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The decision-making process behind nearshoring to efficiently cope with supply chain disruptions: a company case in the Netherlands

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The hardest hurdles demand the hardest efforts, and this year has been exactly this case, both physically and mentally. However, from the hardest hurdles, the greatest satisfactions can arise bearing the best fulfilling feeling I can possibly sense and whom no final grade can affect.

This because I finally concluded one of the phases of my life, begun from a little village of 5000 inhabitants and ended onto a country 1500km far away. Succeeding in this pathway was only made possible by my family, who economically granted me this majestic opportunity of study and supported me mentally throughout this journey, hoping that this conclusion would at least give them back a crumb of what they provided me with.

Besides, I would also like to thank my girlfriend, Agnese. Embarking on this international experience was not initially an easy choice for both of us and most of the people into a relationship would have decided either breaking up or staying into the same previous static situation. What we realized over the last years was that dynamicity and change could never impair our relationship, already a distance relationship, provided that there is a certain level of complicity in every step one decides to take. Initially you, Agni, were the one among us more insecure about this unusual decision of mine, but we together accrued overtime how much this step would have been fruitful for our relationship, which apparently seems to have to be eventful so far. I promise to you that very soon this "turbulence" will be finally over and we can stay together with the serenity we deserve.

Moreover, I would like to thank my friends from Stroncone, Terni and Rome that always stayed by my side, regardless of the distance. Last but not least, a noteworthy mention goes to my university supervisor and company supervisor that gave me the unique opportunity to truly live the reality of a supply chain of a company operating on a global scale, being at the same time fully available to support and help me during this internship period (along with all the colleagues I had the chance to meet).

Sincerely,

Tommaso Andrielli

ABSTRACT

PURPOSE: The world is increasingly facing new disruptions that alter and transform the supply chain of companies operating on a global scale. Getting more and more urgent is a decision between staying offshored or getting closer to the country of origin, thus nearshoring. Based on the reap literature on why embarking on nearshoring, this study has its roots on the advantages on this complex process to analyse the decision making to process to possibly carry out before effectively implementing this decision. The literature is indeed in search of empirical support for advancing the theory of decision making underlying nearshoring.

DESIGN/METHODOLOGY/APPROACH: This is effectuated within a company case through a triangulation of different methods to take into account the numerous factors implied into this complex decision, both qualitative and quantitative attributes: a TCO analysis and a questionnaire have been leveraged, alongside with some relevant computations regarding EOQs. So this methodology contributed to create a scenario analysis in which the Chinese suppliers' efficiency is compared with plausible solution into other countries, mainly European such as Germany, Poland and Czech Republic. This study features an abductive approach, both providing suggestions for the company from the theory while adjourning the latter, which is extremely scant due to the novelty of the topic.

FINDINGS: Results shows how transportation prices are decreasingly impactful on overall costs, in contrast with the current literature and how labour costs can play a role into the final benefits of nearshoring, also providing results in terms of specific country to which nearshoring can be advantageous. Despite a company case, it can be generalised to other situations thanks to its reusable methodology, highlighting different but interesting patterns and results in other industries or contexts.

PRACTICAL IMPLICATIONS: This study provides empirical suggestions to the company to specifically address nearshoring decision per each product category analysed. Thanks to the triangulation of methods utilised, the solution can be highly addressed to the reality, or at least exploited for any similar analysis carried out by the company in the future.

ORIGINALITY: Being an abductive work, it bears useful and insightful results for the company even though some general but agreed assumptions were to be made. Further, this work still brings novel elements to add to the scarcity of theory of decision making process of nearshoring.

KEYWORDS: Nearshoring, Supply Chain resilience, Total Cost of ownership, EOQ, MOQ, offshoring, disruptions

Contents

Chapter 1: INTRODUCTION

1.1 Research background

Identifying the appropriate locations for manufacturing has always been a fertile field to study for addressing correct and punctual decisions inside companies. As a matter of fact, manufacturing capability should be deemed as a core capability, enabling firms to be responsive to market changes and strengthen competitiveness in the market (Theyel et al. ,2018). Since the 1990s developing countries such as Asia, Eastern Europe and South America have been targeted by companies as favorable sites where to locate manufacturing facilities, thus putting into place a process labeled as offshoring (Moussiegt, 2016). The main reason is the low-cost advantages of input, as for instance labor, knowledge and materials (Johnson, 2012)

But it needs to be highlighted that in the last decades a reverse trend has been occurring: a change in manufacturing location which leads many companies to locate back to developing countries (Ketokivi et al. 2017). The main reasons lie into issues such as transportation costs, market proximity and increasing labor costs in developing countries (Foerstl et al., 2016, Fratocchi et al. 2016). Relocation of activities has been labeled in the literature in a manifold of ways: back shoring, reshoring or nearshoring. These are different in meaning as reshoring is deemed to mean to bring manufacturing back to the country of origin (Gray et al., 2013); back shoring means "re-concentration of parts of production from own foreign locations as well as from foreign suppliers to the domestic production site of the company" (Kinkel et Maloca, 2009); whereas nearshoring does not necessarily constitute a locating decision back to the original site, but rather on nearby locations. However nowadays, all of them are also driven by the recent global supply chain disruption of Covid-19 pandemic which had severe consequences on companies located in China, forcing a profound rethink about locating decisions (Chen et al., 2022). In general, a supply chain disruption is intended to be a combination of unintended and unanticipated triggering event that occurs in the supply chain and the consequent scenario that poses severe threat to the normal course of business operations (Bode and Wagner, 2015).

