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GLOBAL SUPPLY CHAINS, GLOBALIZATION AND GEOPOLITICS:
THE SMARTPHONE INDUSTRY IN THE POST-PANDEMIC WORLD

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Abstract:

This paper studies the management of global supply chain (GSCs) risks in the smartphone industry, given recent globalisation trends and geopolitical disruptions. The paper discusses a Supply Chain Risk Management (SCRM) model - based on a seminal contribution to this field's literature and used throughout as a benchmark - before applying it to selected smartphone case studies. The disruptions studied paint a picture of underlying trends in globalisation that have accelerated, and to which GSCs will have to adapt, traditional risks being more likely to occur and cause more damages, in an increasingly uncertain world. Finally, the paper highlights three points common to GSCs risk mitigation given these trends: digitalisation, the restructuring of shoring options and the management of inventories and production capacity.

Keywords: Global Supply Chain Risk Management, Smartphone Industry, Globalization, Geopolitics

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1. Introduction

The IMF (1997) defines globalization as the growing interdependence of the world's economies, cultures, and populations, triggered by cross-border trade in goods and services, technology, and flows of investment, people, and information. The third wave of this phenomenon began after World War II, due to trade liberalization, and exploded in the 1990s (Baracuhy, 2016). Technological advances in transport and communication in the past decades playing a huge part in its acceleration too, making it possible to connect the whole of the global, promoting and simplifying the exchange and coordination of activities in the four corners of the world. For companies, globalisation opened up colossal opportunities, but has also brought a lot of challenges. Increasing customer demands and tougher competition are forcing companies to expand their activities worldwide (whether in production or sales) to take advantage of larger markets, cheaper labour or more favourable business conditions, creating the first global supply chains (GSCs). Companies have gradually abandoned low-margin activities through outsourcing to focus on their core business. This has made the management of the GSCs a key point of corporate strategy, which can provide competitive advantage and lead to success (Narasimhan and Talluri, 2009). Those longer and more complex GSCs have also made them more vulnerable to risks. Risk can be defined by “a chance of danger, damage, loss, injury, or any undesired consequences (Harland, Brenchley & Walker, 2003, p.2). This has led to the necessity of supply chain risk management (SCRM), as discussed in (Blome & Schoenherr, 2011).

The ongoing Covid-19 pandemic has strengthened the need for SCRM. Lockdowns and border shutdowns around the world have caused major disruptions at all levels of supply chains, in raw material supply, manufacturing, transport, distribution and demand. Through its economic as

well as social consequences, the pandemic may also have interacted with the underlying trends of globalization (The Economist, 2020), forcing CSGs to adapt to this new reality.

Smartphones are one of the outcomes and symbols of this globalisation. Firstly, they make the world ever more connected with their countless functions, making it easier to communicate, search for information and coordinate activities to an extent never seen before. Secondly, they are among the most globally manufactured objects, with their supply chain involving millions of workers in hundreds of companies, which are themselves spread across dozens of countries (The Economist, 2018). Smartphones are therefore one of the archetypes of globalisation.

The objective of this paper is to explore the management of risks in global smartphone supply chains using selected case studies, given recent globalisation trends and geopolitical disruptions. To this end, section 2 will be devoted to the smartphone industry and how the recent geopolitical disruptions affected it in the short-term. Then, in section 3, the paper explores the existing SCRM literature and its application to the smartphone industry. The impact of recent globalisation and geopolitical trends is discussed in section 4. Finally, section 5 concludes.

Note that the literature review relies heavily on the contribution of Ila Manuj and John Mentzer (2008), which is a seminal contribution to the SCRM field. This is not overly restrictive, however, for present purposes. Indeed, other related contributions also base themselves on it but have less relevant insights for the main issues I discuss here. In turn, the information used in the case studies is mostly based on analyses carried out by recognised practitioners in relevant consultancy firms, business and economics newspapers, or specialised blogs, due to the recency of the disruptions discussed, and not yet the subject of substantive academic research.

2. The smartphone industry: Background and short-term effects of current disruptions

The first smartphone was invented by IBM in 1992, under the name of Simon Personal Communicator. Although rather rudimentary, this first smartphone already included some elements inherent to its contemporaries. However, 2007 was without any doubt the most revolutionary year for the industry with the release of the very first iPhone and its breakthrough customer-friendly design. A year later, Samsung introduced its first smartphone in response to Apple's device (Tocci, 2019). Since then, smartphones have established themselves as the standard in the mobile phone market and have been the fastest growing segment of the telecommunications sector over the past decade. In 2013, sales of smartphones surpassed sales of more basic devices (Cecere, Corrocher & Battaglia, 2014).

Today, smartphones are one of the most globalised goods in the world and their supply chains are among the most complex, producing around 1.52 billion phones in 2019 (680 million in 2012) for a global sales value of 409bn USD (Statista, 2020), and employing millions of workers in hundreds of companies, which are themselves spread across dozens of countries (The Economist, 2018). It is estimated that around 3.3 billion people have a smartphone nowadays (41.5% of the world's population), a number expected to grow until 3.8 billion people in 2021 thanks to the increasing demand in emerging markets, particularly in India. To better understand the industry's economic stakes, according to the IMF (2018), smartphone components accounted for 33% of Taiwan's exports, 17% of Malaysia's and 16% of Singapore's. In addition, smartphones represented 6% of Chinese exports in 2017.

The smartphone market is dominated by three top players who together account for 53% of the market share: Samsung, Huawei and Apple (Canalys, 2020). If we widen the scope, the top 6 companies (with Xiaomi, Vivo, and Oppo) represent about 75% of the market in 2019

(Appendix 1). Samsung has consistently been the market leader since 2011 before being temporarily dethroned by Huawei in the second quarter of 2020 (Appendix 2). Four of these six companies are Chinese (Khandelwal, 2019).

However, despite having experienced phenomenal growth over the last decade, smartphone sales fell slightly for the first time between 2018 and 2019 (around -2%), due to saturation in developed country markets and a tendency to upgrade less often than before (Statista, 2020). Shortly thereafter, the US-China trade war hit the smartphone industry and its entire supply chain hard, followed by the Covid-19 pandemic.

Geopolitical disruption: US-China trade war

The main cause of the trade war between the USA and China is the negative trade balance of the USA with China. To make up for this deficit, the US began to apply customs duties on certain Chinese products, which later retaliated by doing the same. Tensions then escalated, with each country imposing more customs duties on the other. In May 2019, the trade war took another turn when the US decided to ban Chinese giant Huawei adding it to the “Entity List”, suspected of espionage because of its close ties with the Chinese government and considered as a “national security threat”. Initially, only American companies were banned from doing business with Huawei. Exactly one year after, in May 2020, the Trump administration announced that all non-American companies using American technology (equipment, software, patents etc.) would not be able to do business with Huawei either (Ting-Fang & Li, 2020).

This had two big consequences on Huawei activity. The first one, it prevented Huawei from using American or American technology-based hardware, including American and Asian chip manufacturers, whose components are essential to Huawei. The second consequence of this ban on Huawei smartphone activity is the impossibility of integrating Google services, and especially is operating system Android, on its new phones. For the time being, this ban does not apply to other Chinese manufacturers such as Xiaomi or Oppo.

The loss of the relationship with Google is huge for Huawei. It cannot sell smartphones without its Android operating system and its Google Play Store with all the applications that come with it. This is not a problem in the Chinese market where Google is already banned and where there are therefore alternative apps stores, but everywhere in the world, Google's services are a core requirement. This is therefore a potential death blow for Huawei. However, the Chinese company had already started before the announcement of the American sanctions to work on the development of its own operating system, Harmony, to become independent from Google. But the success of a new operating system in a market that was created and developed around Android and Apple's OS is anything but certain, as Microsoft's failed attempt with Windows Phone proves (Brown, 2020).

