croatia, Bulgaria and Greece (respectively scoring 39.97, 45.27 and 45.76). The index highlights a significant gap between Western and Eastern countries but also indicates that Northern countries are very

well prepared to the deployment of 5G. Western countries are dominating the ranking due to a good consistency within the 6 factors of analysis, occupying 17 spots out of the first 20. Other countries, Southern and Eastern ones, lie below in the ranking as they are much less consistent when analysing all the factors. It is also important to point out that there is a significant correlation between GDP per capita and the final ranking which shows a link between the performance of a country in general and its general progress in the 5G technology.

As disparities exist within the EU, the next paragraphs will analyse the development of 5G in a few selected countries to emphasize the gaps and their reasons.

### *3.1.1 Finland*

Finland is the most advanced EU countries in the 5G deployment and is ranked first on the Europe 5G Readiness Index. The country has already finalized auctions for the three 5G spectrum bands and its 3 phone operators are already selling 5G subscriptions to end-consumers.

### *3.1.2 Croatia*

Croatia is the least advanced EU countries in 5G. It ranks 35<sup>th</sup> in the Europe 5G Readiness Index due to poor performance in “regulation and policy” and “innovation landscape”. The country has not launched any commercial services yet but planned on doing so by the end of 2020.

### *3.1.3 Germany*

Germany is ranking well at the third spot of Europe 5G Readiness Index. It launched commercial services in various cities via 2 phones operators: DT and Vodafone. The country has already auctioned low-band and mid-band spectrum and is on its way to auction high-band spectrum.

### *3.1.4 Belgium*

Belgium can be considered in the EU average when looking at its 5G development. Only one operator, Proximus, has launched commercial services in around 30 cities of the Flemish region. Due to delays in the spectrum auctions, operators have been granted temporary licences to rollout 5G in the country.

All in all, the EU as a bloc shows an important level of heterogeneity and is thus hard to analyse as a whole. Some member states are really well placed in the race to 5G, mostly the Nordic countries whereas Southern and Eastern member states face more difficulties to develop the technologies. Compared to South Korea, the US and China, the EU as a whole is still lagging behind. One of the main reasons for that is the low average revenue per user (ARPU) in the EU which implies a smaller level of CAPEX that is available for European phone operators. It gives them less liberty to invest in new technologies such as 5G (Northstream, 2019).

### **3.2 5G outside Europe**

As we have seen in the literature review, 5G is not only an economic and technological issue but also a national security matter that countries must handle in the best manner. Thus, worldwide deployment of the technology has progressed very fast in the last years and countries like the US and China have made it a top priority. This section will analyse and describe the progress that 3 major economies, the US, China and South Korea have made in order to win the 5G race. Overall, the European 5G Observatory (2020) estimates that 80 operators provide 5G commercial services worldwide as of June 2020 and that, at the same date, 199 5G devices were commercially available.

#### *3.2.1 United States*

In the United States, the race to 5G has become a national security issue since the start of the tensions with China. The Trump Administration has made it a priority to quickly rollout this new technology in order to maintain US leadership in technology.

Even though the US Federal Government has issued a strategy paper, the progresses of the 5G rollout in the country are driven by incremental commercial developments and don't follow a holistic plan (Policy Department for Economic, Scientific and Quality of Life Policies, 2019). Indeed, the bottom-up approach, pushed by private companies, results in a development that can be seen as not well-orchestrated but however efficient.

As of June 2020, the four main phone operators, Verizon, AT&T, Sprint and T-Mobile, have all launched their 5G commercial services. Verizon launched its 5G mobile services in April 2019 and has since continue to extend its coverage in the country. The company first deployed 5G in Chicago and Minneapolis areas and has, as of April 2020, a 5G coverage in around 34 US cities. AT&T first launched its 5G services in December 2018 following trials in 2017 in various US cities. In April 2020, the company's 5G was available in 190 markets covering up

to 120 million people. They also offer high-band 5G spectrum in 35 cities. Sprint rolled out its 5G services in May 2019 in 3 US cities. Since then, the coverage was deployed in more US cities. T-Mobile launched its 5G services via the high-band spectrum in July 2019. However, they switched to a low-band spectrum which allowed them to cover more than 200 million people and 5000 cities. Nevertheless, the change had the effect to deliver a 5G as fast as the already existing 4G services.

Concerning the 5G spectrum auction, the Federal Communications Commission (FCC), a federal agency, is responsible for managing and setting up those auctions. The first auctions started in 2016 after the agency identified high-band 5G spectrum. Since then, operators acquired those licences and two more auctions are still planned for 2020.

### *3.2.2 China*

In China, the deployment of 5G is backed by the government and the CCP. As presented in previous sections, the race to 5G is a strategic priority that has been developed in many states plans. Thus, China is rolling-out 5G in top-down fashion, as opposed to the US. In June 2019, China awarded spectrum licences to the three main operators of the country: China Mobile, China Telecom and China Unicom. They all launched their 5G services in November 2019.

China Mobile first started its 5G trials in 2016. In the following years, it continued to develop the technology by installing base stations in the country. China Unicom has done 5G trials in hundreds of labs in 16 cities of China since 2018. China Telecom also started trials in different cities of China.

### *3.2.3 South Korea*

In the race to 5G, South Korea is the most advanced country, in front of the US and China. The country's operators launched 5G commercial services back in 2019 and has, as of April 2020, more than 6 million 5G subscribers in the country (European 5G Observatory, 2020). Regarding the spectrum, South Korea auctioned mid-band and high-band frequencies in June 2018 and expect a full 5G roll out by the year 2022 or 2023. The three main operators, SK Telecom, KT and LGU+, have already deployed 115,000 5G base stations.

Both SK Telecom and KT do not use Huawei products, however, the Chinese company is not banned from the South Korean network.

### 3.3 Nokia

#### 3.3.1 Company profile

Founded in 1865 in Finland as a single paper mill operation, Nokia have, decades after decades, reinvented itself in order to adapt to changing markets and technological shifts. Indeed, the company have found successes in very different sectors such as cable, paper products, rubber boots and tires, mobile devices and telecommunications (Nokia, 2020). From a company focused on the Finnish market to a renowned multinational, Nokia has grown significantly in the last decades to become a leading company in the telecom industry.

In the 1980s, following the deregulation of the EU telecommunications industry, Nokia entered a new era of its history and decided to turn to mobile phones and telecommunications as its core business. Twenty years later, in 1998, the company became the leading mobile phone company in the world, keeping that spot for a decade. However, Nokia's last business transformation happened in early 2010s when the company decided to divest from its mobile phone position and reinforce its position in the mobile networks and technologies industry, becoming a leading firm in that area.

Today, Nokia is a global communications company producing a wide range of products for the telecommunications industry such as devices, software, antennas, chips and more. In its 2019 annual report, Nokia (2020) communicated a global revenue of €23.315 billion for a profit of €18 million. The revenue has been more or less constant in the last four years whereas it was the first time in those four years that Nokia was able to make a profit. The company is publicly traded on the Helsinki and New-York stock markets with a valuation of €22.78 billion by July 2020. In the last two decades, the company's valuation has massively fluctuated. Going from a more than €100 billion valuation at the peak of its mobile device's leadership to a €6 billion valuation in 2012, the valuation of the firm has reflected the changes in Nokia's core business model over the years.

As Nokia benefits from a strong history of market leadership especially in the mobile phones industry, the company is present in more than 120 countries and in seven regions of the world. To this date, it has deployed around 1,300 networks worldwide with those networks covering up to 6.4 billion subscriptions.

In 2016, Nokia identified six megatrends that will govern the future of technology. Based on those, the company has created its strategy to be able to provide opportunities in those areas and be prepared. In its 2019 annual report, the company states that it “*aims at enabling massive consumer broadband and the industrial automation revolution with large networks at scale*”.

In the same report, Nokia emphasized five axes on which it will work to realize its strategy. First, the firm plans on becoming the leading company in mobile network equipment. Second, Nokia wants to grow its enterprise market segment. Third, it is looking to strengthen its software business. Fourth, it will diversify its licensing business in new industries. Fifth, the company will focus on operational excellence in order to get to better level of management which will create better efficiency and productivity.

As of today, Nokia is structured in 7 business groups: Mobile Networks, Global Services, Fixed Networks, IP/Optical Networks, Nokia Software, Nokia Enterprise, Nokia Technologies.

The Mobile Networks business group includes all the access network technologies from 2G to 5G. Basically, it is the department of the firm responsible for the new 5G technologies. It is able to provide complete end-to-end 5G products and services.

### *3.3.2 Market share*

In its second quarter of 2020, Nokia reported a few interesting numbers regarding its operations. Indeed, the company communicated that they have reached 152 commercial 5G engagements. Among those, Nokia signed 83 5G commercial deals and 32 of those deals have already been finalized (Nokia, 2020). At the end of 2019, Nokia (2020) announced that it had closed 62 5G commercial deals. Thus, we can see an important increase of 25% in their commercial deals in only half a year.

The Q2 2020 report also tells us about the regional sales that the company have done which is a good indicator to analyse the evolution of its market share in different regions of the globe. In its €5.1 billion in quarterly revenue, Nokia made its sales in Asia-Pacific (17%), Europe (31%), Greater China (6%), Latin America (4%), Middle East and Africa (8%), North America (34%). Even though, the company has a great worldwide presence, the majority of its revenue is made in Europe and North America.

According to the Dell'Oro Group (2020), a renowned independent research firm in the telecom industry, the revenue share for telecom equipment of Nokia in the first quarter of 2020 accounted for 15% of the whole market. Huawei, the leading firm in the industry accounted for 28% and Ericsson, Nokia' European rival, accounted for 14% of the market. Those three companies represent the top 3 firm in the industry and are strongly competing for contracts around the world.

Looking at the Dell'Oro numbers, Nokia can be considered as the second telecom equipment manufacturer in the world. However, the company is facing intense competition coming from

Ericsson. Due to the US Huawei ban, many operators, especially allied US countries, have decided to decrease or cease their involvement with Chinese manufacturers in fear of retaliation from the US. Thus, many contracts are now open for both Nokia and Ericsson which has created a tough environment for both companies. Moreover, Nokia has suffered critics in the last few years regarding its management of the 5G technology.

According to Bloomberg (2020), Nokia is facing intense pressure from its competitors, mainly Huawei and Ericsson. The company is looking for options such as asset sales or mergers, in order to stay competitive and avoid a decrease in its market share. Indeed, the market value of the firm has significantly decrease in the last few years due to the fact the Nokia did not manage well its costs regarding the 5G technologies. Also, it took too much time to innovate and deliver credible 5G products which led them at a disadvantage compare to its competitors.