Therefore, what is becoming increasingly crucial is the concept of supply chain resilience. This is regarded as the ability to successfully recover from a disruptive event which would throws the firm away from its normal operational path (Novak et al., 2021). As stated by Shen and Sun (2021), resilience is a fundamental factor that companies need to put into practice to thwart every sort of disruptions. In detail, disruptions are often exemplified by the notion of grey swans, namely the events with low probability bearing high impact on organizations, diverging from the black swans, unforeseeable and unique events "occurring once every 100 years" (Akkermans et al., 2017). Covid 19 Pandemic falls within the grey swans' category as it occurs with a recurrency of five or ten years, similarly to natural disasters and manmade accidents (Shen and Sun, 2021), and needs to be tackled through a strong supply chain resilience (*Coronavirus Is Proving We Need More Resilient Supply Chains*, 2022).

Based on the literature, reshoring or nearshoring decisions are beneficial for improving the resilience of the supply chain of companies in certain situations, thus constituting a link between these two factors (Giuseppina & Michele, 2018; Miroudot, 2020). Indeed nearshoring decisions represent an effective strategy to cope with supply chain disruptions, especially when these concern the entire globe.

1.2 Problem indication

Company x is a Dutch company active in metalworking and woodworking field for the last 50 years. It offers a wide variety of products ranging from the machinery for industrial usage to the accessories for a daily and handy usage. This company serves its products through delivery services thanks to the recent growth in the E-Commerce market, and through its owned shop located in the Netherlands. Recently they have overcome national borders, succeeding in delivering products in France, Belgium and Germany. As previously mentioned, this company is sourcing large part of its products in Asia and is wishing to locate its manufacturing in a different place which might suits its situation.

Company x collaborates with Asian suppliers mostly through private labels' agreement. This means that products are, in most of the cases, made by an external manufacturer (manufactured and assembled), but branded with the name of the company issuing the order. This represents a financial burden for the company that has to sustain the whole production batch, enclosing set-up cost and start cost; but on the other hand, the marketing and sales price can be directly handled by the company. This strategy is coupled with a Make to Order strategy in which an order is placed on the basis of the forecasts made by the company and then the production line is started by the supplier. Conversely to a make to stock strategy, the order is placed by the customer (Company x) and then forwarded to the manufacturer that start to produce the requested quantities as soon as the order is received: it will eventually entail more lead time before the order is ready compared to a MTS strategy in which the quantities produced are stocked by manufacturer beforehand. Overall MTO strategy and private labels agreement contribute to having production lead time much larger than the transport time in some cases (as for instance in large wood and metal working machinery). Of course, learning capability is lower with higher lead time, because there would be more open orders while the market is still changing with respect to the initial situation. So responsiveness to demand would be impaired. This is what basically occurred during the recent pandemic period of 2021.

Indeed, Company x has suffered from the differing customer demand in the past years because of Covid 19 pandemic, reflexed into unstable sales patterns. For instance in 2020 demand for tools skyrocketed because people had to stay at home and were likely to renovate their houses, mostly requesting hand tools and power tools. The trend moved into the opposite direction from the 2022 onwards, as people would rather spend their money on other activities than hand working such as holidays or spare time activities. The problem was that from company' side, forecasts in 2022 were still based on the past year hence contributing to increase stock for wrong products. Indeed company x has now a problem with stocks of products: those products that could

make significant revenue in normal times has not been in stock in the recent years due to demand disruptions and vice versa for the wrong products.

Below the chart of the overall availability of products since 2021 is shown (chart 1). The concept of availability is relevant here as it regards the percentage of days on a yearly basis in which a product has been in stock ready to be sold. As depicted, the availability value has always been under the target value of 90%, standing at around 80% during the 2021 and 2022; a gap of 10% from the target value might seem negligible at a first glance but it actually represents a gap of almost 40 days of stock in a year. Data from the mid of 2021 (older data was not available on the company software) to December of 2022 is hereby displayed.