After the announcement of the first ban by the American government, all of Huawei's American suppliers such as Broadcom, Qualcomm, and Intel (who supply a third of its chips) announced that they would cease their collaboration with immediate effect. Huawei, through its subsidiary HiSilicon, designs the Kirin chips for its flagship telephones in-house and has them produced by TSMC, one of the world leaders in the manufacture of chips. With the announcement of the ban for non-American companies taking effect on 15 September 2020, Huawei reserved earlier in the year the production capacity of the Taiwanese company to produce as many Kirin 9000 chips as possible for storage and to anticipate short-term demand for its next models (GizChina, 2020). Also, other manufacturers of electronic chips that could have replaced TSMC, such as Taiwan's MediaTek, also use American technologies for the manufacture of components and are therefore unable to work with Huawei. SMIC, another potential manufacturer for the Shenzhen-based company, does not have the technology or production capacity to produce the state-of-the-art chips designed by Huawei (GizChina, 2020). However, in October 2020, some companies, such as Qualcomm or Samsung, which had applied for a sanction exemption licence, were awarded it and will therefore be allowed to rework with Huawei but for certain

components. This leaves an opening for a potential authorisation of TSCM, Huawei's largest chip supplier (Valiyathara, 2020). For the time being, Huawei is exploring all possible options for sourcing chips. With Qualcomm having recently obtained a licence, Huawei could use its chips for its flagship phones, whereas before it only used them for its entry-level and mid-range phones. A partnership with Samsung is also being studied, to manufacture chips with only European, Japanese and Chinese technologies, even if they still lag behind the Americans (Goldman, 2020).

As a result, the sanctions have caused a lot of damage to Huawei in the short term, especially in foreign markets. Although the launch of the Mate 30 in September 2019 was surprisingly successful (first phone without Google applications) and increased the company's revenues by 13% in the first half of 2020 (even surpassing Samsung in Q2), the second round of sanctions that blocked Huawei from suppliers such as TSMC did a lot of damage to the company. According to IDC (2020), it saw in Q3 2020 a decline of 22% of its sales, in a smartphone market that decreased by 1% over the same period. Even in the Chinese market, its shipments fell by 15%. Its competitors are recovering its market share, like Xiaomi which sold 13.8 million more devices when Huawei lost 14.7 million (Appendix 3). In Europe, Huawei's sales fell by 25% and those of Xiaomi increased by 88%. Concerning its suppliers, Huawei's haste to increase its inventory of components before the sanctions came into force on 15 September caused their sales to explode. Novatek's sales (a supplier of display integrated circuit driver chips) for the month of August increased by 30% over the previous year and TSMC's sales by 16%. However, after this date, many suppliers are likely to be heavily impacted by the ban. Huawei accounts for 20% of TSMC's revenues, but TSMC is expected to see this gap filled due to strong demand from other customers for 5G equipment. Samsung also expects a negative impact on its sales, as does ASE Technology Holding, the world's biggest chip packaging and testing house, which expects its revenues to fall by 7-9% (Nikkei Asia, 2020).

The trade war did not affect Apple as much as its rival Huawei, but it was not without consequences for the Cupertino-based company. One of Apple's strengths is its huge and complex network of suppliers, much of which relies on China. A few years ago, Tim Cook responded to the idea that Apple assembled its products in China for purely financial reasons: "There's a confusion about China. Its deep tech ecosystem makes it the only country capable of providing the right mix of expertise, suppliers and labour at the scale Apple needs" (Crabtree, 2020). Because of tensions between the US and China, Apple's dependence on China has also become one of its biggest weaknesses, as China is also the second largest market for the brand. Although Apple is one of the largest importers of goods made in China, it has managed to avoid the new tariffs on most of its products, largely thanks to strong lobbying by its CEO Tim Cook on the White House, who has met with Donald Trump many times over the past two years (Nicas, 2020). iPhones were not subject to the taxes until 15 December 2019, when 15% customs duties should have been applied, which were finally avoided two days before they came into effect thanks to an agreement reached between the US and China (Wood, 2019). According to renowned Apple analyst Daniel Ives, these taxes would have caused the price of the iPhone to rise by between \$120 and \$150, and consequently a drop in demand of between 6 and 8%. According to a Bank of America study, shifting Apple's production to the US would add 15-25% to the cost of their devices, and would destroy their demand if this increase were passed on to customers. Moreover, according to Ives, moving only 5-7% of Chinese production to other Asian countries such as India or Vietnam would take 18-24 months (Newmyer, 2020). The cost of leaving China is therefore significant.

In the short term, Foxconn, the Taiwanese electronics giant which employs more than a million workers in China and manufactures most of Apple's components and products, announced through its board nominee and semiconductor division chief Young Liu that it was able to give Apple all the support it needed to adjust its production if the trade war worsens: "Twenty-five

percent of our production capacity is outside of China and we can help Apple respond to its needs in the U.S. market. We have enough capacity to meet Apple's demand" said Liu (Bloomberg, 2019). However, Apple has so far not given any orders to take iPhones out of China. However, Foxconn has moved the assembly of some iPad and MacBook devices to Vietnam to minimise the impact of the trade war. In the medium and long term, to diversify its production away from China, Foxconn has already spent \$1 billion to build a factory in India at the request of the US company. It also has plans to open a plant in Wisconsin (Reuters, 2020). Foxconn CEO Liu Young-Way explained in 2019 that the trade war had divided the world in two with two different sets of supply chains to meet their demands.

On the Chinese side, the government could have used Apple as a lever to put pressure on the US government as it is doing with Huawei, for example by restricting access to some of the rare materials that Apple needs. But the fact that Apple generates nearly 5 million jobs in China through its activities (twice as many as in the US) gives it political protection. On the other hand, its sales have fallen since the tensions began, with many Chinese making "patriotic" purchases from local brands, which has given Huawei a boost (Crabtree, 2020).

Global economic disruption: Covid-19 pandemic

The whole smartphone industry took a second big blow because of the Covid-19 pandemic, which has been hitting the world since the beginning of the year 2020, and all the consequences that follow (border closures, lockdowns etc.) which have caused a drastic drop in the sector's sales in the first and second quarters of nearly 20% (Appendix 4), (Gartner, 2020). This drop is expected to be temporary but might persist in time depending on the extent of the economic impact of the pandemic on all stakeholders.

The pandemic has disrupted the upstream and downstream parts of the supply chain. Upstream, lockdowns have disrupted the supply chain by forcing component or assembly plants to close.

Most manufacturers' supply chains, dependent on China, where the pandemic started, have found themselves short of critical components/materials for their devices. Lots of suppliers that were already operating with razor margins found themselves in financial distress. In addition, the very small inventories kept by the manufacturers and the travel restrictions affected logistics, and caused many delivery delays (Accenture, 2020). In February, the coronavirus was centred on China and the concern was therefore about making enough smartphones to meet the demand. But in March, after China recovered and the world entered lockdown, sales collapsed (Canalys, 2020). Moreover, even at that time, shortages of components persisted due to restrictions that were put in place at different times in different regions, most supply chains having a complex network established around the world. The delivery time for high-end semiconductors doubled from 18 to 36 weeks (Scott, 2020).

Downstream, the demand for smartphones fell. The pandemic and lockdowns have left millions of people in a precarious financial situation, with irregular incomes and great uncertainty about their jobs. Even better-off households have tended to spend less because of the uncertain economic environment. As a result, unless replacing a broken one, buying a new smartphone is no longer a priority for many people, who will prefer to save or spend on more essential goods (Accenture, 2020; Matthews, 2020). Replacement cycles have become longer (Counterpoint, 2020). As such, smartphone shops on the high streets closed, which has strongly contributed to reducing the possibility of purchase and thus demand.