As we are in the middle of 5G investments coming from phone operators, the future of Nokia will depend on its ability to proof its superiority over Ericsson. Indeed, Nokia is rumoured to be getting out of China due to the strong performance of Huawei, ZTE and Ericsson. Thus, the company will be looking to find new contracts in other regions of the world especially countries that are not favourable of Chinese products and are looking for substitutes (Sun, 2020).

### **3.4 Huawei**

#### *3.4.1 Company profile*

Huawei was founded in 1987 in Shenzhen by a former Chinese military officer called Ren Zhengfei. Started in an apartment with a few thousands of dollars, the company started to sell phone switches in rural China. As the company was created in the post-reform era, it quickly grew to become a world-leading telecommunications company.

In 2012, Huawei became the world's largest telecommunications equipment maker overtaking Ericsson and Nokia, its most notorious competitors (The Economist, 2012). After having surpassed Apple in terms of phone sales in 2018, Huawei recently overtook the South Korean giant Samsung and became the biggest phone manufacturer in the world with the highest number of shipments in early 2020 (Forbes, 2020).

According to its website, Huawei is a private company fully owned by 104,572 of its employees through an in-house mechanism (Huawei, 2020). As the scheme is only available for company's employees, Huawei denies any involvement of the Chinese government or any governmental institutions from its shareholder structure. For years, the company has denied those claims that the company is not fully independent and that it is controlled by the CCP.

Regarding its governance, Huawei strongly differs from Nokia due to the fact the company is private but also Chinese. Shareholding employees elect a Commission that will then elects the Chairman of the Board and the other board members. The Board of Directors elects four deputy chairs and three executive directors. Among those deputy chairs, three of them will take turn and serve as rotating chairman of Huawei.

In its 2019 annual report, Huawei (2020) reported that it employs more than 194,000 people worldwide and that it operates in more than 170 countries, serving around three billion people. The same year, Huawei made a revenue of \$122.972 billion, a 19% increase compared to 2018, with a net profit of \$8.971 billion.

Huawei's vision is to build a fully connected, intelligent world. In order to achieve that, it has targeted four areas in which the company needs to work to deliver on that vision. First, the company wishes to promote connectivity as a right as it is the future of the human foundation. Second, Huawei plans on developing its AI, data and cloud applications in order to deliver pervasive intelligence. Third, it looks at technologies like AI and cloud as tools to create personalized experience for individuals and companies so that everyone can have a seamless experience with its products. Fourth, Huawei want to develop digital platforms as it sees that those will become the bedrock of society in the future. It will allow everyone to become more agile, efficient and dynamic.

Huawei is offering a very wide range of telecommunications equipment such as end-to-end 5G products and services. Those services are in direct competition with Nokia's offerings which we presented earlier and are sold to phone operators worldwide.

In recent years, Huawei has been the target of many allegations of spying with some countries calling it a national security threat. Even though the company is still able to grow its business, it is starting to become a serious issue as it has lost many contracts in consequence and has suffered from negative representations of the company, especially in Western countries. Duchâtel and Godement (2019) explain that even though the company theoretically belongs to the employees, the shareholding structure is very opaque and links between Huawei and the CCP could be made as every worker's union in the country is under the control of the party. Moreover, 12,000 employees hold a CCP membership and thus the indirect links between the company and the party are hard to blur. The authors also emphasize the privileged relationship of Huawei with the Chinese government as shown in the numerous financial and political contributions that the company have received over the years.

Huawei has denied any links with the CCP and the Chinese government and tries its best to improve its image in foreign countries via intense lobbying of politicians and worldwide communication campaigns.

### *3.4.2 Market share*

Huawei is the largest and leading firm in telecommunications equipment in the world. As of February 2020, Huawei had already secured more than 90 5G commercial deals (European 5G Observatory, 2020). According to Dell'Oro (2020), the company accounted for 28% of telecom equipment revenue share in the first quarter of 2020, far away from the second and third largest companies, Nokia (15%) and Ericsson (14%).

In its 2019 annual report, Huawei (2020) broke down its revenue by business segments which gives us an idea of its revenue coming from its telecom equipment branch. By computing the carrier business and enterprise business branches, which are both selling telecom networks solutions, we can see that it represents 44.9% of its revenue, around \$55.214 billion in absolute number. The report also details the company's revenue by geographical locations which is another good indicator to analyse Huawei's market position in different regions of the world. In 2019, Huawei's revenue was distributed as follows: China (59%), EMEA (24%), Asia Pacific (8.2%), Americas (6.1%) and Others (2.7%). It is interesting to see that the majority of Huawei's revenue comes from its domestic market in China, which represents a massive amount in absolute number due to its size. As Nokia earned the majority of its revenue from Europe and North America in 2019, Huawei earned the majority of its from China. Regarding the Chinese market, it is not an unusual situation as China has been accused of using preferential treatments for its domestic companies in its market (Duchâtel & Godement, 2019). When looking at the numbers we presented for both Nokia and Huawei, it is clear that, today, Huawei is double the size of Nokia in terms of telecommunications equipment sales. Indeed, the Chinese company has a much bigger size, mainly due to its incredibly dominant position on the Chinese market.

Recently, Huawei has been under intense scrutiny due to accusations from the US that the company could be a threat for countries' national security as explained above. Those allegations could have very bad repercussions on Huawei's market share in some regions of the world. The company is already banned in some countries like the US, Australia, Japan and the UK. The direct consequences of that is a complete loss of market share in those countries. However, there could also be indirect consequences as allied countries of those nations could also decide

to simply ban the company in order to not anger its allies, especially the US. As an example, the latest decision of the UK to ban Huawei will have an impact on the decisions of significant EU member states like France and Germany. The EU is still in an early stage of 5G deployment and is thus still an important market for telecommunications equipment vendors (Reuters, 2020).

## **Chapter 4: Innovation policy**

### **4.1 Nokia**

#### *4.1.1 Research and Development*

As we have presented earlier, Nokia has a strong history of changing its business models to adapt to technological shifts. Those changes have been made possible by investing significant sums of money into R&D projects in order to come up with cutting-edge innovation. This is more and more true today as the company is now focusing on the telecommunications equipment market which is driven by innovation with strong competition. In the early 21<sup>st</sup> century, when the company was leading the mobile devices industry, Nokia was known to spend a lot of money on R&D. Indeed, the company's R&D expenditures were so high that they were influencing the whole Finnish economy and could have a significant impact on the whole country's economic and innovative health (Ali-Yrkkö & Hermans, 2002).

Today, Nokia has a global network of R&D centres which allow the company to stay competitive in regard to innovation. According to its website, Nokia has 17 global research centres worldwide in the following countries: Belgium, Canada, China, Finland, France, Germany, Greece, Hungary, India, Italy, Japan, Poland, the Philippines, Portugal, Romania, Slovakia, the UK and the US. Those centres are maintaining a strong network of universities, other research centres and leading scientists in order to deliver the best results for Nokia. Indeed, the company is collaborating with many external actors to deliver the most disruptive research. Pontiskoski & Asakawa (2009) explains that Nokia's R&D strategy is about sourcing knowledge globally due to the peripheral location of Finland. Then, this knowledge will be treated and studied internally where the company will be able to develop it into innovation. Thus, the strategy is to work on the development of efficient R&D global processes to gain some competitive advantage in the company's industry.

In order to drive its R&D effort, Nokia has a unique in-house unit called the Nokia Bell Labs which is the research and innovation arm of the company. With a 100-year history, the Nokia

Bell Labs is at the centre of some of the most innovative technologies of the ICT industry. It is also the house of many leading scientists and has an impressive record of Nobel-winning scientists and Turing Awards recipients. Nokia Bell Labs follows Nokia’s R&D strategy which is to create a global network of knowledge. Indeed, this was highlighted by its President who stated that the Bell Labs is about “*innovating by drawing from the global community of brilliant minds*” (Nokia Bell Labs, 2020).

The mission of the Nokia Bell Labs is to define and invent game-changing technologies as well as advising the market on how to use them. It focuses on three different areas : Patents and standards leadership ; Research leadership; and End-to-end leadership (Nokia, 2020).

Patents and standards leadership aims at growing Nokia’s portfolio of innovation and intellectual property. It is a significant part of the company’s revenue but also helps it to develop global standard and thus adding value to Nokia’s products and services.

Research leadership allows Nokia to work on software, hardware and applied sciences’ research. Nokia’s goal is to define the next industrial revolution.

End-to-end leadership for the Nokia Bell Labs is about developing end-to-end solutions for the company’s business groups. The purpose of this is to deliver the best products and services to Nokia’s clients: service providers, enterprises and industries.

Nokia’s R&D is at the basis of the company’s business model which is to sell the best telecom equipement to its clients. Nokia Bell Labs is at the start of this effort. Then, Future X Network architecture is taking the Labs’s innovation and bring them into real-life industry solutions. At the end, the business groups will bring those solutions to market.

*Nokia Bell Labs => Future X Network architecture => Business Groups*

Regarding R&D spending, Nokia is very well positioned compared to its competitors, Huawei, Ericsson and ZTE. In its 2019 annual report, Nokia (2020) reported its R&D spending for the last three previous years:

<b>Year</b>	<b>2019</b>	<b>2018</b>	<b>2017</b>
R&D expenses	€4.411 billion	€4.620 billion	€4.916 billion
% of net sales	18.9%	20.5%	21.2%

*Figure 3: Nokia's R&D spending*

According to Davies (2019), R&D spending of Ericsson, Huawei and ZTE in the first semester of 2019 were as follows 18%, 15%, 14,9% in the same order. Thus, in percentage of sales, Nokia is the highest R&D spender in its sector in 2019.

All in all, Nokia's R&D strategy is based on the creation of global networks of experts in their fields. The company is spending a significant amount of money in R&D relatively speaking in order to develop cutting-edge innovation, mainly through its research and innovation arm, the Nokia Bell Labs.