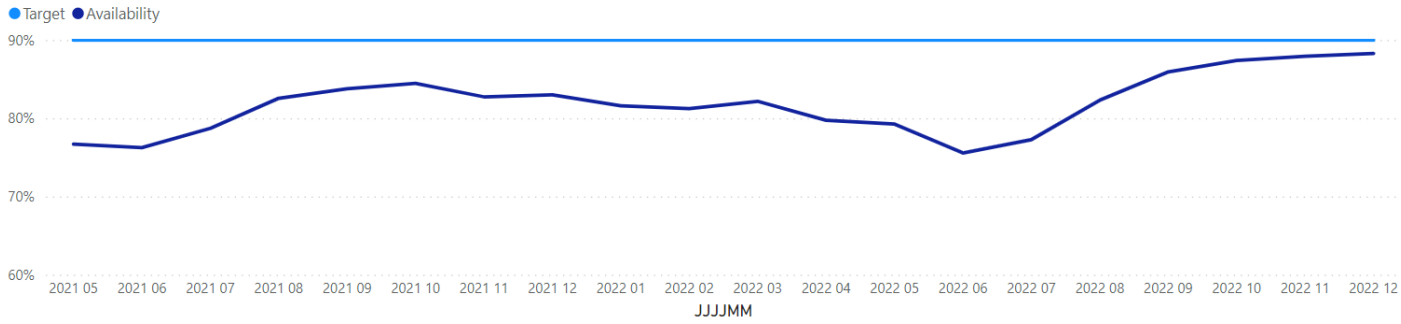

Chart 1

A deeper specification is necessary regarding those products demanded during the pandemic period useful for house maintenance and renovation, namely hand tools and power tools' categories. The former comprises tools such as screwdrivers, pliers and wrenches (chart 2) while some power tools' example of items are polishers and pneumatic hammers (chart 3). As you can see in the two tables below, from August 2022 onwards, the availability of these tools increased following the forecasts based on the previous years' demand patters but in reality in the moment they were delivered to the company, these tools were not requested anymore from customers as daily habits returned back to normality. The fact that availability skyrocketed from the mid of 2022 is a clue of the long lead times and misaligned forecasts after the disruptive Covid 19 period.

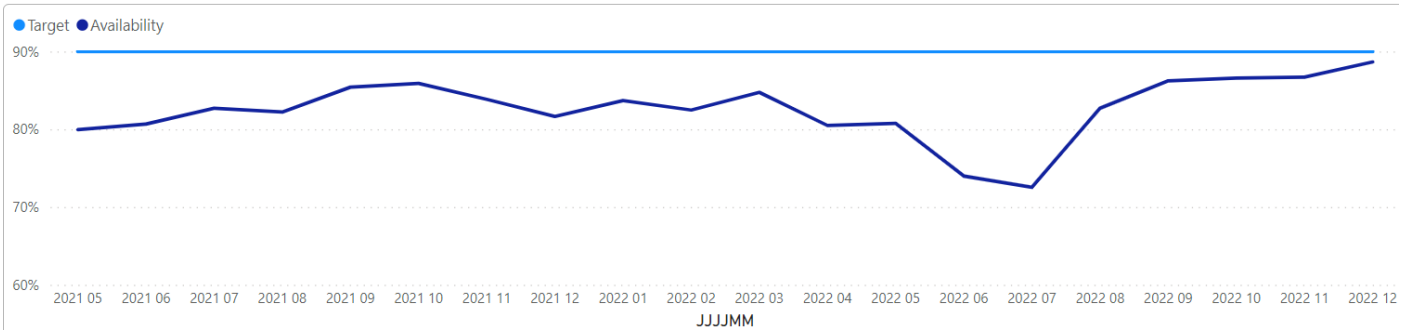

Chart 2

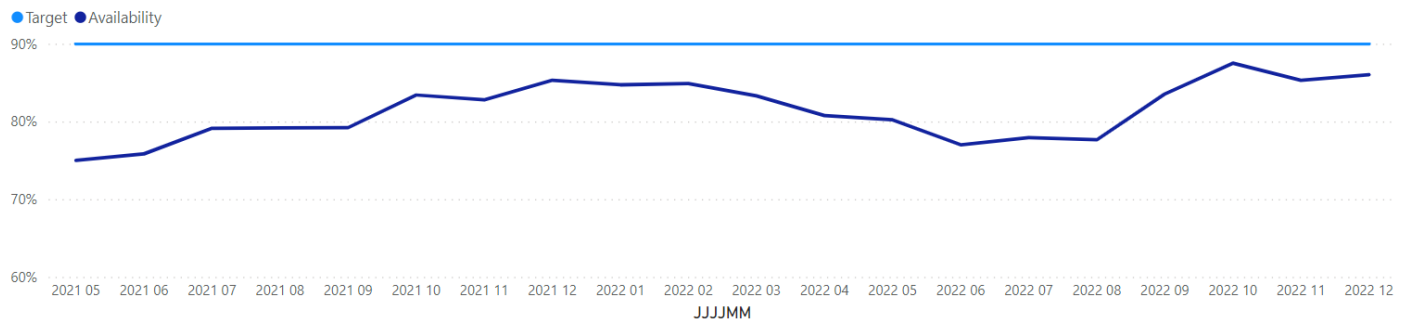

Chart 3

This situation lead to a current problem: now that the world has come back to their usual demand pattern, there are not enough stocks for the most profitable products because of the large lead times characterizing the Asian suppliers. The category of workshop tools, which includes work benches, storage systems and compressors, has been characterized by an average availability of 76% in the last year as shown in the chart 4. “A” category products are the most profitable products in the whole assortment of company x. Each product is indeed labelled with a double digit letter respectively related to turnover and sales. More information can be retrieved into the Appendix A.