3. Managing global supply chains risks: Brief literature review

According to Hise (1995), the main objective of global supply chains is profit maximisation. However, to achieve this goal, GSCs must be flexible and responsive to deal with an ever-changing global environment and a booming global economy. This implies permanent

challenges for companies regarding the management of their supply chain and a strong relationship with its different stakeholders (Keeney, 1994). In the countries where they established a link of their supply chain, these challenges can be economic (tax rates, duties, exchange rates etc.), infrastructural, political (government stability, laws etc.), cultural (languages, customs etc.) and competitive (Schmidt & Wilhelm, 2000).

They also have a greater exposition to disruptive events. For instance, September 11th, natural catastrophes or the subprime crisis in 2008 showed that an event that impacts one member of the supply chain can also cause the shutdown of other its members, and disrupt the whole chain (Mentzer and Manuj, 2008a). The various risks linked to global supply chains all revolve around the same axes. However, according to Manuj and Mentzer (2008b. p.26), "growth in outsourcing and off-shoring, increasingly demanding customers, geographical dispersion of supply chain, access to markets in emerging economies, and unanticipated events such as terrorist acts and natural disasters will lead to increased complexity, risks, and opportunities in global supply chains". This means that in an increasingly complex world and economy, supply chains will also be subject to growing uncertainty and risk, and therefore require a high degree of coordination, control, and communication (Manuj & Mentzer, 2008a).

Based on a review of the existing literature in this field, Manuj & Mentzer (2008) have developed a model that is now a reference for companies to manage their GSC risks. This 5-step model goes from risk identification to the implementation of strategies to avoid or mitigate it, or the losses associated (Appendix 5 & 6). Here are its different steps:

Risk Identification > Risk Assessment and Evaluation > Selection of Risk Management Strategies > Implementation of Risk Management Strategies > Mitigation of Supply Chain Risks.

Risk identification consists of finding potential risks that could disrupt the supply chain and classifying them into different categories (Appendix 7).

Supply risks refer to the upstream part of the supply chain and include sources such as disruption of supply, inventory, quality issues etc. Demand risks refer to the downstream part of the supply chain and include variations in demand or new products introductions by competitors. Operational risks are directly linked to focal firms' activity, while security risks (IS or infrastructure security, vandalism, terrorism etc.) can occur throughout the supply chain (Appendix 8). Macro, policy, competitive and resource risks belong to the company's domestic and global environment. However, all these risk categories may be interconnected, and a risk may belong to more than one category. For example, a general decline in wages (macro risk) can lead to a sharp drop in demand for a product (demand risk).

Several ways for **risk assessment and evaluation** appear in the literature but Manuj & Mentzer (2008b) developed one based on potential losses linked to the risk identified, its probability to happen, its impact/consequences and an estimation of the worst-case scenario (Appendix 9).

To predict supply risks more specifically, Trkman & McCormack (2009) propose assessing each supplier's risk based on its environment, attributes, performances, and supply chain characteristics. This model tries to avoid or mitigate supplier's non or under-performance and assumes that the suppliers' environment can be very different from that of the focal company and is therefore not subject to the same risks.

The third step of Manuj & Mentzer's model (2008b) is the choice of the appropriate **risk management strategy**. They can be classified in seven different categories: avoidance, postponement, speculation, hedging, control, transferring risk and security (Jüttner, Peck and Christopher, 2003). Some are closely related to each other, and the use of one might induce the use of another one. They aim to reduce the probabilities of losses associated with the identified risks.

Avoidance strategy is used when a risk (for instance, related to a product or a market) is unacceptable. It can take the form of divestment of assets or operating only in low uncertainty markets.

Postponement strategy “entails delaying the actual commitment of resources to maintain flexibility and delay the incurring of costs” stated Bucklin (1965, p.2). The movement of goods from the factories only after some orders are placed is a form of postponement aimed at avoiding potential loss by only producing products that are certain to be sold (Zinn & Bowersox, 1988).

On the other hand, speculation is the opposite of postponement. It aims to anticipate customer’s demands in a competitive and customer-centric environment so as to provide the company with a competitive advantage (Perry, 1991).

The hedging strategy revolves around different customers, suppliers and factories scattered around the world so that one event cannot affect the entire network, or in different proportions. It is a risk reduction through diversification.

The control strategy entails vertical integration to reduce the risks of demand or supply failures in GSCs, thereby protecting themselves from opportunistic behaviour or supplier-buyer power balance. However, it increases fixed costs and reduces variables ones.

The transfer or sharing of risk can be done through outsourcing. This allows companies to focus on their core business, on the most profitable activities and to transfer low value-added activities and part of the risk to suppliers.

Finally, the last strategy used to avoid or mitigate risk is the security strategy. It does so through regulations or special directives so as to prevent risks or unusual events, or deal with them in the best possible way.

In the proposed model, a strategy can be chosen according to the type of supply chain, the risk profile or the industry.

The model's next step is the **implementation of risk management strategies**. According to Mentzer & Manuj (2008a), two factors are crucial in this phase of risk management. The first one is complexity. Freedman (2003) argues that reducing complexity is a crucial point in strategy implementation. In increasingly complex supply chains, it is possible to do so by giving more flexibility to the supply chain. Flexibility can be defined as the ability to react to an unexpected event quickly or with a little effort or cost (Upton, 1994). It therefore provides the company with a capacity to respond to circumstances that had not been planned before. The second one is organizational learning, which allow a better identification and assessment of the risks. In a follow-up paper, Mentzer & Manuj (2008b) added that information systems were also crucial for an effective implementation and assessment of the risk strategies, due to the huge quantity of data that has to be processed throughout the model.

Finally, the last step is **the mitigation of the supply chain risks**. Risk mitigation aims to reduce the probability of risk occurrences and lessen the negative impact of a risk (Kern et al. 2012), while risk management strategies "are used to proactively address the probability of expected (though uncertain) events" (Mentzer & Manuj, 2008, p.16). All risks cannot be avoided. A mitigation plan acts like a back-up plan enabling the company to react if the most damaging case scenarios were to happen.

How are GSCs organised in practice and how is this framework applied in the smartphone industry? Of course, each manufacturer has its own specificities and for the purpose of the study, this paper will go through the examples of Samsung and Apple, two of the main players in the industry, which have two very different models. Although different, these two models are both focused on profit maximisation through the offshoring of all or part of the activity, one of the key drivers of globalisation (Hise, 1995).

Samsung's model is based on a *control strategy* and is therefore vertically integrated and produces its components in-house in its own factories around the globe. Literature in strategic management (Porter, 1990 & Barney, 1991) explains that to stay competitive, a company should concentrate on high-value-added activities or core competencies and outsource low-value-added or non-core activities. However, this vertical integration enables the firm to control the entire production process from design, manufacture of components and assembly and therefore eliminate *supply risks*, such as quality issues, opportunistic behaviours and creating new competitors by sharing knowledge. In the same way, it eliminates some *operational risks* by maintaining a single quality standard across all the factories, and some sources of *demand risks* by being able to adapt quickly to a rapidly changing market (Thi Pham, Darabi & Willmot, 2015). Being vertically integrated also enables Samsung to supply other manufacturers such as Apple with a good number of components for their smartphones, even though they are in direct competition on the market (Ming Kwok & Lee, 2015).