#### *4.1.2 Patents*

In its 2019 annual report, Nokia CEO reported that the company was making good progress in the area of patenting and licensing. Those business opportunities are part of Nokia's strategy to create long-term value for the firm and its customers (Nokia, 2020). Indeed, patents are a strategic area for any technological firm and the telecommunications equipment sector is no difference to that rule. As 3G and 4G patents owners have controlled the way the smartphone industry has developed, it seems logic to think that 5G patents owners will also have the ability to transform the new ecosystem of connected devices in the way they want (Pohlmann, 2018). For 30 years, Nokia has been developing cutting-edge technology and has been leading the mobile devices industry by creating significant worldwide standards. The company has today a big patent portfolio and keep on growing it thanks to their constant high level of investments in R&D (see previous section). On its website, Nokia (2020) showcases its strong market position regarding technology patent. Indeed, the firm reports that, by the end of 2019, it had reached the impressive number of 20,000 patent families thanks to combined R&D investments of €129 billion in the last two decades. It also reports that, in 2019, it has filed for more than 1,300 new patents.

By the end of 2019, Nokia reported that they declared more than 2,100 patent families considered as essential for 5G standards to the European Telecommunications Standards Institute (ETSI), which is an official institution that handle 4G and 5G standards. Nokia Technologies, which is one of the company's business groups, is responsible for the handling of the patent portfolio of the firm. The group is also responsible for the monetization of the portfolio and thus responsible for the revenue of Nokia's innovation. In 2019, Nokia Technologies made a revenue of €1.487 billion with an operating profit of €1.239 billion. Even though this number is interesting to analyse the size of Nokia's patent portfolio in its global revenue (around 6.37%), it is not very relevant to this thesis as Nokia Technologies gathers all

of Nokia' patents which are not all related to 5G or telecommunications equipment. Indeed, the scope of Nokia patent and brand licensing is very large and includes mobile devices, consumer electronics, connected cars, payment terminals and more.

In the previous section, we presented the Nokia Bell Labs which is the innovation arm of Nokia. The Bell Labs play a significant role not only in R&D investment but also in defining industry standards through the establishment of new patents. It is one of the Labs missions to deliver those patents which will enable Nokia to stay competitive in the 5G race.

Going back to the patent race, it is interesting to look at the evolution of Nokia's patents number to understand its strategy and see how the company is trying to grasp leadership in 5G.

As stated above, Nokia reported 2,100 5G standard essential patents (SEP) by the end of 2019. In March 2020, the company announced that it had reached the number of 3,000 5G SEPs which would be an increase of 50% in less than six months. In a press release, the company explained that they have now declared around 3,4000 SEP to one or more of the 2G, 3G, 4G, 5G technologies. Among those, 3,000 are relevant for 5G standards. The Nokia Bell Labs contributed to the majority of those and around 200 licensees are using and paying for those patents, via the Nokia Technologies business group (Nokia, 2020). However, this announcement has been criticized and its veracity is questionable. According to Bicheno (2020), the press release is mostly a PR stunt coming after another positive press release from Huawei. Indeed, patents are very difficult to analyse due to their complexity but also due to the ongoing development of 5G standards. Recently, telecoms firms like Nokia have started to communicate a lot about the development of their patent portfolio. However, those numbers are most of the time very complicated to verify and are essentially put out to increase the leadership's image of a firm. Indeed, when Nokia reported patent declarations numbers, it omitted to explain what a declaration is (an application or a full patent?).

In a report about 5G patents, Hassan, Kumar and Luby (2020) reported that Nokia held 1,031 declared 5G patents by the end of 2019 to the ETSI. This number is far from the 2,100 announced by Nokia in its 2019 annual report and would rank the company in the 6th position regarding the holders of 5G patents declared, far away from Huawei. Thus, we can see that depending on the criterias applied, patents can show a very different picture.

#### *4.1.3 Mergers and Acquisitions*

As we have presented above, Nokia had businesses in many different sectors since its creation in 1865. In the 2010s, the company decided to enter the telecommunications equipment industry

and exit the mobile devices sector. In order to execute that strategy and become a leading company in this new industry of choice, Nokia entered in significant M&A deals in the last ten years. The picture below represents a non-exhaustive list of some of Nokia M&A deals and restructuring phases:

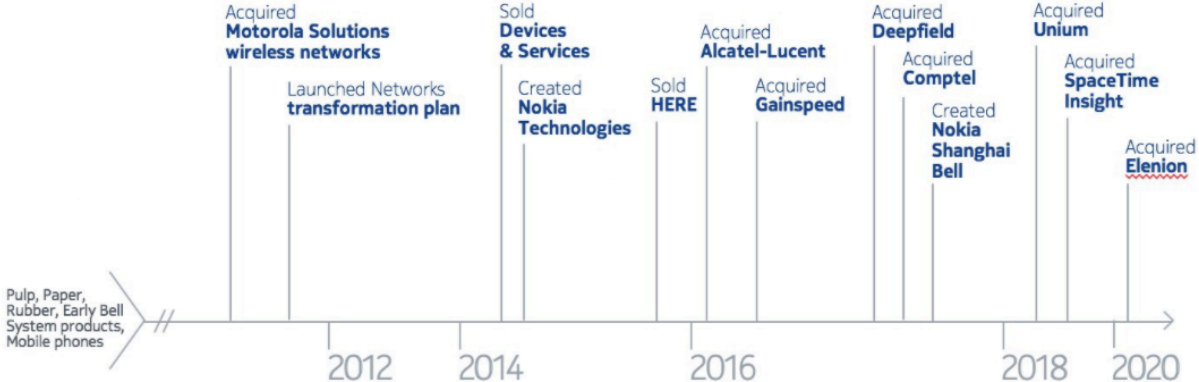


Figure 4: Some of Nokia's M&A deals since 2010

In 2012, Nokia was in a near-death situation due to the very poor performance of its mobile devices sales and lack of good leadership which had a very negative effect on its stock price. Indeed, Nokia was suffering from intense competition coming from the new smartphone's companies such as Apple and Android. As a result, Nokia's stock reached an all-time low with a market valuation of \$6 billion compared to \$153 billion in 2007, a 96% decrease (Boston Consulting Group, 2017).

EXHIBIT 1 | Nokia's Market Capitalization Fell Dramatically as the Market for Mobile Phones Shifted

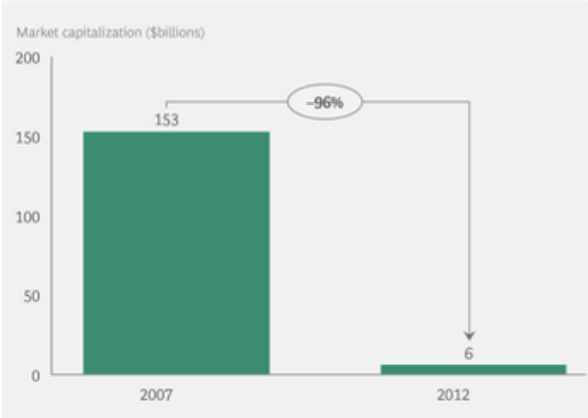


EXHIBIT 2 | Since the Turnaround, Nokia's Market Cap Has Grown More Than 500%

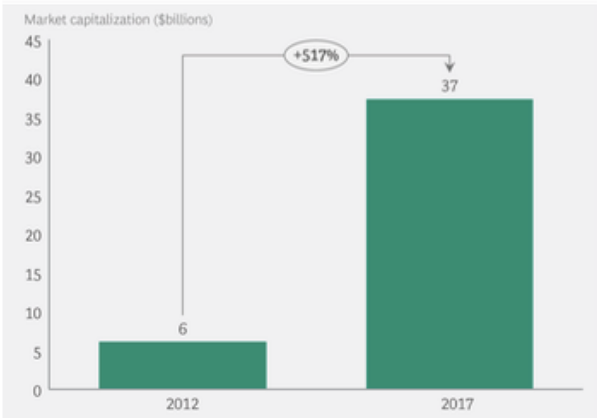


Figure 5: Evolution of Nokia's valuation

In order to execute their business model change, Nokia entered into a few significant M&A deals that allowed them to quickly transition into their current core business.

The first important M&A deal was the sale of Nokia's mobile devices unit to Microsoft for \$7.2 billion in September 2013. Prior to that, Nokia and Microsoft were partners and sold the same mobile devices. However, when Microsoft decided to launch its own branded handset and with

the addition to the mounting pressure from other companies, Nokia decided to sell its famous mobile devices unit which really marked the start of their transformation. In an interview with McKinsey & Company (2016), Risto Siilasmaa, Nokia's Chairman, stated that negative data regarding Nokia's mobile devices future and the interest from Microsoft made him accept the sale of the unit, otherwise it could have ended badly for the company.

In the same year as its mobile devices unit's divestment, Nokia decided to buy-out the other half of its joint-venture with Siemens, called the Nokia Siemens Networks (Nokia already owned half of it). Before this acquisition, the joint venture was basically in stagnation mode as neither of both companies wanted anything to do with it because both decided to stay out of the network business. Nokia Siemens Networks was looking for a buyer and as the Microsoft sales was going on, Nokia saw a great opportunity and saw great value in it in order to continue its strategic turn. With the completion of Microsoft sales acted, Nokia was financially able to pursue half of Nokia Siemens Networks for €1.7 billion which laid the foundation of the Nokia Networks business group (Nokia, 2020).

The complete display of Nokia's strategic turn to telecommunications networks came in 2015 with its bid to acquire Alcatel-Lucent, a French American company specialized in IP networking, ultra-broadband access and cloud applications. This massive €15.6 billion acquisition allowed Nokia to become a full-service infrastructure provider, capable of delivering end-to-end network solutions. It was also a great way to increase the company's presence in North America (Boston Consulting Group, 2017). Risto Siilasmaa explained later that the acquisition was the perfect answer to the management's questions of how to change the company's strategy. As Nokia expected the world to become more digital, it saw an opportunity to develop its end-to-end solutions and Alcatel-Lucent was the natural candidate. The acquisition allowed for Nokia to become a leading company in mobile networks and to gather 40,000 R&D employees under the same banner. It also allowed the firm to develop massively its innovative unit as the Nokia Bell Labs was acquired in this deal.

In the same year, Nokia divested from HERE, a mapping service that became irrelevant as the company continued its shift.

In recent years, Nokia continued to acquire new companies such as Elenion Technologies, SpaceTime Insight and Unium. They all follow the plan of Nokia to reinforce and increase its leadership position as a mobile network provider (Nokia, 2020).

All in all, Nokia has been significantly using M&A in order to develop its company but also its innovation units (Alcatel-Lucent brought the renowned Nokia Bell Labs). Major acquisitions and divestments like the Microsoft sale, the NSN acquisition, the Alcatel-Lucent acquisition

and the HERE sale allowed the company to completely transform its core business in less than 10 years. Even after those M&A deals, the company continued to invest in innovative firms as part of its strategy to increase its technological leadership in the sector.