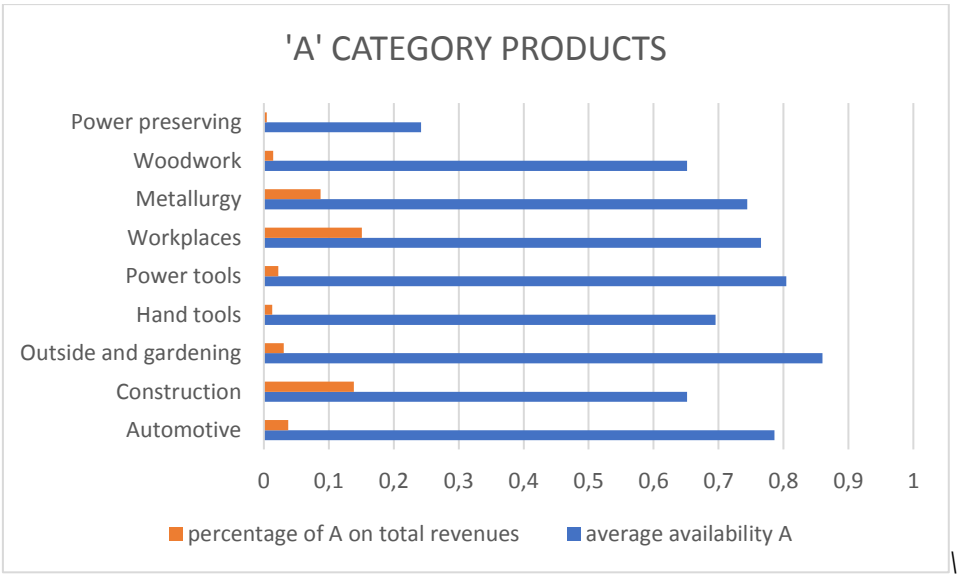

Chart 4

Getting nearer to Europe with some categories can improve the situation, taking into account also the current ordering policy of the organization. Indeed only small orders can be issued at the present in order to not make stocks costs weight on the overall finance of the company. So, still, the company cannot adopt a risk prone strategy on orders, missing the opportunity to leverage the possible potential of the best products. Therefore

having closer suppliers could be helpful as more orders can be issued more often with less risks of stock outs and high keeping costs for products.

The stock problem is exacerbated by long lead times of around an half year time as shown in Chart 5 where lead times across the different products' categories are displayed. These long lead times are due to the aforementioned long production time of some products that requires more than 100 days before being sent to the Netherlands. However this also depends on the dimension of the items requested and also on the fact that many products with largely different production time are sourced from the same suppliers, posing the problem of either ordering them together for the same ETD date (day in which products depart from suppliers for transportation) or in different ETD date. This can thus extend the total lead time, generating delays in transportation and production. A diversification of supplier towards closer countries therefore represents a plausible solution.

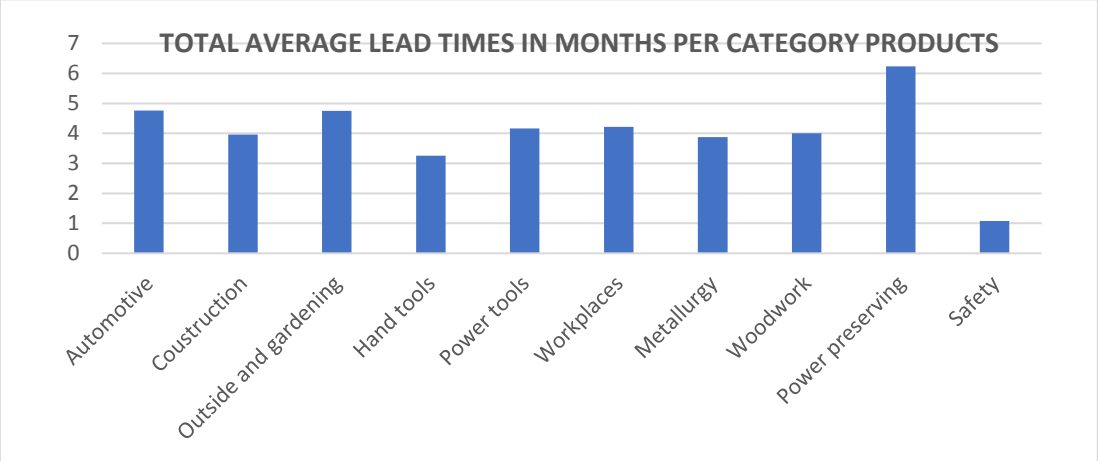

Chart 5

Besides transparency is concerned. Indeed one additional motive underlying the nearshoring intention of company x is to get closer to the suppliers, in order to better know the processes and the real identity of them: as a matter of fact, in their words, "some of the suppliers have never been seen". The great distance from the suppliers makes difficult to directly check on the transparency and compliance towards company x' requirements, also due to different legislation existing across the European and Asian continents. Of course, having suppliers nearer would ease any walk-in process to check on quality and compliance.