Samsung's GSC is also based on a *hedging strategy*, due to the global dispersion of its in-house factories to prevent the *supply risk* of disruption if an unexpected event were to happen in one of those factories or countries. This strategy was first motivated by the idea of reaching as many customers as possible in different emerging markets, and therefore avoid *demand risks*, potentially due to unforeseen events in one of these markets, and to diversify its customer portfolio in the context of a slowdown in more mature markets such as the USA or Europe (The Economist, 2018). Secondly, they aimed to avoid *policy risks* by circumventing the significant customs barriers in these markets. To illustrate these points, Samsung's smartphone components are manufactured mainly in South Korea, Thailand, and Malaysia. They are then sent to its assembly plants, such as in Vietnam, a country strategically located on the sea routes with tax incentives and "politically stable, with a good labour environment and which supports the industry", according to Samsung Electronics' managing director (Thi Pham, Darabi & Willmot,

2015). The fact of being established in a stable, with cheap labour costs and good governmental incentives country like Vietnam also avoids *policy risks* and some sources of *macro risks* such as wages increase. The Vietnamese factory produces 120 million smartphones per year, mainly for the European and North American markets. This is where most of their smartphones are produced (Adnan, 2019). The company also has a huge factory in India, which has recently also been able to produce 120 million units a year. This factory is mainly destined for the Indian market, one of the most lucrative markets, and allows Samsung to be competitive on its prices, which would not otherwise be possible due to high import taxes (*policy risks*). It also exports to the European, African and West Asian markets from India. In contrast, South Korea now accounts for less than 10% of smartphone production, mainly for its local home market. Like India, Brazil is home to a Samsung factory because of its high import taxes (*policy risks*), which supplies the entire fast-growing South American market, avoiding therefore *demand risks* (Adnan, 2019). In 2015, Samsung also opened a factory in Indonesia to support local demand, more to avoid the tax on imported luxury goods (*policy risks*), of which the Korean company is a part, than to establish a new production centre for the world (Thi Pham, Darabi & Willmot, 2015).

Unlike the industry standards, Samsung shut down in 2019 all its smartphone factories in China because its market share in the country had fallen to less than 1%, and therefore no longer produces any smartphones there (Adnan, 2019). This *demand risk* due to increasingly growing Chinese competitors like Huawei or Xiaomi which resulted in a drop in demand, led to an *avoidance strategy*, through divestment of assets in this country.

Apple is an example of a completely opposite model. In 1998, Steve Jobs and Apple hired Tim Cook (now the group's CEO), an expert in supply chains, who based Apple GSC's model on *hedging* and *transferring risk strategies*, by creating a complex network of suppliers and subcontractors for Apple around the world (The Economist, 2018). This results in outsourcing

of all the iPhone's component production to numerous suppliers mainly in the USA, China, Korea, Taiwan, Japan and Western Europe, to focus on its high-value core competency (product design) and leave low value-added activities for suppliers. It allows the firm to get rid of *operational risks* and transfer it to its suppliers. In the same way as Samsung, having globally dispersed suppliers helps Apple reduce the risk of being hit by an unexpected event at the same magnitude everywhere it is present.

China plays a central role in Apple's GSCM. According to R. Russell and B. Taylor (2019, p.453), Apple's top 200 suppliers "represent at least 98% of Apple's procurement expenditures for materials, manufacturing, and assembly have over 750 global facilities. Of those facilities, over 340 of them and 14 out of 18 Apple's final assembly facilities are in China". In addition, of these assembly plants, seven are owned by Foxconn, which employs more than a million workers in China. One of the main reasons for Apple's presence in China is that it relies on a huge number of Chinese workers working nearly 60 hours a week at a derisory cost to the company's profitability. Its workers earn an average of between \$1.5 and \$2.5 per hour, which allows Apple to capture nearly 60% of the value of an iPhone. The cost of Chinese labour is only 2% of the value of an iPhone (or \$12 for a device worth \$600), which is the smallest share of the overall cost of the smartphone (R. Russell and B. Taylor, 2019). Giving China an important role in the SC hedging strategy is above all, besides the cost of labour in the country, the flexibility of suppliers thanks to their ability to deploy a colossal number of workers and engineers at any given time to make potential necessary changes (Girotra & Netessine, 2012). This allows Apple to have an important agility and avoid *demand risks* by being able to respond quickly to any variation in demand. However, *policy* and *macro risks* may increase if any disruptive event were to happen in the country, a significant part of Apple's SC could be paralyzed.

The efficiency of Apple's supply chain is based on two main crucial points. The first is the establishment of strong supplier relationships (Ross, 2020). Apple knows that outsourcing in China can imply *supply risks* but made it one of the most important factors on its success. It controls almost every part of its complex supplier network, using its size and influence to get the best product at the best price for the customer. When searching for suppliers, Apple's priorities are quality, technological capacity, and scale. Apple tests the supplier by having them produce samples and monitors the entire process. It also has very strict quality standards and controls everything the supplier does, inputs, costs, yield and even the supplier's suppliers, requiring the supplier to work with those recommended by Apple. It also has more than 600 engineers at its suppliers to help solve potential problems and improve plant efficiency. It is very hard to become one of its suppliers, and Apple is always looking to diversify its supplier portfolio to increase its bargaining power. Despite this, competition is intense because becoming an Apple supplier is considered one of the highest recognitions in terms of manufacturing prowess (O'Connor, 2018). These strong relationships give Apple the flexibility to respond to surges in demand and ensure it of the high quality of its products (Ross, 2020). Even though it outsources and is not vertically integrated, Apple controls almost every facet of its suppliers, aware that *supply risks* in China are high. It therefore uses a *transferring strategy* to pass on risk and low value-added activities to the supplier while controlling it almost totally, so that it also has some benefits from the *control strategy*, such as quality.

Secondly, strategic inventory management is key in the supply chain. Tim Cook is a supply chain expert and understands the need to keep inventories to a minimum in an industry where change is constant and products are constantly being replaced (Ross, 2020). As a result, the company has only six days of inventory in its warehouses (Nielson, 2019) and gives them great agility if a competitor releases a new product which reduces the value of those in stock, and therefore reduce costs and *demand risks*. All these factors enable Apple to push costs to the

minimum. However, these small inventories are very vulnerable in case of a major disruption in the supply chain, where Apple would have to react very quickly to keep meeting demand. Finally, the challenge of the iPhone distribution process is to be as quick and as cheap as possible. It begins months before it is formally launched (Russell & Taylor, 2019). This is a perfect example of putting *speculation strategy* into practice to gain a competitive advantage. However, according to The Economist (2018), the global supply chain for smartphones has three main weaknesses that manufacturers will have to address: market saturation (*demand risks*), fragile companies (*supply risks*) along the supply chain and the end of the golden age of globalisation (*macro/policy risks*). This last weakness will be further discussed later in this paper.

Regarding market saturation, the number of sales in the Chinese market fell by 0.3% in 2017 and Westerners have upgraded less. The global smartphone market fell by 2% in 2018 and remained stable in 2019. The reasons put forward are the slowdown in replacement cycles and the lack of revolutionary innovation, which is causing demand to fall in mature markets such as the US, Europe and China. On the other hand, markets such as India are still experiencing strong growth (Mishra, 2019). However, supplier revenues have increased by around 10% in 2018 thanks to the more expensive components found in smartphones (The Economist, 2018), with the total value of iPhone X parts increasing by 28% compared to the previous model, according to IHS Markit. To offset this risk of demand in mature markets, manufacturers will have to diversify their customers by putting more emphasis on emerging growth markets (*hedging strategy*).

The main weakness of the supply chain is the high number of fragile subcontractors (Appendix 10: Finances of Apple and its 42 largest suppliers and assemblers). Apple and thirteen of its chip suppliers retain more than 90% of total profits from the Apple system. At the same time, smaller suppliers of more basic components take the biggest risks by having more employees

to pay, more inventory and more spending on assets. As a result, they have on average a low return on assets of 90%, a net margin of 2% (see chart in appendix 10) and revenues that have not increased for 5 years (The Economist, 2018). By taking a wider range of 132 suppliers in the smartphone industry, a third of them see their margins shrink every year. This leaves suppliers much more exposed to the sector's last big problem: a possible end to the golden age of globalisation. This includes the return of protectionism, illustrated by the trade war between the US and China. Smartphone and chip manufacturers would be protected by their high margins and cash flow, but tariffs and low margins would put many suppliers in great difficulty if the conflict escalates. According to The Economist (2018), more than half of these 132 companies would be loss-making if costs increased by 5%, which represents a considerable *supply risk*. To avoid or mitigate the risk of supplier's non or under-performance, Trkman & McCormack (2019) proposed an assessment of supplier's risk, assessing for each of them their environment, attributes, performances and supply chain characteristics.