## **4.2 Huawei**

### *4.2.1 Research and Development*

As a relatively recent company (compared to Nokia), Huawei is already a leading firm regarding its R&D expenditures and is today considered as a very innovative company. Before analysing Huawei's current R&D strategy, it is interesting to see how such a recent firm was able to develop its innovative capabilities in such a short time.

In a study about how technological imitators in emerging nations achieve technological catch-up, Liu and Zheng (2013) explains that the technological catching-up of Huawei came in three phases (Stage A, Stage B and Stage C). In Stage A, Huawei was an imitator of switchboards and was selling those in Hong Kong. Due to increased pressure from competitors, the company realized that it would be in its best interest to develop its own technological capabilities. Thus, it started to hire highly educated engineers to develop those capabilities. They were able to develop very good assimilation skills of foreign technologies via, for example, reverse engineering which then gave them a more developed sense of knowledge in their field.

In Stage B, Huawei significantly continued its development of technological capabilities. Starting with the « Huawei Basic Law » which acted as the firm's constitution and elaborated on the company's management program, Huawei developed its technological strategy with the aim to reduce its dependence on foreign firms and to start imitating and improve foreign technology for its own needs. The company set the annual R&D expenditures targets of 10% of its revenue and started to develop its R&D capabilities abroad by cooperating with other leading institutions with the aim to connect with foreign markets.

In Stage C, Huawei reinforced its R&D capabilities by investing more and more in it. In recent years, it has never invested less than 10% of its revenue in R&D. Also, the firm has reinforced its R&D position by opening and investing in foreign centers, it also collaborates with many international stakeholders to continuously develop its knowledge.

An important aspect of Huawei's R&D strategy was its internationalization process. Indeed, before becoming a leading technology company, Huawei used R&D internationalization as a vector for its development. The company thought that by using updated foreign research findings and learning from successful competitors, it could help the firm to grow. Chen, Zhao

and Tong (2011) explains that Huawei’s international R&D developments had three goals. First, the firm could monitor international technological innovation by setting up technology-monitoring units and thus benefit from spillovers. Second, the company could decrease its R&D costs and increase its efficiency by collaborating with renowned centers of excellence in innovative countries. This allowed the company to benefit from great R&D human resources and leading R&D environments. Third, Huawei could tailored-made its offers based on different markets and increase the efficiency of its technological supply chain by partnering with the right local partners.

As we have seen, the hiring of R&D specialists has been a part of Huawei’s innovation and R&D strategy. According to Schaefer (2020), the conditions for Huawei when entering the telecommunications equipment industry were favorable to start a strategy of hiring to catchup. Indeed, as the telecom industry was in a low investment cycle, many experts were available and Huawei could hire a lot of foreign R&D specialists. Thus, the company was able to combine its cheap capital and labor in China with its top of the range R&D units abroad.

As of today, Huawei has become a significant player in R&D in the telecommunications industry. The company has reported a few numbers that show Huawei’s commitment to research and innovation. Indeed, it reported that out of its 194,000 employees, around 49% of them, 96,000, are working in R&D related units. Also, the company’s R&D expenditures was at an all-time level of 15.3% of its revenue, which is €16.84 billion in absolute amount. Huawei also states they it has invested more than €76 billion in R&D in the last 10 years and employs around 15,000 people for basic research. The table below shows the R&D spending of Huawei in the last 3 years. Numbers were obtained by analysing the three last annual reports and converted in EUR with the currency rate at the end of each year.

<b>Year</b>	<b>2019</b>	<b>2018</b>	<b>2017</b>
R&D expenses	€16.845 billion	€12.842 billion	€11.454 billion
% of net sales	15.3%	14.1%	14.9%

*Figure 6: Huawei's R&D spending*

In its 2019 annual report, Huawei (2020) presented its strategic turn regarding its innovation policy. For years, the company has focused on what it calls Innovation 1.0. Innovation 1.0 was centred around technological, engineering, products and solutions innovations that could answer the markets and customers’ needs. The goal was to help Huawei’s partners to increase their revenue and help them solving their business issues.

With Innovation 2.0, Huawei is changing its strategy and will focus on basic research and vertical integration of its products and services. The company plans to strengthen its partnerships with industries and universities to accelerate business models' developments. The philosophy behind the new strategy is open innovation where Huawei will connect different stakeholders of the business and research world to drive innovation.

#### *4.2.2 Patents*

As Huawei is claiming the top spot in the telecommunications equipment industry, patents and intellectual property are a very important aspect of their innovation strategy. As we have explained, the networks equipment industry, as the whole technology sector, is driven by innovation thus the importance of patents is significant. However, the patents war going on in the industry is essentially driven by communication and PR stunts. Like we explained earlier with Nokia, companies are trying to position themselves as leaders in patents in order to claim the innovative leadership position. Due to the technicality of patents (not all patents are equal), it can be hard to effectively decide on who is leading this race.

Regarding Huawei's patents position, the firm is highly engaged in the development of those and reports a few interesting numbers every year.

By the end of 2019, Huawei claimed that it held more than 85,000 patents worldwide. Among those, 30,000 were granted in China, 40,000 were granted in Europe and the US and the 10,000 others in the rest of the world (Huawei, 2020). On their website, the company claims that it holds more than 20% of the world's 5G SEPs with more than 21,000 "contributions" which is the highest number in the industry. As with Nokia, the term "contributions" can mean different things.

Next to the company's well-thought communication, some industry reports and studies can help to understand the state of Huawei's patents portfolio.

In a recent data analysis, IPlytics, a German patent data company, reported that Huawei was leading the industry when looking at 5G SEPs. Indeed, the firm has declared 3,147 5G SEPs, leading the industry and followed by Qualcomm, Nokia and Samsung. The report also highlights that Chinese firms, including Huawei and ZTE, accounted for 34.02% of all 5G SEPs, making it the first country in that area (China Daily, 2020).

A recent report from GreyB, a renowned technology research company, also describes the state of the 5G patent race. The report focused on core 5G SEPs and analysed the top companies in the industry. As a conclusion, the report shows that Huawei is leading the industry when it

comes to those patents. Indeed, out of 2,386 declared 5G patents from Huawei, 321 of them can be described as core 5G SEPs. When looking at the whole industry, those 321 patents represent 19% of all, making Huawei the top-ranking firm in that area (Bicheno, 2020).

Distribution of core SEPs with live granted patent families

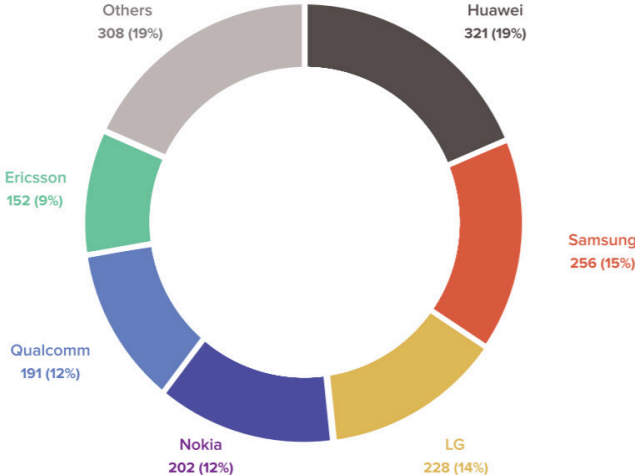


Figure 7: Distribution of 5G core SEPs

In another report from GreyB, the research company reports that Huawei is leading the race in 5G patents in general with 13,474 5G patents. This number represents the total number of patents related to 5G, without focusing on SEPs or core SEPs. This report emphasizes in another way that Huawei is very well positioned in the patent race compared to its competitors (GreyB, 2020).

In light of the growing tensions between Huawei and the US, the Chinese company’s position in the patent race might help them to avoid losing some of their revenues. Indeed, as some countries are banning Huawei and welcoming its European competitors, Huawei might activate its patents on the competition to still benefit from its loss in market share. As of now, Huawei is basically not using its patents because of cross licensing with competitors. But in case more countries decided to ban the Chinese firm, holding as many patents as possible might increase its leverage in those negotiations (Reuters, 2020).

Having analysed Huawei’s patents numbers and figures, it is interesting to understand how the firm was able to develop such a strong position in patents development. In a study comparing Huawei and ZTE IPR’s strategy, Godinho and Ferreira (2013) claims that Huawei has implemented an aggressive patent strategy as part of its innovation policy. By filing as many patents as possible, the Chinese firm was able to strongly develop its patent portfolio which could bring it a considerable part of new revenue. Huawei’s patents strategy followed its

business development strategy in terms of locations. Indeed, the company is targeting the Asian, African and European markets which are where the firm applied for most of its patents. The authors sum up by highlighting that Huawei's patent strategy is a reflection of its aggressive commercial and technological stance.

In another study comparing Huawei and Ericsson patent data, Joo, Oh and Lee (2016) found out that even though Huawei relied on Ericsson's intellectual property in its early days, the Chinese firm later adopted its own innovative strategy by relying on more recent research and scientific knowledge. The authors explain that Huawei's leadership position in its sector can be linked to its ability to develop independent innovative capabilities and technological strength.

#### *4.2.3 Mergers and Acquisitions*

As we have seen with Nokia, M&A deals can play a significant role in the innovation policy of a firm. However, it seems that Huawei is not fully embracing M&A when it comes to the development of its innovation capabilities.

According to Crunchbase (2020), Huawei has completed 9 M&A deals since its creation. Even though those deals are interesting to analyse, the size of those are not really significant compared to the size of the firm. We will analyse some of those M&A deals but also the ones that failed.

In 2003, Huawei started a joint venture (JV) with 3Com, a US leading company in networking solutions, called H3C. The objective of the JV for Huawei was to have access to international markets thanks to the highly developed channels of its partner. Also, Huawei could learn from a leading US technology firm and develop its knowledge and capabilities through spillovers. As the joint venture became very profitable for Huawei, the company decided to buy the global operations of 3Com in 2007. However, US regulators did not authorize the sale as 3Com had contracts with the US military and that could bring national security issues (Roll, 2018). In 2010, 3Com was finally sold to HP.