Lastly, as the company is growing into an international scope (striving to expand their market into other countries in Europe) , they want to ensure that their suppliers are ready to scale up or down (like during Covid 19) swiftly and neatly. So resilience to future grey swans is concerned as well to prevent the current situation to occur again.

1.3 Problem statement and conceptual model

Company x wants his supplier to be closer to the country of origin, but does not know where to move precisely, Middle and Eastern Europe are plausible ones. In this way they can better tackle grey swans which profoundly impacted demand patterns, wrongly affecting forecasts. Now that the world has shifted back to normality once again, there are stockouts for good products and high stock costs for products that are not requested anymore. At the same time, provided that only small orders can be issued, more frequent orders might be beneficial for the company in order to be responsive to future demand patterns. Hence nearshoring is deemed to be a proper solution mainly due to lower lead times, as well as benefits in terms of compliance and transparency problems with farther suppliers.

1.4 Research questions

Theoretical research questions:

RQ1: What are the advantages of nearshoring?

RQ2: What is the decision-making process behind a nearshoring process?

Empirical research questions:

RQ3: What are the decision factors that Company x should take into consideration for nearshoring?

RQ4: Where and for which category it's better to locate its production, if there are any opportunities?

Chapter 2: LITERATURE REVIEW

In this chapter the concept of nearshoring is going to be deeply analysed, making reference to the current state of the literature. The decision making process will be deeply explicated. Moreover, an explication of supply chain resilience will be carried out, making connection to the aforementioned concept. In this way the two theoretical questions will be answered.

2.1 Nearshoring

Considering that a main variable of this thesis work is nearshoring process, we cannot gloss over some strictly related notions such as reshoring and offshoring. These stand indeed at the opposite sides of a locating decision involving both the geographic feature and the corporate control over the activities that undergo this type of process (Pietrobelli et al. 2023). The table below shows this comparison among the three different location decisions.

	INSHORE	**NEARSHORE**	**OFFSHORE**
INSOURCE	*Domestic divisions*	*Foreign direct investment in a nearby country*	*Foreign direct investment in a farther country*
PARTNERSHIP	*Domestic partnership*	*Regional partnership*	*Foreign partnership*
OUTSOURCE	*Source from suppliers of abroad countries*	*Source from foreign supplier situated in a nearby country*	*Source from supplier usually situated in another continent*

Table 6: own composition drawing from Pietrobelli et al. (2023)

The horizontal axis represents the geographic feature, whereas the vertical axis represents the differing decisions that can be adopted on the basis of the boundary of the company (the well-known "make or buy decision"). In the company case, manufacturing and assembling activities are outsourced and mostly offshored in the Asian countries. As denoted by Piatanesi and Arauzo-Carod (2019), nearshoring is chosen when a firm is not willing to inshore or to stay offshored, trying to attain a certain balance between low costs and competitiveness inside the market. Indeed nearshoring is situated at the halfway of the offshoring and inshoring as it represents repatriating certain capabilities and part of the value chain from a foreign country to a location closer to the country of origin (Fratocchi et al. 2014; Ellram et al. 2013; Bals et al. 2016). This is the definition taken for granted in this thesis work. Nonetheless, nearshoring could imply as well an expansion abroad, but limited to a geographically closer country, but this is not the case of this thesis project work (Ellram et l 2013; Fratocchi et al. 2014). .

2.2 Drivers of nearshoring

The body of literature on nearshoring have been increasingly growing in to the last decades, thanks especially to the support from many academic researchers (Stentoft et al, 2016; van Hassel et al. 2022; Zhai et al. 2014; Barbieri et al. 2014; Barbieri et al. 2019) , but also articles from consulting companies such as Mckinsey and Deloitte are significant in this field ("Next-shoring: a CEO's guide", 2014b; Burke et al.2023). To better underscore the drivers, I think it is appropriate to classify the motivations based on three different characteristics, as also suggested by Barbieri et al. (2017) and Bals et al. (2016), but it is fundamental to remind that these can be intermingling together:

- Internal strategic motivation;
- External strategic motivation;
- Managerial mistakes

These drivers are similar to those attained in a reshoring process. Indeed in the literature in some cases, reshoring is deemed to be a process aimed to augment geographical proximity of certain activities, thus enclosing also the nearshoring. This is the main reason for adding literature related to reshoring as well in the next table. Besides, reshoring's literature is partially less scant than nearshoring's.