To stay in the race, the sector's top players will be called upon, sooner or later, to deal with all these challenges and this new emerging context, notwithstanding their current domination and well-oiled supply chains.

4. Exploring the long-term implications of disruptions in light of recent globalization trends

Now, this paper will discuss the long-term effects the disruptions outlined in section 2 on the smartphone industry, but also on GSCs in general. It will show that these disruptions will only amplify a more global phenomenon that has already been present in international trade for more than a decade: "slowbalisation" (Stangarone, 2020). In this much more volatile world where countries tend to be inward-looking and alliances are increasingly uncertain (Thomson Reuters,

2020), companies will need to be able to understand these trends and rethink their supply chains to operate in this world. These future supply chains will have to be built around three main points: restructuring, better management of inventories and production capacity, and digitalisation. Of course, these pillars do not free companies from implementing traditional GSCRM models such as the one presented above, but on the contrary complement them and push them further by adapting them to the new realities. Due to the recency and lack of hindsight of the events discussed, the information is based on analyses by recognised practitioners in relevant consultancy firms, business and economics newspapers, or specialised blogs, and not on academic research, which is still very little developed.

US-China trade war

The short-term disruptions of the trade war discussed in section 2, which originally was a *policy risk*, resulted in a *supply risk*, *demand risk*, *operational risk* and *resource risk*. However, it will also have long-term consequences for smartphone SCs, but also for the Chinese and US semiconductor industry.

Firstly, Huawei (but also more broadly China) will be forced to become more independent and use only Chinese technology. China has already started to invest heavily in improving it to catch up and become much less dependent on the US (*control strategy*), decreeing that by 2025, it will be completely technologically independent, and that Huawei will move all chip and processor production within the country. According to Yu Chengdong, CEO of Huawei Consumer Business Group, "because the Chinese chip manufacturing industry is not matured, we are faced with the problem of no chips. The only problem now is production, Huawei has no way to produce. Chinese companies have only made designs in the process of globalisation, and this is a lesson." (GizChina, 2020). This lack of means of production is explained by the fact that it was cheaper to buy chips abroad than to invest in domestic production, so China did

not "build" the sector. To reach its objective, China has, according to Nikkei, recruited nearly one-tenth of Taiwan's chip engineers, or nearly 3,000 engineers, to close the technological gap in the sector.

For the USA, this will represent a heavy loss since many companies will lose their partnerships with Huawei and other Chinese manufacturers which together represent nearly 50% of the smartphone market. In addition, chip manufacturers will remove American equipment from production lines to maintain their market share in China, the biggest buyer of chips. The role of the USA in the electronic components market in general is likely to weaken considerably (Schmieg, 2019). However, some countries where Huawei has a strong presence may not want to follow this trend. Add to this the future independence from Android with Huawei's new OS, Harmony, and it is not impossible that a two-tier technology system, one controlled by the USA and the other by China, will emerge in the coming years (Schmieg, 2019).

Secondly, for foreign companies, the trade war has highlighted the over-dependence on China in their GSCs, accelerating the already-existing tendency for companies to leave China for other South East Asian countries (*hedging strategy*). Apple has already been producing certain models of its iPhones in India since 2019. But for the moment, in the smartphone industry, these moves out of China have been on a small scale, as countries such as Thailand and Vietnam are not yet ready for large-scale IT manufacturing, according to Dan Wang, a tech analyst at research group Gavekal Dragonomics (Crabtree, 2020).

Covid-19 pandemic

As discussed in section 2, the Covid-19 pandemic disrupted in the short-term both the upstream and downstream smartphone supply chains. A global pandemic is not included in the risk table developed by Manuj & Mentzer (2008) but appears in other classifications as a *natural risk* or *discrete risk* (Trkman & McCormack, 2009). However, for companies, it has been transformed

into *supply, operational, demand, policy* and *macro risks*, due to the broad disruptions and consequences it has had.

In the long term, the Covid-19 pandemic will also impact both the demand and supply side of the smartphone industry. On the demand side, it has accelerated the digitalisation of the workplace and will probably increase sales of smartphones, which people will need even more than before. For example, contactless payments by phone have exploded to allow secure payment and will probably be a new standard once the pandemic is over (Matthews, 2020). On the other hand, it is still too early to know whether the smartphone has fallen in customers' purchasing priorities (Accenture, 2020). On the supplier side, the pandemic has highlighted the weaknesses of CSGs and is likely to lead manufacturers to rethink their supply chains in the post-pandemic world to make them more resilient. For example, by building contingency plans that anticipate types of crises and improve their management, by focusing on production (local or regional) closer to end customers, by improving communication and data sharing with partners to get a clear picture of the network, or by diversifying suppliers, manufacturing, or transport options (McCrea, 2020). This will be further discussed later in this section.

At a more global level, due to globalisation, supply chains have become very sophisticated and a vital point for companies' competitive advantage. Over the years, their increasing length, distribution, and the reduction of inventories to reduce costs have reduced the margin of error and the flexibility to adapt to disruptions (Deloitte, 2020). The pandemic revealed these weaknesses to the world and the interconnectedness of the economy amplified it by propagating through transport routes. As a result, the disruptions caused by Covid-19 in one place have spread throughout supply chain networks and have had global repercussions within and across industries (ILO, 2020). In this case, a huge proportion of global smartphone production is taking place in China, which was the first country to be hit by the pandemic, and this has had wide-

ranging consequences, demonstrating the lack of preparedness of actors to react quickly (ABI Research, 2020). Consequently, all supply chain actors have been affected, from raw material extraction to distribution, all over the world. As with smartphones, lockdowns have created *demand risk* in addition to *supply risk* for every category of products (ILO, 2020).

According to a study by Accenture (2020), 94% of Fortune 1000 companies have had supply issues due to the pandemic. WTO predicts that global merchandise trade will fall by 13 to 32% in 2020. According to a survey of 715 OEM companies (Original Equipment Manufacturers) carried out by Jabil (an American manufacturing company which supplies certain components to Apple in particular), 70% of them have seen the supply chain disrupted. Similarly, 62% have experienced production delays due to component shortages or supply issues, 43% have seen margins shrink, and 42% have been forced to raise prices. Only 13% of the OEMs interviewed have implemented their predictive supply chain risk management program, while 64% did not even have one (either totally non-existent or still under development).

Covid-19 is not the first epidemic to disrupt supply chains (SARS, avian flu etc.) but it is the only one to have done so globally (Iakovou & White). And it will also have long-term consequences on their structures and way of functioning. The pandemic has highlighted their structural problems and fragility, and above all their need to be rethought (Accenture, 2020). China's dependence on the manufacture of essential goods such as medical goods has proven to be dangerous. Sudden customer demand for some goods (medical, groceries etc.) and falling demand for others (non-essential goods) has shown the inability of supply chains to rapidly change production to meet this demand. Now more than ever, companies must redesign their supply chains around a key word: resilience (Iakovou & White).

“Slowbalisation” and international trade

The term “Slowbalisation” was first used in 2015 by the Dutch trend-watcher Adjiedj Bakas, to describe the recent reshape of globalisation. Indeed, between 2008 and 2017, the trade openness (ratio of world exports/imports to world GDP) dropped from 61% to 53% (Appendix 11). In the same period, the FDI decreased of 2% and in 2018, 50% of FDI flowing in Asia came from other Asiatic countries as well as 60% of FDI in Europe came from the region (Kandil, Battaïa & Hammami, 2020).