A few years after the failed attempt to buy 3Com, Huawei was successful in buying its joint venture with Symantec. In 2008, Huawei and Symantec established their joint venture called Huawei Symantec. As part of the deal, both companies invested \$150 million and set R&D centres in China and in the US. The goal of the JV was to develop network security, storage and other applications for telecom carriers and enterprise customers. In 2011, Huawei decided to buy the 49% stake of Symantec in order to acquire the whole venture and develop its product

portfolio. As Huawei already owned 51% of the venture and that the JV was set up in Hong Kong, the deal could be approved and faced less hurdles compared to the 3Com deal that was subjected to US regulators (Reuters, 2011).

In May 2010, Huawei purchased some of 3Leaf’s assets for \$2 million. 3Leaf is a US company specialized in server architecture. However, due to mounting pressure from US regulators, the Chinese firm finally decided a few months later to divest from its investment after a recommendation from CFIUS, the Committee on Foreign Investments in the US. Even though that deal was cancelled, Huawei said that it allowed them to build a better understanding and relationship with US regulators regarding foreign acquisitions and that Huawei will continue to bid for companies where it can see technological potential (CIO, 2011).

In 2019, Huawei acquired Vocord, a Russian company specialized in facial recognition systems, for \$50 million.

As we can see by the small size of Huawei’s M&A deals, the Chinese firm is not spending a lot of money on other businesses regarding its innovation policy. One of the reasons might be the difficulty for Chinese firms to buy western companies, especially in the US. Indeed, as we have presented earlier, the US and now the EU both have powerful investment agencies that have the ability to block M&A deals for national security reasons. Huawei being a technology company, its acquisitions should usually be reviewed by national regulators which makes it really hard for those to be accepted.

**4.3 What are the differentiating factors in both companies’ innovation policies?**

As we have presented both companies innovative capabilities with a focus on R&D, patents and M&A, we can now present a comparison between both firms to highlight their differences but also their similarities.

First, let’s have a look at both firms’ total R&D expenditures in the last three years.

		<b>2019</b>	<b>2018</b>	<b>2017</b>
<b>Nokia</b>	R&D expenses	€4.411 billion	€4.620 billion	€4.916 billion
	% of net sales	18.9%	20.5%	21.2%
<b>Huawei</b>	R&D expenses	€16.845 billion	€12.842 billion	€11.454 billion
	% of net sales	15.3%	14.1%	14.9%

*Figure 8: Comparative table of Nokia and Huawei’s R&D spending*

From this table, two significant trends can be observed. First, when looking at the absolute amount of R&D expenditures, it is clear that Huawei has a much bigger size. In the year 2019, the Chinese company spent close to 4 times the amount that Nokia spent that same year. However, it is important to emphasize that Huawei is a part of many different sectors. Indeed, the company also holds a strong position in the mobile devices sector but also in cloud applications. Thus, not all of those R&D expenditures are dedicated to mobile network equipment whereas in Nokia’s case, the most part of its R&D expenditures goes in mobile network equipment. The second observed trend is when we look at the R&D numbers as a percentage of revenue. In that case, Nokia invested much more money than Huawei in R&D in the last three years. However, we can see a decrease of Nokia’s R&D expenditures as % of net sales which is due to the decreased in R&D investments and a stagnant revenue over the last years.

When we look at the differences of R&D spending in percentage of revenue since 2008, we can see that Nokia has outspent Huawei in R&D. However, and as we stated above, those relative numbers should also be compared with the absolute amounts which show a different picture. The following graphs describe Huawei and Nokia’s R&D spending (Atkinson, 2020):

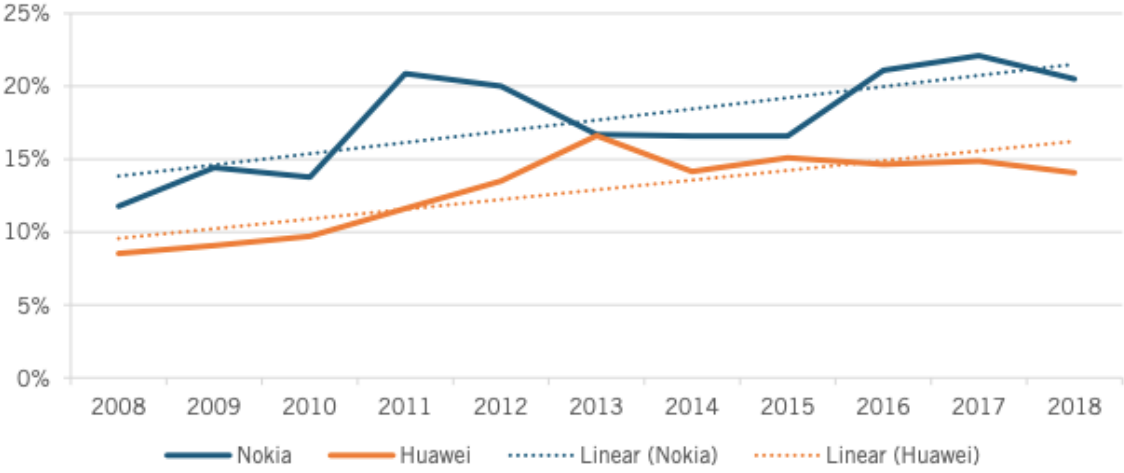


Figure 9: Nokia and Huawei's R&D as % of net sales, 2008 to 2018

Regarding patents, both companies are strongly invested in developing a significant intellectual property portfolio. The following graphs and table will show the position that they both hold in their sector.

For the total 5G patents that the companies hold, Huawei is leading the sector with 13,474 patents by the end of 2019. Nokia is sixth in that ranking with 5,554 5G patents (GreyB, 2020).

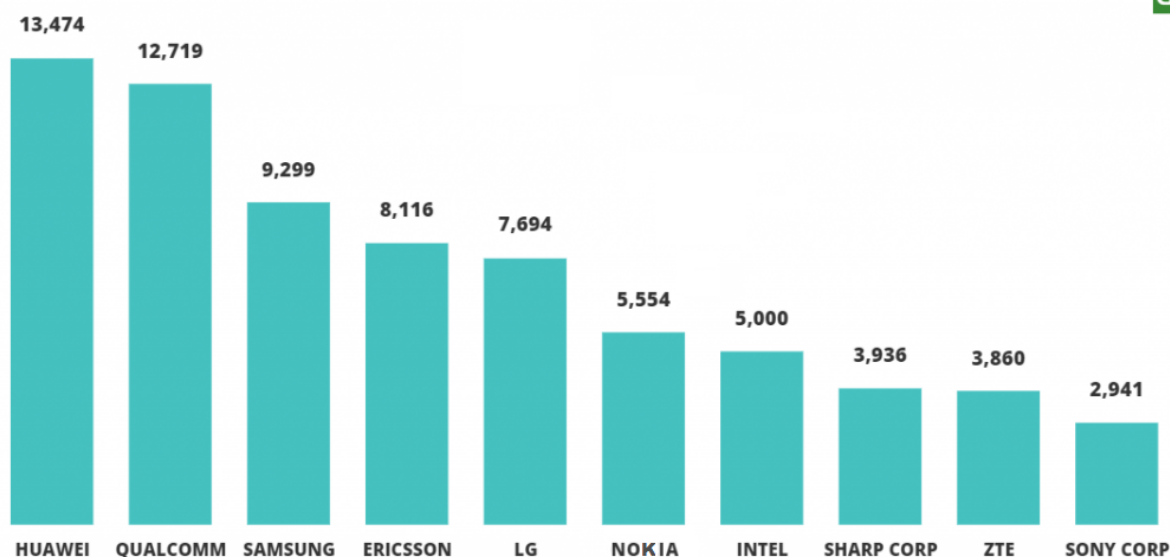


Figure 10: Distribution of 5G patents

However, even though this ranking shows a strong difference between both companies, it can't be used as a way to demonstrate that Huawei is leading the industry in terms of innovation. Indeed, all of those patents have different values and only using the number of patents as the only metric in the 5G race might create bias (Forbes, 2020).

For that reason, it is interesting to analyse the difference between Huawei and Nokia in 5G core SEPs. Using those specific patents might show a better image of the race to 5G as it takes the value of the patent into consideration.

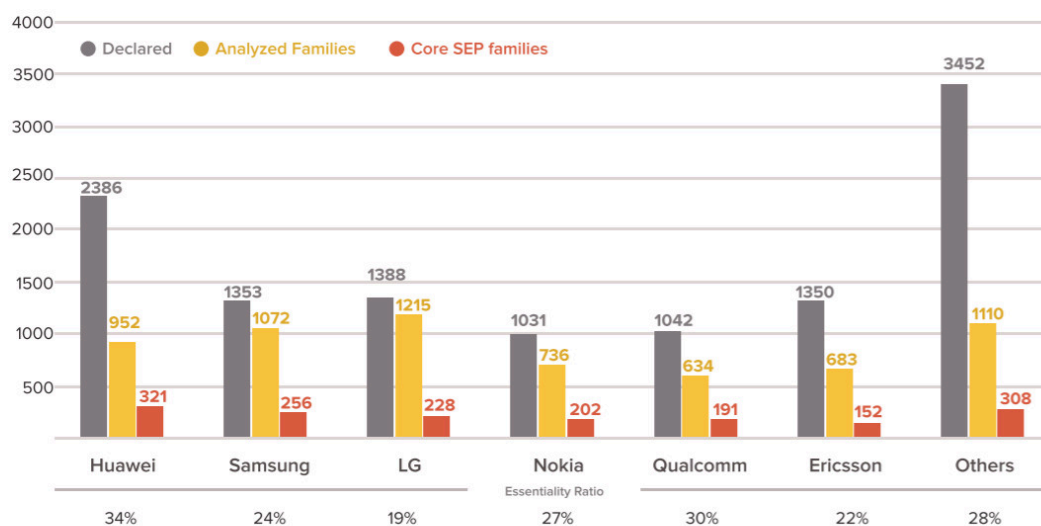


Figure 11: Essentiality ratio of top companies' core SEPs

On this table, we can see that Huawei owns 321 5G core SEPs and Nokia owns 202 of those (Bicheno, 2020). Huawei is still leading the industry however the difference between both firms is relatively much smaller compared to the graph presented before.

The last factor comparing Nokia and Huawei is the M&A deals. For Nokia, M&A has become a part of its strategy as the company have engaged in many deals in the last ten years in order to do its strategic turn. However, Huawei has been very discreet regarding M&A and has not participated in many deals, except for the buying out of joint ventures of non-US firms.