General motivations	*specific drivers*	*related Main References*
Internal strategic motivations	Cost (logistic, wages, coordination and quality compliance)	Fel & Griette, (2017); van Hoek & Dobrzykowski, (2021); Boffelli et al.(2020); Bolter & Robey, (2020); van Hassel et al. (2022); Piatanesi & Arauzo Carod(2019)
	Product (quality issues, competences like Made-in effect, strategy shift, technology exploitation)	McIvor & Bals,(2021); Bolter & Robey, 2020; Srai & Ané (2016); Gadde et al. (2019)
	Operations (shorter lead time, better responsiveness to market, supply chain fluidity, sustainability and circular economy)	Louis Paoul Tardif (2023b); Orzes & Sarkis, (2019); Fratocchi & Di Stefano (2019); Delis et al. (2019); Grappi et al. (2019); Nandi et al. (2020); van Hassel et al. (2022)
External strategic motivations	Institutions (political stability, corruption, taxation, availability of infrastructures, skilled workforce and natural resources)	Ellram (2013); Srai & Ané (2016); Wan et al. (2019); Feinberg and Gupta, (2009)
	Disruptions (Natural disaster, pandemics, war)	Akkermans et al. (2017); Shekarian & Parast (2021) ; Asafo-adjei et al. (2023); Wong et al. (2020)
Managerial mistakes	Lack of capabilities	McIvor & Bals, (2021); Fel & Griette (2017b); Fratocchi et al. (2016)
	Bandwagon effect	McIvor & Bals, (2021); Fel & Griette (2017b); Di Mauro et al. (2017)
	Bounded rationality (utilization of prior experience, tacitness of required knowledge)	McIvor & Bals, (2021); Foerstl et al. (2015); Di Mauro et al. (2017)

Table 7: own composition

2.2.1 The internal and external strategic motivations

Barbieri et al (2018) embodied the internal and external drivers together since often influencing reciprocally each other: an internal strategic need can draw on external reasons indeed, remarking the complexity of decision making for a relocation decision given its intrinsic heterogeneity.

The main element included into internal strategic drivers are costs. Costs are often deemed as an advantage for those companies that executed an offshoring process and when it commences to be eroded a relocation can be a plausible solution. Often reconnected to external motivations as well, importance of labour costs and logistic costs has been greatly discussed (Piatanesi & Arauzo Carod, 2019; Fel & Griette, 2017; van Hoek & Dobrzykowski, 2021). Despite the inverse relationship between labour cost and skilled costs, the former can become unstable throughout time (also for external reasons such as disruptions or inflation), thus looking for relocating into closer countries can turn out to be more advantageous and economic. Quality control and coordination costs are equally a fundamental factor to cope with (Boffelli et al. 2020): it is evident that a managerial walk-in into a factory on a closer country is more favourable and likely to occur less rarely with respect to a "edge of the world" location.

Among internal strategic drivers, there's the product. It can be related primarily to quality issues (Gadde et al.,2019), especially for the developing countries, but it can also follow strategy shift imposed by the corporate level: for example shrinking portfolio products, aiming for better innovation through technology exploitation (Bolter & Robey, 2020) or a launch of a new mix of products(McIvor & Bals, 2021). Moreover it has to do with competences retrieved in some cases of nearshoring and reshoring like the Made-in effect (Stentoft et al. 2016), namely capabilities that are best to locate in a certain country rather to another, due to characteristics peculiar of a certain country as for instance the craftmanship in Italy deriving from a strong tradition of the country in that activity.

A third driver lies at the operational level of the value chain. As widely known, relocation practices necessarily brings shorter lead times and thus bigger responsiveness to the market request, which is possibly connected to the innovativeness mentioned earlier into the product driver. Hereby supply chain fluidity is concerned as well. As exposed by Louis Paul Tardif (2023b), it is a fundamental KPI measurement to assess the productivity of the supply chain based on its inherent velocity: the higher it is, the smoother the supply chain is and less delays materialize. This has not been a trend indicator so far, but it is gaining momentum during these years and necessarily requires transparency in order to be fostered. Moreover sustainability needs to be noted, even though it has received scarce attention by the literature, especially when concerning environmental and social sustainability (Orzes & Sarkis, 2019). In the literature review made by Fratocchi & Di Stefano (2019), relocating to the home country is deemed to be positively impacting to the environment (shorter transportations times), yet further analysis on the impact of voluntary international standards such OHSAS and pollution is suggested, along with more development on the impact of the two pillars in a separate way. Nonetheless, a certain impact of these two pillars of the sustainability concept on reshoring

and nearshoring practices is proved, even though not as a main principal driver. Delis et al. (2019) have found insights on firms that are exploiting reshoring opportunity to demonstrate that local jobs stands above the mere profits. The social factor has been deepened also by Grappi et al. (2019) with the purpose of looking out for benefits on employees, coming up with interesting and positive findings on the relation between reshoring decisions and intrinsic motives on people inside the organization. Yet, the literature in this field remains scant and full of avenues. Lastly, an important but often omitted topic related to operations and sustainability in reshoring practices is circular economy: locating a part of the value chain closer to the origin site can be helpful when wanting to reduce the waste, allowing for greater flexibility and resilience. Lately this can be enabled through developed systems of digitalization and technologies such as blockchain (Nandi et al. 2020; Wilson et al. 2022).