This "slowbalisation" has its origins in the financial crisis of 2008, which saw the volume of international trade and cross-border investment fall. Supply chains and the interconnectedness of the world have shown that they are exposed and fragile to disruptions such as exchange rate fluctuations, natural disasters or trade tensions (European Parliament, 2020). The rise of the Chinese middle class and its growing consumption has meant that China has begun to turn to its domestic market, halting its growth in the global share of exports in 2015, and increasing its share of imports (The Economist, 2020). Manufacturing has become increasingly automated, making the main reason for cost savings less relevant. In addition, events such as the Japanese tsunami in 2011 cut US Toyota production by a third, underlining the risky nature of long supply chains. Trade slowly began to shift to more regional blocs. The rise of populism and nationalism in several countries, symbolised by the election of Donald Trump in 2016 and the Brexit, has shown companies that they are also exposed to the political risk from protectionism, as shown by the example of the trade war between China and the US. Finally, the Covid-19 pandemic made companies realise their dependence on China, and the fragility of their long, hyper-connected supply chains. In addition, driven increasingly by a growing public awareness, they are now also concerned about their standard labour conditions and their ecological footprint (The Economist, 2020). “Slowbalisation” can be understood as the consequence of *macro* and *policy* risks that have materialized and disrupted international trade.

Today, most companies and governments are concerned that supply chains have been pushed too far (Irwin, 2020). In a more disruptive world, where international cooperation is lacking and alliances unstable, it is time to rethink supply chains for tomorrow's world.

Supply chain resilience in a post-covid and “slowbalised” world

Supply chain resilience is defined by “the ability of a given supply chain to prepare for and adapt to unexpected events; to quickly adjust to sudden disruptive changes that negatively affect supply chain performance; to continue functioning during a disruption; and to recover quickly to its pre-disruption state or a more desirable state” (Iakovou & White; Brookings, 2020).

It is well known that managing supply chain risk is crucial for the competitiveness of companies, and the growing number of research and tools developed in this sector for companies proves it, as for example the well-known model of Manuj & Mentzer (2008) presented in the literature review. However, these tools have not been adopted by a large majority of companies. The companies' focus on cost reduction and asset efficiency has led to fragile, lean and offshore supply chains. In the short term, a resilient supply chain may be more costly but will provide a competitive advantage in the long term (Iakovou & White, 2020).

To be resilient, a supply chain must be fast in detecting, responding to, and recovering from unforeseen events. It must also be end-to-end, data-driven and controlled: it must allow for broad visibility and transparency throughout the chain, from "suppliers to suppliers" to "customers to customers". It must also have emergency or security stocks, and a diverse supplier base, whether offshored, nearshored or reshored. The latter must be able to continue to supply or provide increased production in the event of supply problems (Iakovou & White, 2020). To provide supply chains with such attributes, here are three of the key points (Appendix 12).

Firstly, the structure of supply chains must change. The trend that had already begun to emerge in the last decade after the events described above and that will become even more pronounced

in the post-pandemic world is reshoring or nearshoring in certain industries, mainly in those most likely to be disrupted, or those of strategic importance at the national level. In addition, companies will need to increase the diversity of their suppliers so that the failure of one supplier does not block the rest of the chain (ILO, 2020). As the business environment and the various costs have changed significantly in recent years, particularly labour and energy costs, supply chains have been encouraged to change their configuration to adapt to this new environment and reduce their exposure.

Some production has moved to other countries, mainly in South-East Asia, Mexico or Eastern Europe, but the large share of China in world trade means that there is no simple substitute and excludes for the moment a total abandonment of the country, tending towards "China +1" strategies, i.e., that part of certain production would remain in the country. Moreover, these potential new countries of production still need to invest in their manufacturing capacity to be able to accommodate the companies (World Economic Forum, 2020). This trend of nearshoring will increase the regionalisation of trade, which will further accelerate the already existing growth of trade between countries in the same geographical area (McKinsey, 2020). It is therefore likely in the future to see the emergence of different blocs led, for example, by the USA, the EU and China. Countries such as Japan, India or Brazil would trade with these blocs less formally (Veltheim, 2020).

For developing countries, this reshoring/nearshoring represents a development challenge. Some of them might not benefit from the economic spin-offs of industrialisation through GSCs, as China largely did in the past. They might also not benefit from the latest technological trends such as artificial intelligence and automation, and therefore become "left behind" in this new environment (ILO, 2020). On the side of developed countries, the production that will come back will not mean as many new jobs as before the relocation, as the new factories will be virtually automated (Neuvonen, 2020).

Secondly, the resilience of supply chains will require better management of inventories and production capacity. Until now, most companies have been in the habit of keeping inventories low to save costs. Resilience will therefore be strengthened by increasing inventories of raw materials, work-in-progress and finished goods, to build up safety stocks or emergency stockpiles. An increased production capacity to be able to respond to a surge in demand and limit the impacts of possible future disruptions will also enable companies to achieve resilience. This strategy can be costly but can turn into a crucial competitive advantage in the event of disruption. This cost will also depend on the risks identified by the company and its risk aversion (Iakovou & White, 2020).

Finally, new technologies offer enormous potential for supply chains to gain greater visibility throughout the chain and achieve business resilience against disruption through digitalisation (Deloitte, 2020). Technologies such as Internet of Things (IoT), 5G, robotics, cloud-based Artificial Intelligence (AI) or 3D printing will, for example, provide real-time data that can be used to decide on the transshipment of raw materials, work-in-progress or finished products to ensure stock balance. Furthermore, it can distribute relocatable production (Iakovou & White, 2020). Anne Petterd, Communications and Commercial Partner, Baker McKenzie explains that digitalisation also favours the relationship with suppliers, from their selection to the management of this relationship, by facilitating communication, coordination and giving visibility on their financial situation avoiding the risk of insolvency. Also, digitalisation thanks to new technologies makes it easier to identify potential risks and measure their impact, to be able to respond to them in the best possible way. In addition, these advances in new technologies and artificial intelligence may present many future opportunities, especially in terms of sustainability, which is becoming increasingly important for consumers. Thanks to them, companies will be able to integrate into their supply chains elements and good practices in terms of respect for labour rights, production sustainability, business ethics, environmental protection

etc. (World Economic Forum, 2020). From a risk management point of view, the aim is to set up a supply chain that not only seeks to reduce risks, but also, and above all, that can adapt to them and recover quickly (Deloitte, 2020).

The result of these implementations will be to combine the advantages of a diversified and decentralised supply chain (e.g., having a production capacity or inventories close to the final consumers for the sake of speed) with those of a more centralised supply chain (economies of scale, reduced capital expenditures etc.). A supply chain which is data-driven, resilient and agile will be able to detect, adapt and recover from disruption by adjusting production capacity if needed, contrasting with most of current supply chains which minimize costs but may be unable to navigate through unexpected changes. Depending on the need, these future supply chains will be depending on the situation, either agile or lean (Iakovou & White, 2020).

5. Conclusion

The purpose of this paper is to explore how to manage risks in global supply chains given recent geopolitical disruptions, through the example of the smartphone industry. After briefly describing the smartphone industry and the short-term impacts of the US-China trade war and the Covid-19 pandemic on it, the paper relies mainly on a GSC risk management model that is the reference in the field to describe the "traditional" way of managing these risks. Then, thanks to studies conducted by consulting firms, recognised journals and specialised blogs, the paper analyses the possible long-term effects of these two events on globalisation trends and how these will influence the structure of future supply chains. In addition to basing themselves on more traditional risk management models as described above, companies will have to go further and put supply chains at the centre of their attention, based on three main points: their structure

through reshoring or nearshoring, a better management of inventories and production capacity, and above all their digitalisation.

On the other hand, this study has some limitations. Because of the recency of the events and trends mentioned, there is no hindsight on their long-term effects, and almost no academic research on the subject now, especially in the smartphone industry, which may leave doubts about the effectiveness of the proposed measures. Moreover, for the same reason, these measures are addressed to GSCs in general, and not specifically applied to the smartphone industry (even if they are mostly transposable to this sector).