## **Chapter 5: The role of state intervention**

### **5.1 Nokia**

In this section, we will investigate the role of governments and public funding in the development of both Nokia and Huawei. Indeed, as both companies are part of the technology industry, their deployment is considered as strategic for governments. Thus, those governments usually play a role in their growth in order to capture some of that in the country or expand the country's knowledge abroad.

In Nokia's case, the company has had a very strong relationship with its country, Finland. As one of the country's national champions, the firm has a significant impact on different domestic factors such as employment, technological progress and taxes. Thus, Finland has supported the firm in many regards as we will see now.

In a paper about the role of Nokia in the Finnish innovation system, Ali-Yrkkö and Hermans (2002) describes how Nokia helped Finland but also how Finland helped Nokia to grow its innovation capabilities. The authors give three ways in which Finland helped Nokia to develop its innovative capabilities from the 1970s to the 2000s.

First, the country has directly invested in the R&D projects of Nokia. Tekes, the National Technology Agency (under the Ministry of Trade and Industry), is responsible for the support and funding of technological development in the country. The agency invested a lot of money in the information and technology industry, a third of its funding in 2001, and has thus invested a lot in Nokia's R&D capabilities. In 1969 it invested 200,000 FIM and 108,000,000 FIM in 1999. In those 30 years, the absolute amount of funding to Nokia has grown constantly. However, when looking at the share of the funding in the total R&D expenditures of Nokia, it has varied a lot depending on the period. The following table details the funding of Tekes to Nokia, both in absolute number and as a percentage of the company's R&D spending:

	Nokia's R&D exp., FIM mill.	Percent of total sales	Tekes funding, FIM mill.*	Percent of Nokia's R&D exp.
1969	9.0	1.6 %	0.2	2.1 %
1970	12.0	1.6 %	0.9	7.8 %
1971	15.0	1.9 %	0.8	5.3 %
1972	20.0	2.3 %	1.6	8.0 %
1973	29.0	2.7 %	2.5	8.5 %
1974	38.0	2.3 %	2.9	7.7 %
1975	47.0	2.8 %	2.4	5.1 %
1976	55.0	3.1 %	2.4	4.4 %
1977	55.0	2.9 %	5.0	9.0 %
1978	59.0	2.3 %	4.1	6.9 %
1979	72.0	2.3 %	4.0	5.6 %
1980	95.0	2.1 %	25.0	26.3 %
1981	172.0	3.0 %	25.0	14.5 %
1982	212.0	3.3 %	10.0	4.7 %
1983	267.0	3.8 %	17.0	6.4 %
1984	355.0	3.8 %	28.0	7.9 %
1985	456.0	4.1 %	8.0	1.8 %
1986	539.0	4.5 %	23.0	4.3 %
1987	581.0	4.2 %	26.0	4.5 %
1988	795.0	3.6 %	36.0	4.5 %
1989	950.0	4.2 %	18.0	1.9 %
1990	1164.0	5.3 %	30.0	2.6 %
1991	933.0	6.0 %	47.0	5.0 %
1992	1113.0	6.1 %	57.0	5.1 %
1993	1472.0	6.2 %	73.0	5.0 %
1994	1900.0	6.3 %	64.0	3.4 %
1995	2531.0	6.9 %	65.0	2.6 %
1996	3514.0	8.9 %	62.0	1.8 %
1997	4560.0	8.7 %	74.0	1.6 %
1998	6838.0	8.6 %	79.0	1.2 %
1999	10442.0	8.9 %	108.0	1.0 %
2000	15375.0	8.5 %	47.0	0.3 %

\* Based on Tekes' funding decisions. Data before 1983 is from the Ministry of Trade and Industry Technology Office.

Authors' own calculations (sources: Nokia's annual reports, Häikiö (2001).

Figure 12: Tekes funding of Nokia, 1969 to 2000

On this table, we can see that in some period, Tekes funding of Nokia' R&D has been significant such as in 1980 where it accounted for 26.3% of the company's total R&D expenditures. In that period, Nokia was developing the GSM technology which made Tekes to invest a big sum of money in the company's projects. In the beginning of the 1990s, as an economic crisis decreased the size of Nokia' R&D, Tekes increased its funding to the company so that the company could see a continuity in its research projects even during the crisis. All in all, Tekes has played an important role in the funding of Nokia' R&D. It also played the role of a buffer for example during the 1990s crisis when the company had to decrease its own R&D expenditures.

Second, Finland helped Nokia' research and innovation capabilities by creating an important pool of highly skilled workers due to its high level of higher education. Indeed, when Nokia felt the need for more highly skilled employees, Finland increased its university places in some technical faculties. During the 1990s, the number of places in technical faculties has increased by 2.5% annually which provided many talented employees by the end of the century for Nokia. Third, Finland provided a very good technological environment for Nokia to grow its business. Indeed, the country has led the telecommunications development since the 1960s via deregulations of the market but also partnerships with other countries to create a significant

network sharing the same standards. By allowing foreign competition in their markets, it allowed Nokia to get a first mover advantage and thus develop its capacities at home before expanding internationally.

Next to Finland and more recently, the EU has also provided indirect support for Nokia. Indeed, the creation of the 5G PPP funded by €700 millions of public EU funds, has provided the Finnish company with many available projects in the region. As we have presented in the theoretical part, the 5G PPP funds 5G projects all over the continent and thus opening new contracts for Nokia. By analysing all of the projects from the three phases, we can see that Nokia took part in 31 out of the 62 projects (5G PPP, 2020). Even though, this cannot be considered as direct subsidies, it allowed Nokia to grow its revenue and thus develop its R&D capabilities.

With the increase of tensions between China and the US, Huawei has been banned from doing business in the US or with US businesses. Other countries followed the US with the ban thus opening new markets for Nokia and Ericsson. As the US is lobbying foreign allies to also ban Huawei from their domestic networks, this obviously resulted in a massive support for Nokia. Even more, the Attorney General of the US, William Barr, recently stated that the US could enter in both Nokia and Ericsson shareholding structure in order to boost the companies and overtake Chinese telecommunications firms. Soon after, this idea was denied by the Trump Administration (Reuters, 2020). Even if the idea was not followed, this situation shows that the US, via its Huawei ban and its trade war with China, is actively politically supporting both Nokia and Ericsson in order to decrease Huawei's market share, especially in Europe.

## **5.2 Huawei**

In the theoretical part, we saw that China and the CCP are highly invested in the development of the country's own innovation capabilities. Indeed, innovation has a central role in China's industrial policy. Thus, the telecommunications industry is considered as strategic for China and its development. Through the Ministry of Information Industry, the government keeps a tight control on this sector and continues to oversee it very closely (Low, 2007). In that regard, the Chinese state has been highly supportive, politically, technologically and financially, in the development of Huawei, at home or abroad. In this section, we will analyse the role of the Chinese government in the development of Huawei's innovative capabilities.

According to Lewis (2019), the Chinese government is aggressively supporting Huawei in its international development in order to gain security leverage against the country's biggest

competitors. Indeed, the author explains that China is looking to create a global intelligence network and Huawei can help that goal by providing telecommunications equipment worldwide. This hypothesis has been at the centre of the Huawei ban debates in the US and its allies. However, the firm has strongly denied allegations that both the company and the Chinese government were working together to collect data from its network.

Even if those allegations are hardly proven and cannot be hundred percent verified, the Chinese government has offered great support to Huawei in the last decades.

Atkinson (2020) claims that China implemented mercantilist telecommunications policy which had the effect not only to boost Huawei’s innovative capabilities, but also to reduce global innovation in that sector. The following table shows those policies and their effect on global innovation in the telecommunications industry:

Type of Policy	Impact on Global Innovation
Funding technology development and sharing with industry	Harmful
Forced technology transfer	Harmful
Intellectual Property theft	Harmful
Currency manipulation	Harmful
Export financing above OECD guideline levels	Harmful
Tariffs	Harmful
Government-allocated domestic market shares to Chinese firms	Harmful
Political hardball to gain foreign markets	Harmful
Supporting foreign corrupt business practices	Harmful
R&D tax incentives, favorable to Chinese firms	Neutral
R&D subsidies (favorable to Chinese firms)	Neutral
Low cost financing for Chinese firms only	Neutral
Limited export control regime	Neutral
Supporting STEM education	Helpful
Supporting more rapid broadband rollout, including 5G cell sites	Helpful

Figure 13: CCP's innovation policies and their effects on global innovation

In the 1980s, as China started its reforms and that the country decided that the telecommunications equipment industry should become a strategic one where the country needed complete control on its network, the Chinese government allowed foreign firms to sell their components at the conditions that those firms should have a Chinese partner and work under a joint venture. Thus, all of the telecommunications equipment multinationals set up JVs with Chinese companies in order to grasp the market opportunities in China. The effect of this policy was that by the year 2000, 0% of the equipment came from imports (60% from JVs and 40% from Chinese firms) compared to the year 1982 when 100% of the equipment was imported from foreign multinationals.

Among those Chinese firms that partnered with foreign companies in JVs was Huawei. The Chinese firm directly benefited from that system by setting up 4 JVs with foreign partners. First, Motorola and Huawei created joint laboratories on systems research in 1997. Second, Lucent and Huawei set up a joint lab on microelectronics in 2000. Third, NEC and Huawei started a lab around 3G in 2000 in Shanghai. Fourth, Siemens and Huawei established a JV around wireless topics.

Huawei has significantly benefited from those JVs thanks to transfer agreements where the firm could learn extensively about foreign technologies and replicate those later. Also, foreign firms would train engineers and scientists via their global R&D centres in China which helped Huawei to develop the skills of its workforce by hiring those trained employees. Huawei also benefited from other JVs even when the company was not directly involved in those. JVs were obliged to train Chinese engineers, and many acted as a school to develop the country's innovation capabilities (Atkinson, 2020).

As we have seen in the theoretical part, China implemented, at the end the 20<sup>th</sup> century, an innovation policy based on indigenous developments. In the case of the telecommunications industry, it had the effect to shift from the JVs to domestic telecommunications equipment providers, such as Huawei. The Chinese government started to directly fund companies like Huawei via military contracts and even provided Huawei with a government prototype that Huawei could then copy and sell.