Moving on to the external strategic drivers, there are two main drivers: institutions and disruptions.

Starting from the latter, during 2021 and 2022 almost 40% of UK companies have decided to terminate agreements with at least one international suppliers to shift to a domestic alternative one ("Is reshoring the solutions for supply chain disruptions?", 2022). As already clearly explained in the introduction, disruptions can be exemplified as "Grey swans" as expressed by Akkermans et al. (2017), namely that an occurrence with low probability and strongly impactful on organizations. Disruptions falls within the definition of environmental risks provided by Shekarian & Parast (2021), which in turn is enclosed into the general concept of supply chain risk. According to them, environmental risks are "external to the firm" and "may affect a particular value stream or any node or link through which the supply chain passes"; other examples are natural disasters or wars. Disruptions can also be classified on the basis of the impact (Asafo-adjei et al. 2023): supply, infrastructure and catastrophic. The first one is connected to the ability of supplier for not succeeding in delivering the promised quantity and quality of the goods in order to support the operations of the focal firm (Wong et al., 2020); infrastructure is instead referred to technology malfunctions or any type of disaster that causes a breakdown or failure of systems affecting sharing information, communication or movement of commodities in the supply chain (Wong et al., 2020); catastrophic is an unanticipated event with low likelihood, overlapping with the definition of grey swans already highlighted.

Last but not least, institutions play a role on reshoring and nearshoring' decisions, possibly making the organizational at ease through a wide array of improvements. This field is reap of researches especially in the literature regarding factors like political stability and corruption (Wan et al. 2019; Feinberg and Gupta, 2009). Moreover the importance of law enforcement can turn out to be crucial here, as it would favour companies suppliers' law compliance. For instance, in many developing countries where the law enforcement is soft and different from Europe's , there have been various scandals in terms of safety and quality of the workplaces and workforce, adversely impacting on brand image of companies; therefore improving legislation and law compliance can thus be beneficial when aiming at hosting companies in a

nation. Finally, as defined by Srai & Ané (2016), availability of skilled workforce, natural resources and infrastructure can be factors that institutions can leverage for attracting relocation practices.

This is a personal and general summary of the motivations leading to relocations activities retrieved from the relevant literature. Nonetheless, it is crucial to remind how these factors are often inextricably and reciprocally connected and thus it is not recommended to consider them distinctly. However, it is noteworthy to quote the study from Ketokivi et al. (2017) which proposes to shun away from these kind of classification based on location features (labour costs), organizational features (plant role's in the firm's network) and temporal perspective (lead time and demand patterns). Indeed he carries on an analysis on a decision perspective on linkages between production, supply chain, market and product development using three main concepts from organizational design domain: coupling, specificity and formalization. It is concluded that at least one high level of one these three factors is associated with locating production in a high cost country (high GDP).

2.2.2. Managerial mistakes

The third and last category of drivers includes mistakes committed by firms on costs calculations and performance. This might depend on three distinct motivations: (McIvor & Bals, 2021; Fel & Griette, 2017b)

- Inappropriate knowledge and capabilities to effectively assess consequences of a previous offshoring decision. For instance incomplete knowledge of an offshoring location including suppliers capabilities can negate cost benefits implied in this decision, resulting into a reshoring process (Fratocchi et al. 2016);
- A second motivation is bandwagon effect, implying a slavish imitation of another company's move, without fully and thoroughly considering the real need of urgency for an offshoring decision (Di Mauro et al. 2017);
- Lastly bounded rationality is regarded. Reality is complex, thus humans cannot make a perfect and thorough decision that suits perfectly the situation faced. This refers to natural limitations in human mind, making impossible to envisage every outcome arising from supplier-buyer relationship in a foreign country (Di Mauro et al. 2017). This can lead sometimes to the utilization of prior experience or emotions in an offshoring decision (Foerstl et al. 2015)

2.3 Advantages of nearshoring

Drawing from the classification carried out in the last paragraphs, it is clear and straightforward what are the main advantages:

- cost, product and operations related advantages;
- supply chain resilience when dealing with disruptions;

- exploitation of better external conditions in terms of fiscality, political stability and resources availability (human, material and infrastructure)

In this thesis we are going to analyse the connection with the topic of supply chain resilience, extremely in vogue in the last ten years due to the continuous occurrence of different type of disruptions and accidents.

2.3.1 Supply chain resilience

Having its roots into the Latin language ("resilire" that means to rebound), resilience is defined as the ability to recover effectively and quickly from a disruption (Behzadi et al. 2020); it helps on dealing swiftly with impactive events, allowing to keep serving the changing customer demand. Concept explanation of disruption has been given into paragraph 2.2.1. For all those firms immersed in global supply chains , supply chain resilience has become a core capability able to alleviate negative impact of disruptions (Queiroz et al., 2022).