This therefore leaves room for future research, both on the efficiency and long-term feasibility of these future supply chains, and on the future of the smartphone industry in the post-pandemic world.

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7. Appendixes

Appendix 1:

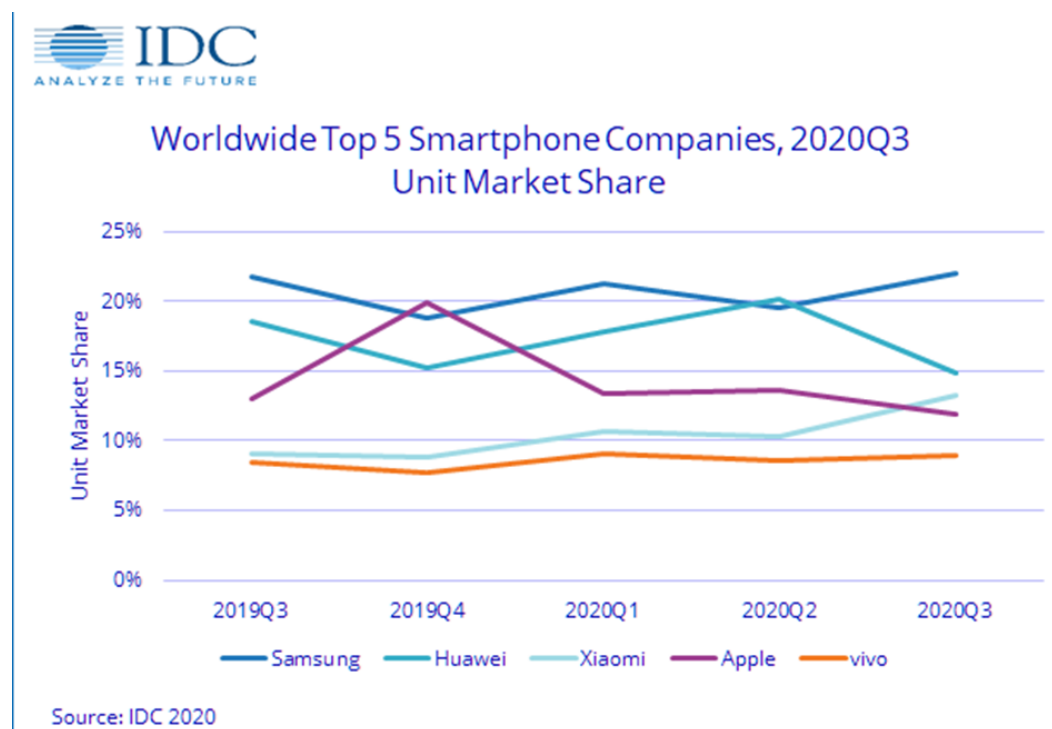
Worldwide smartphone shipments and annual growth
Canalys Smartphone Market Pulse: 2019

Vendor	2019 shipments (million)	2019 market share	2018 shipments (million)	2018 market share	Annual growth
Samsung	298.1	21.8%	293.3	21.1%	+2%
Huawei	240.6	17.6%	206.0	14.8%	+17%
Apple	198.1	14.5%	212.2	15.3%	-7%
Xiaomi	125.5	9.2%	120.6	8.7%	+4%
Oppo	120.2	8.8%	116.0	8.3%	+4%
Others	384.3	28.1%	441.4	31.8%	-13%
Total	1,366.7	100.0%	1,389.4	100.0%	-2%



Note: percentages may not add up to 100% due to rounding
Source: Canalys Smartphone Analysis (sell-in shipments), January 2020

Appendix 2:



Appendix 3:

Top 5 Smartphone Companies, Worldwide Shipments, Market Share, and Year-Over-Year Growth, Q3 2020
(shipments in millions of units)

Company	3Q20 Shipment Volumes	3Q20 Market Share	3Q19 Shipment Volumes	3Q19 Market Share	Year-Over-Year Change
Samsung	80.4	22.7%	78.2	21.8%	2.9%
Huawei	51.9	14.7%	66.6	18.6%	-22.0%
Xiaomi	46.5	13.1%	32.7	9.1%	42.0%
Apple	41.6	11.8%	46.6	13.0%	-10.6%
vivo	31.5	8.9%	30.2	8.4%	4.2%
Others	101.7	28.8%	104.2	29.1%	-2.4%
Total	353.6	100.0%	358.5	100.0%	-1.3%

Source: IDC Quarterly Mobile Phone Tracker, Oct 29th, 2020

Appendix 4:

Table 1. Worldwide Smartphone Sales to End Users by Vendor in 1Q20 (Thousands of Units)

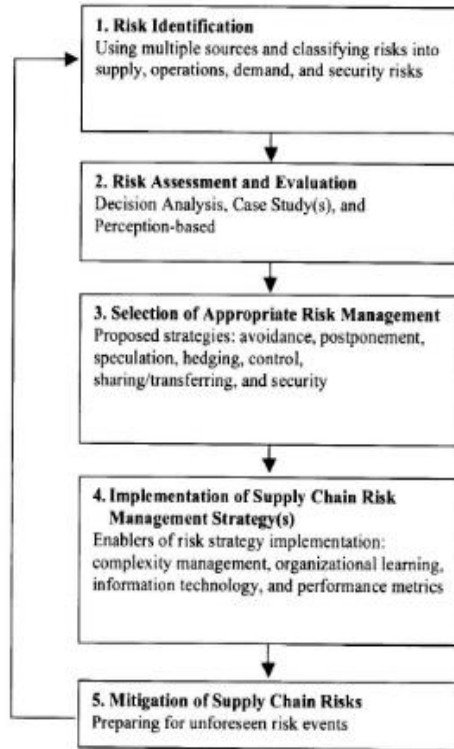
Vendor	1Q20 Units	1Q20 Market Share (%)	1Q19 Units	1Q19 Market Share (%)	1Q20-1Q19 Market Growth (%)
Samsung	55,333	18.5	71,621	19.1	-22.7
Huawei	42,499	14.2	58,436	15.6	-27.3
Apple	40,920	13.7	44,569	11.9	-8.2
Xiaomi	27,817	9.3	27,424	7.3	1.4
OPPO	23,949	8.0	29,589	7.9	-19.1
Others	108,621	36.3	143,279	38.2	-24.2
Total	299,138	100.0	374,917	100.0	-20.2

Due to rounding, some figures may not add up precisely to the totals shown.

Source: Gartner (June 2020)

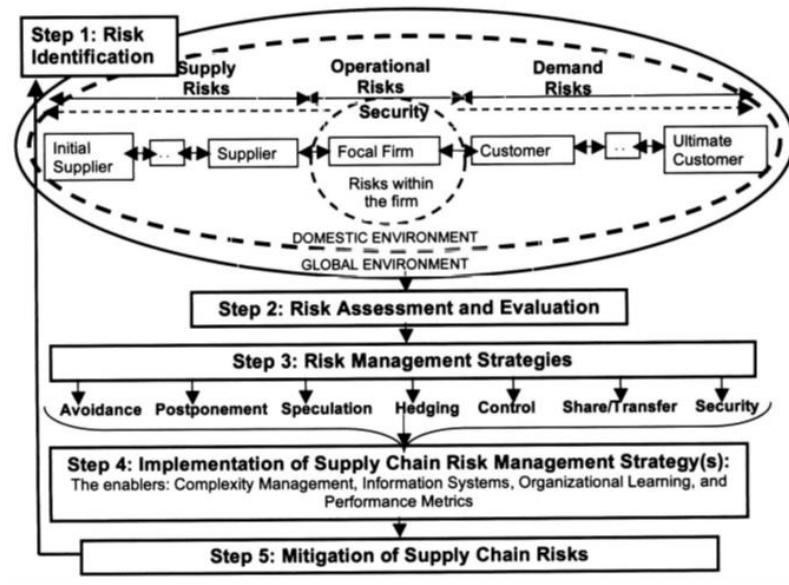
Appendix 5:

A FIVE-STEP PROCESS FOR GLOBAL SUPPLY CHAIN RISK MANAGEMENT AND MITIGATION



Appendix 6:

GLOBAL SUPPLY CHAIN RISK MANAGEMENT AND MITIGATION FRAMEWORK



Appendix 7:

SUMMARY OF RISKS

Type of risk	Source
Supply Risks	Disruption of supply, inventory, schedules, and technology access; price escalation; quality issues; technology uncertainty; product complexity; frequency of material design changes
Operational Risks	Breakdown of operations; inadequate manufacturing or processing capability; high levels of process variations; changes in technology; changes in operating exposure
Demand Risks	New product introductions; variations in demand (fads, seasonality, and new product introductions by competitors); chaos in the system (the Bullwhip Effect on demand distortion and amplification)
Security Risks	Information systems security; infrastructure security; freight breaches from terrorism, vandalism, crime, and sabotage
Macro Risks	Economic shifts in wage rates, interest rates, exchange rates, and prices
Policy Risks	Actions of national governments like quota restrictions or sanctions
Competitive Risks	Lack of history about competitor activities and moves
Resource Risks	Unanticipated resource requirements

Appendix 8:

RISK IN THE EXTENDED SUPPLY CHAIN



Adapted from Mentzer (2001)

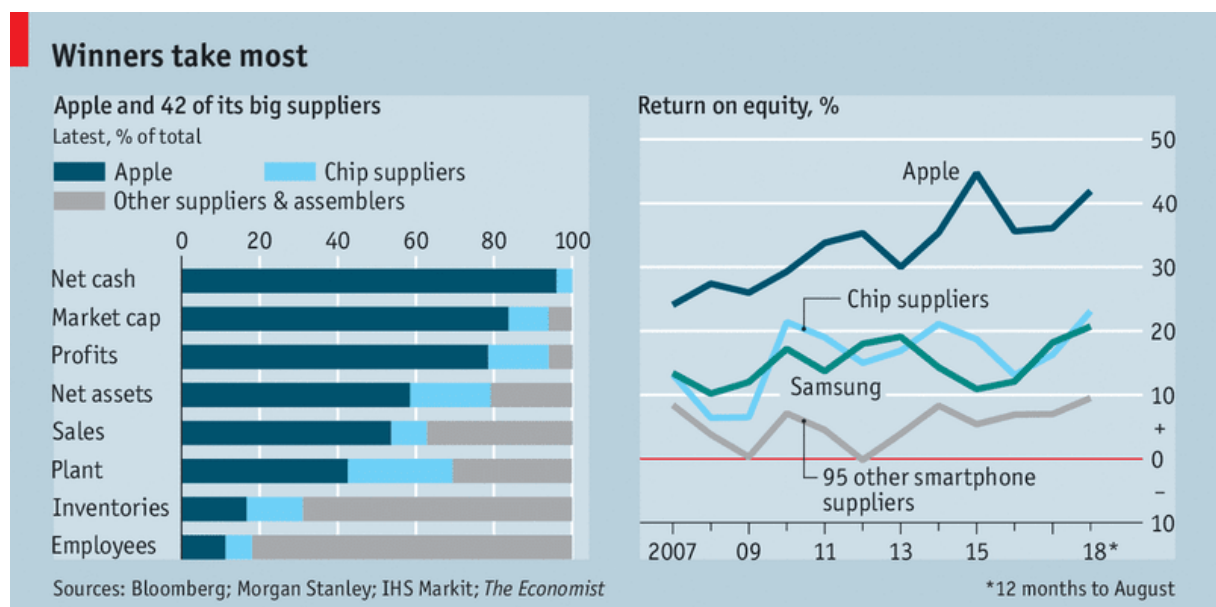
Appendix 9:

RISK ASSESSMENT AND EVALUATION

List of Risks	Potential losses		Probability		Impact/Consequences		Worst possible scenario	Is the worst possible scenario acceptable	Other considerations/factors esp. competitors' exposure to similar risks	Final evaluation of risk ^c
	Quant (\$)	Qual	Quant (p) ^a	Qual ^b	Quant	Qual				
<i>Example of Supply Risks: Reliability of suppliers</i>								Yes / No		
Disruption of supply	\$10,000/per day		0.25		\$2,500 per day		Loss of 10% customers if supply disruption lasts over 3 weeks	No	Many competitors with no quality differences who can supply to our customers	Serious
Macro										
Policy										
Competitive										
Resource										

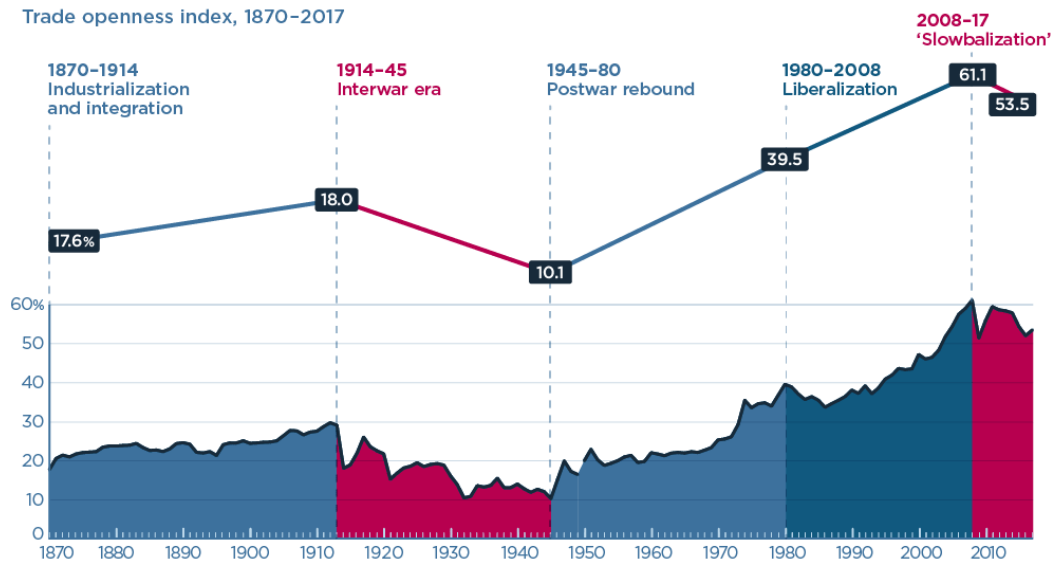
^a 0 ≤ p ≤ 1 (0 means no risk at all and 1 means a definite event)
^b Qualitative probability: very unlikely, improbable, probable, and very probable
^c Final evaluation of risk: Insignificant, Minor, Serious, and Catastrophic
 Note: All numbers are examples only.

Appendix 10:



The Economist

Appendix 11:



Note: The trade openness index is defined as the sum of world exports and imports divided by world GDP. 1870 to 1949 data are from Klasing and Milionis (2014); 1950 to 2017 data are from Penn World Tables (9.0).

Source: Our World in Data, <https://ourworldindata.org/grapher/globalization-over-5-centuries>.

Appendix 12:

FROM PRE-COVID-19 CRISIS SUPPLY CHAINS	...TO A MORE RESILIENT PLANNING
Geographically long supply chains	Reshoring/Diversified supply chains
Largely Brick and mortar business (less online)	Retooling to online
Manual processes	Automated processes
Traditional logistics	Green logistics/Climate-friendly supply chain
Traditional linear supply chains	Circular supply chains
Less use of technology	Increased use of IoT, artificial intelligence, AR VR, robotics to enhance visibility and operations