One of the most significant support that the government gave to Huawei was the protection of its domestic market from foreign firms. Indeed, after Chinese telecommunications firms became able to provide domestic products, China set up strong import barriers such as tariffs and push the Chinese phone operators to buy from Chinese firms like Huawei. As Huawei (and ZTE) had close to a monopoly on the Chinese markets, it secured them massive amounts of revenue that they could use to then develop their R&D capacities. Basically, this policy worked as an indirect subsidy given the huge size of the Chinese telecommunications market. Those secured revenues also allowed Huawei to develop its sales on international markets where they could compete against Ericsson and Nokia and strongly decrease their prices to win market shares.

Another indirect support from the Chinese government was their low commitment to make their domestic firms respect intellectual property. Indeed, IP theft in China became a recurring debate as experts started to question the ability for Huawei to develop more patents than its competitors with less R&D spending, implying that the firm could develop so many inventions by stealing the competition's IPs.

According to Defraigne (2014), Huawei's development has been actively supported by China's industrial policy via cheap loans and public procurement from the People's Liberation Army (Huawei's founder is a former PLA officer).

In 2019, an article from the Wall Street Journal (2019) claimed that since the firm's creation, the Chinese government has given \$75 billion to Huawei. Indeed, the article reported that the Chinese state has fuelled the company's growth by supporting the firm via different techniques. Among those \$75 billion, \$46 billion came as loans or credit lines for the company's customers. The company also received \$1.6 billion in grants and received \$2 billion in land discounts. The last \$25 billion were obtained through tax cuts between 2008 and 2018.

As we have seen in this section, the Chinese state has actively supported Huawei which follows the country's industrial policy goal to develop national champions that could compete on foreign markets against established multinationals.

## **Chapter 6: Discussion**

### **6.1 Analysis**

The race to 5G has become strategic for the majority of the global players. The US, China, South Korea and the EU all have publicly acknowledged the necessity to deploy 5G as fast as possible in order to launch the next industrial revolution which 5G will bring thanks to its high-speed internet and low latency capabilities. All of those countries have started a few years ago to deploy this new technology. With South Korea opening the trail, all advanced economies are opening and licensing new 5G spectrum to operators. Thus, operators are in the midst of 5G deployment and are now in a phase of investments in new 5G telecommunications equipment. In this race, telecommunications equipment providers such as Huawei and Nokia have become essential in building the architecture of the future 5G networks. More than that, those firms occupy a strategic position as the 5G networks will be subjected to billions of data on a daily basis, making those networks highly sensitive and closely related to countries' national security. As we have stated, Huawei is currently leading the race against its competitors as the company has rapidly develop its 5G products portfolio and has, as of February 2020, reported 90 5G commercial deals.

In this practical part of the thesis, we analysed and described Huawei and Nokia's innovation policies as well as the degree of state interventions in each firm in order to understand how a Chinese company, Huawei, was able to become the leading firm in its industry against an established and experienced EU company, Nokia. At the beginning of this part, we stated that

we would answer two distinct questions regarding Huawei. Thus, we analysed different elements of both companies in order to come up with two answers. However, given the strong link between Huawei’s innovation policy and China, it seems more appropriate to give one answer as both elements are dependent from each other. The following table captures the important data that were detailed in the practical part:

	<b>Nokia</b>	<b>Huawei</b>
<b>Date of foundation</b>	1865	1987
<b>Country of origin</b>	Finland	China
<b>Total revenue</b>	€23.315 billion	€109.669 billion
<b>Revenue from mobile networks (estimation)</b>	€18.209 billion	€37.997 billion
<b>Commercial deals</b>	83 (as of July 2020)	90 (as of February 2020)
<b>Global telecom market share (according to Dell'Oro)</b>	15%	28%
<b>R&amp;D spending (2019)</b>	€4.411 billion	€16.845 billion
<b>R&amp;D spending (% of net sales, in 2019)</b>	18.9%	15.3%
<b>5G Patents (according to GreyB report)</b>	5,554	13,474
<b>5G core SEPs (according to GreyB report)</b>	202	321
<b>Degree of M&amp;A in innovation policy</b>	High	Low
<b>Degree of state intervention</b>	Average	Very High

Figure 14: Comparative table of Nokia and Huawei's innovation policy

As we have seen, China’s interventions in its telecommunications market allowed Huawei to build strong innovation capabilities. In 2002, Ren Zhengfei acknowledged that without China’s control of the telecommunications market, his company would have probably not existed (Atkinson, 2020). The Chinese government implemented various policies with the goal to protect its market against foreign competitions thus giving the necessary space for its domestic firms, like Huawei, to grow massively and easily. Those policies were: public procurement programs, protection of the Chinese market, undervalued currency, lack of enforcement on corruption, limited export controls of domestic firms, tax incentives, export financing, lack of control on IP theft (Atkinson, 2020). All of those policies gave the ability for Huawei to grow

massively by focusing only on the Chinese market, giving the firm a safety net in its revenue flows which could be strongly invested in R&D. Today, Huawei significantly outspend Nokia in R&D expenditures. The Chinese firm also holds a massive portfolio of 5G patents with some studies calling it a leader in that area. Next to that, Huawei opened a lot of foreign R&D centres with the goal to create global networks of experts and scientists. By investing in advanced economies, the firm was able to benefit from spillovers from these countries and learn from them.

On the other hand, Nokia has had much less support from Finland or the EU. Finland financially supported Nokia via subsidies but those are still significantly lower compared to Huawei. With the EU, Nokia is able to take part in public-private partnerships and thus benefits from EU funds. Again, those funds' sizes are insignificant compared to the alleged \$75 billion the Chinese government supported Huawei with (Wall Street Journal, 2019). However, Nokia still invested more money than Huawei when looking at R&D expenditures as a percentage of the firm's revenue. But because Nokia has to compete hard against Ericsson, Huawei, ZTE or Samsung on global markets, the Finnish company's revenue is much lower than the one from Huawei who has an exclusive access to the massive Chinese market. Thus, in absolute amount, Nokia can't compete with Huawei's R&D expenditures.

Another significant difference between both firms was the use of M&A in their innovation policy. Whereas Nokia acquired a lot of competitors to develop its innovation capabilities, Huawei mostly focused on its in-house R&D units and did not take part in massive M&A deals as a way to boost its innovation capacities which is not uncommon for Chinese companies as they have been very cautious about international mergers and acquisitions deals (Nolan, 2012). All in all, we can say that Huawei was able to become the leader of the 5G equipment industry due to the following features. First, Huawei engaged with foreign companies in order to benefit from their knowledge and technological spillovers (joint ventures and foreign R&D centres). Second, the Chinese government massively supported Huawei by giving them close to an exclusivity on the Chinese market which secured their revenue and thus their R&D expenditures. Third, Huawei significantly invested in R&D capabilities to deliver cutting-edge technologies and also develop its patent portfolio to be able to develop internationally recognized standards.

## **6.2 The future of Nokia and Huawei**

The deployment of 5G is now into full effect in the majority of advanced economies. Mobile phone carriers are investing massive sums of money to update their networks and deliver the highly anticipated improvements of the fifth generation of mobile networks. Based on our analysis of Nokia and Huawei's innovation policies, market positions and states support, we can investigate about their future within the networks equipment sector.

Regarding Huawei, the Chinese company was able to become the leader of the 5G market thanks to high investments in R&D but also its preferential treatment in the Chinese market. As we have seen in the practical part, the majority of Huawei's revenue (59%) was made in China. With the full deployment of 5G in China in 2019, the company will have to start looking for other markets in order to sustain its growth. Furthermore, gaining market shares outside of China, especially in Europe, Asia and Africa is a part of the company's strategy. The growing concerns about Huawei products, launched by the US, will have a negative effect on its relations with foreign countries, especially in Europe where many countries are used to follow the US leadership. Thus, the big challenge for Huawei in the coming years will be to work on its image by investing time and money in proving that its products are not only the best but are safe from a security perspective.

On the other hand, the growing concerns about Huawei will be beneficial for Nokia as the company will be able to seize back some of its market share in Europe. The recent ban of Huawei in the UK will probably have an impact on other European countries' decisions. Thus, Nokia will enter in a fierce competition with its European rival, Ericsson. The challenge for Nokia will certainly to show that its products are more advanced than the ones from Ericsson and that it has the ability to roll out its products faster.

All in all, Huawei's leadership will be challenged by national security concerns and it will have to proof two things: its products are the most advanced and its company is independent from the Chinese government.

## Conclusion

The deployment of 5G has become a strategic race all over the globe. With the increase presence of digital solutions in the day-to-day life and business environments, the last generation of mobile connectivity has been branded as the key to unlock the full potential of the fourth industrial revolution. The telecommunications industry has presented 5G as the first step to the development of ground-breaking inventions such as self-driving vehicles, smart cities, connected devices and remote surgeries to cite the most famous ones. Moreover, its full deployment is supposed to bring significant economic growth worldwide and create millions of jobs.

Facing this foreseeable revolution, major world powers have designated the deployment of 5G as a strategic issue to the broader race of technological leadership. Among those, the EU, China and the US have made the deployment of 5G a priority in the coming years. In the EU, the newly-elected von der Leyen Commission has oriented the bloc's industrial policy around a green and digital transformation. In this policy, innovation occupies a central place and 5G will be one of the drivers of this transformation. In China, the CCP has made it a priority to develop the country's innovative capabilities in order to catch-up with high-income countries. Thus, 5G will allow the country to develop new industries and, at the same time, develop its national champions domestically and abroad. For the US, the deployment of 5G has become a national security issue in order to keep its global technological leadership and drive the future industry standards that 5G will allow.

In this race, the telecommunications equipment providers occupy a strategic place and, as a consequence, have been critical in the deployment of the 5G networks worldwide. This thesis has presented the innovation policies of two of the biggest firms in that sector, Huawei and Nokia. Moreover, it has shown the degree to which state interventions have played a role in the development of those firms' innovative capabilities.

As of today, Huawei is considered as the leader of the telecommunications equipment sector. With more than 90 signed commercial deals and a 2019 revenue of €37.997 billion for its mobile networks business only, the Chinese firm has succeeded to overtake its European rivals in a few years. In this thesis, we have shown that those accomplishments were made possible thanks to a powerful and aggressive innovation policy. At its beginning, Huawei has taken advantage of technological and knowledge spillovers from the joint ventures that the company established with high-income countries' firms. Based on the acquisition of foreign technologies, the company was able to develop indigenous innovations by massively investing

in R&D in China. In addition to that, Huawei has benefited from an exclusive access to the Chinese market during its development. Indeed, the company did not suffer from a strong foreign competition as the CCP restricted and regulated the Chinese telecommunications industry to protect its developing national champions like Huawei. With a protected significant source of revenue, Huawei was able to invest more than 10% of its net sales into R&D which gave it the ability to build a significant patent portfolio as well as top of the range products and services.

Following Huawei at the second spot in the telecommunications equipment market share by revenue, Nokia has successfully comeback from a steep downfall after having led the mobile devices sector. Since 2012, the Finnish company has been able to develop its mobile networks business thanks to an efficient innovation policy. Indeed, we have showed that Nokia has used strategic M&A deals in order to completely change its core business in less than a decade. Moreover, the company has highly invested in R&D which allowed the firm to develop top of the range end-to-end mobile network solutions. However, those R&D investments, relatively high compared to the competition, could not match the absolute amount spent by Huawei due to its massive revenue.

Looking back at Huawei, it is interesting, but should not be surprising, that the company shares a lot of common features with China's industrial policy. We have seen that the PRC's industrial policy goals were to reach domestic cohesion and strategic autonomy. In order to achieve those, the CCP has been protecting and supporting a few national champions in their domestic market. In the beginning, the national champions benefited from foreign technology spillovers due to the joint ventures policy set up by the CCP. After that, the national champions were given market protection within China which gave them the possibility to grow domestically. Recently, the Chinese government has pushed those national champions to expand on foreign markets and follow the go-global policy in order to compete with foreign firms and have an influence on international standards. As we can see, this policy follows the development of Huawei in the last decades.

This thesis has shown that the similarities between Huawei's innovation policy and China's industrial policy have created international concerns regarding the independence of Huawei and thus, the reliability of its products. The US and some of its allies have completely banned the company from doing business on their territories and with their domestic companies. Indeed, the Trump Administration has used the Huawei ban to increase its leverage in its negotiations with China regarding the trade war that the two countries are in.

Thus, the EU has become an important and strategic market for Huawei if it wants to succeed in its international expansion strategy. Following the call from the US to ban Huawei in the EU, the Commission has offered a toolbox for member states to make the decisions, however, those member states are still responsible for the decision.

This thesis offered an in-depth analysis of Huawei's innovation policy as well as the contribution from the CCP in it. Based on our analysis, we have shown that China is significantly supporting its national champions to go out and expand on international markets. Moreover, we have seen that Huawei's leadership position has been acquired thanks to massive R&D investments following the acquisition of foreign technologies.

It would be simplistic to think that the Chinese state support in Huawei or the telecommunications industry has been marginal and exceptional. This strategy is based on a consistent industrial policy that covers all the strategic sectors defined by the CCP. Thus, the EU should expect to face other situations where significant Chinese companies expand on its market. In 2010, 46 Chinese firms belonged to the Fortune Global 500. In 2020, 124 Chinese firms are in the ranking. It is clear that Chinese firms following the go global strategy will increase their presence in EU markets. So far, the divergences between EU member states have prevented the EU to respond accordingly. The challenge for the EU Commission will be to bring a common response on to how to handle the expansion of Chinese firms in its internal market.

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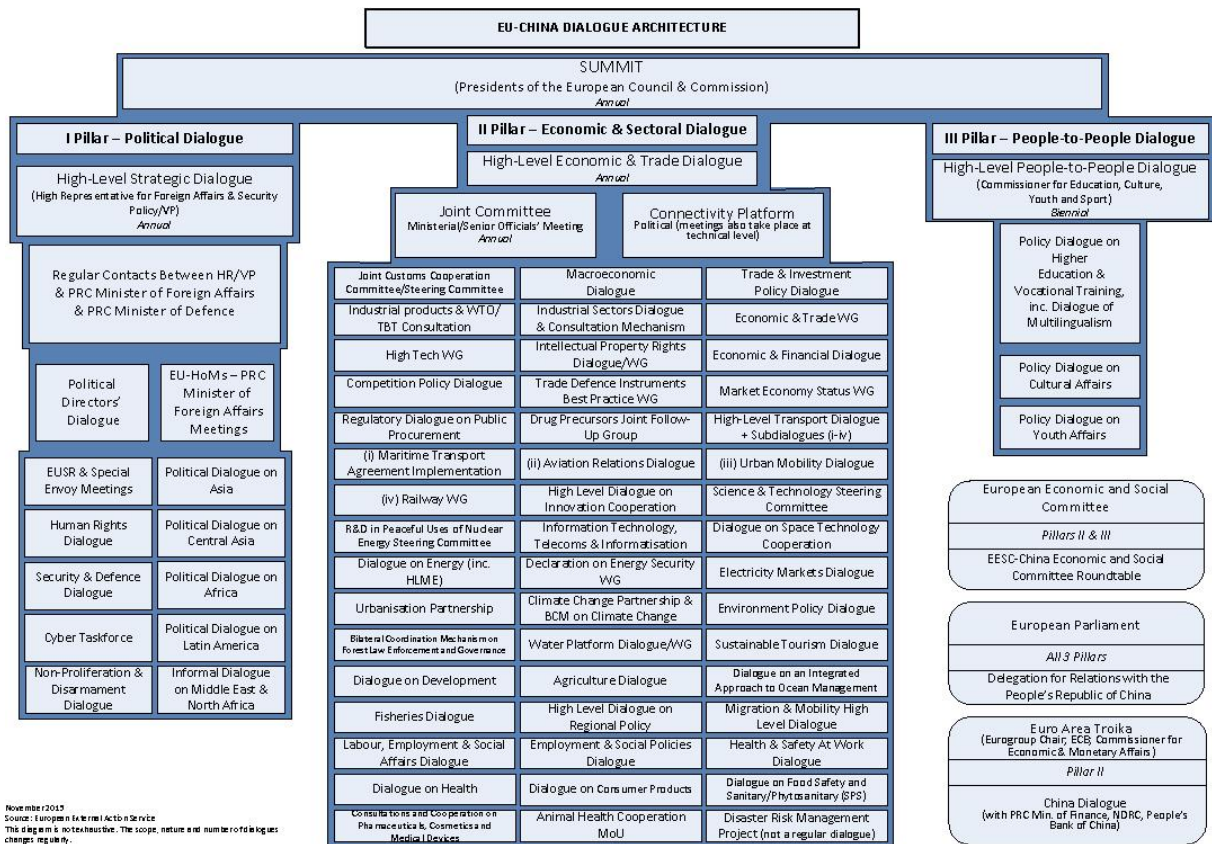
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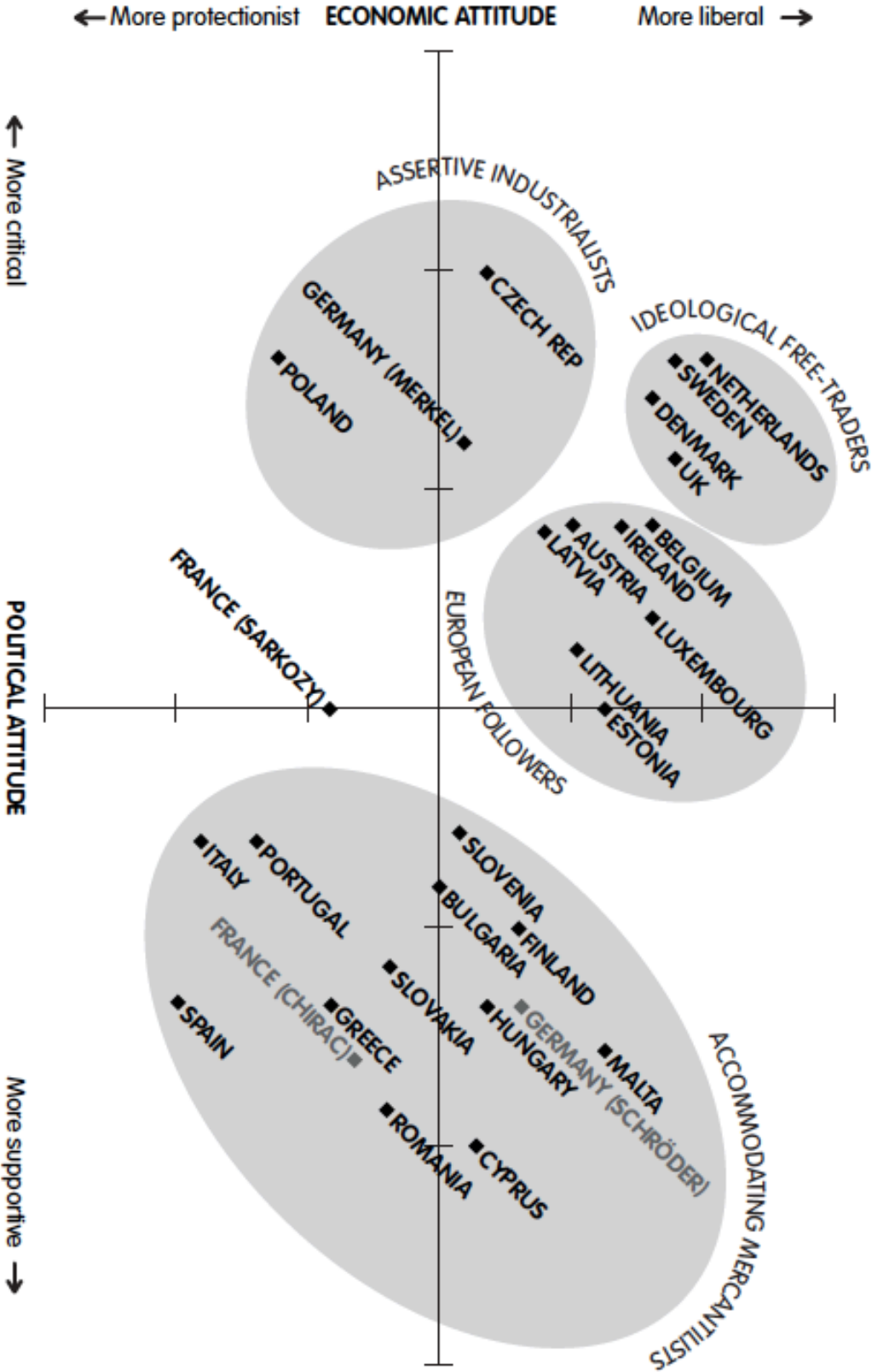
# Appendices

## Appendix 1: Architecture of the EU-China relation



November 2015  
Source: European External Action Service  
This diagram is not exhaustive. The scope, nature and number of dialogues changes regularly.

Appendix 2: Fox and Godement’s classification of EU countries towards China



EU Member State attitudes towards China