Studies on resilience are enormous, with specialization on supply chain resilience. As pointed out by Shen & Sun (2021), various considerations have been carried out regarding the identification of principles underlying this concept which can be summarized into flexibility, agility, visibility, collaboration, info sharing and culture of risk management. Besides, supply chain resilience has been described as "a support for firms for making them capable of coping and recovering from disruptions to the original state of operations" (Yang &Hsu, 2017). This capability is both static and dynamic. It is static when is addressed to improve the readiness and preventative measures to soften and reduce the probability of any threat, while the dynamism stems from the ability of managing with disruptions in real-time and increasing the recovery speed (Yang &Hsu, 2017). Wieland and Durach (2021) exposed a socio-ecological perspective contrasting it with the engineering one. Engineering perspective mainly aims at resetting the former situation from a disruptive event as the main focus lies on an equilibrium steady state (Sammarco et al., 2022), reflected on metrics such as time to recovery and time to survive (the longest time that customer service is in place despite a disruption): TTR is supposed to be smaller than TTS to ensure that disruptions are prevented (Simchi-Levi et al., 2014). On the other hand, social-ecological perspective is hinged on persistence, change and unpredictability taking into account a possible transformation to a new regime of behaviour after a disruptive occurrence. It contemplates adaptability, often motivated by the necessity to survive and thrive for the community; therefore grasping new opportunities generated from crisis is the basis of this conception. Different SCM researchers have argued the importance of both building redundancy and developing flexibility in the supply chain (Nikookar & Yanadori, 2022). Redundancy allows for resilience through buffer stocks which compensates lost resources after a disruption; firms achieving flexibility can swiftly change from one state to another by switching supplier, relocating facilities, changing distribution modes (Brusset & Teller, 2017).

Nonetheless, although the concept of supply chain resilience has been analysed in depth, practical relevance is truly missing with very few indicators to represent it in real scenario(Shen & Sun, 2021). A recent article by Behzadi et al. (2020) developed a metric called as net present value of lost profit (NPV-LP) to assess the operational performance integrating existing metrics like recovery time, recovery level and loss of performance while recovery, thus incorporating three different facets of the concept of resilience. Further studies are still needed in the literature.

2.4 The decision making process behind nearshoring

As also stated by Boffelli et al. (2020), the "why" of nearshoring has undergone through numerous studies into the literature, as explained in chapter 2.2; but in the latest years a tendency towards the "How" is growing even if still at a slower pace, trying to devise a pragmatic and thorough decision making process, starting from the reflections on drivers made during the past decades.

There have been some studies that analyse the decision making and implementations phases for a reshoring decision such as the one by Bals et al. (2016). In this paper, the researchers' main findings represent the backbone for a relocation decision, pointing out two consecutive and looping main process, namely the decision making and the implementation. In reality, this article focuses on reshoring, considered as the activity of moving back from a previous offshored location. Therefore the definition of nearshoring used in this thesis (see paragraph 2.1) is mostly aligned with the one provided for reshoring into the mentioned article, hence leveraging this described methodology is in fact relevant to this thesis. Going into detail with the decision making process, it is constituted by five main steps:

1. Current boundary determination;
2. Capability & performance analysis of current state;
3. Information gathering on alternatives;
4. Data analysis and solution development;
5. Shoring sourcing decision.

The implementation part is constituted by three steps:

1. Disintegration at former source/location;
2. Relocation to new source/location;
3. Reintegration to connect with other value creation activities.

This is the backbone of this thesis' work even though only the former phase will be deeply examined while still taking into consideration the latter, but without the same extent of attention: as a matter of fact implementation process requires a strong work experience and an exaggerated amount of detail which stand out of the scope of this thesis.

As far as decision making process is concerned, the first two points are included into the problem indication's paragraph, whereas the remaining three will be thoroughly analysed through the methodology leveraged by Van Hassel et al. (2022). This study can be considered as the first attempt to devise an extensive and comprehensive tool for a well-grounded nearshoring decision. First, it commences with a selection of different nearshoring countries is made, and then a SWOT model is carried out with the purpose to entirely denote every positive and negative aspect of a location decision in a certain territory. At the end of this process, 3 alternative scenarios are chosen. Secondly, a Total Cost of Ownership model is utilized: TCO is a method which tries to take into account every sort of costs, going from transportation costs, stocks costs to risk costs also encompassing different alternative transport mix (air, rail, maritime, road). A qualitative analysis is executed as well: it includes questionnaires on the weighs of certain attributes (value, time and costs) on nearshoring decision. As a matter of fact, whenever nearshoring is a complex decision, hard data cannot be the sole constituents for the final choice because of the high complexity deriving from the uncertainty of the market. Afterwards, results from the latter analysis is combined with hard data related cost ensued from the TCO analysis. By mixing these two results, the study comes up with real numerical data that actually gives out an insight on the final costs of nearshoring on the selected countries with different transport mix. At the end the decision maker will have to make a decision on the basis of the selected transport mix. However, it is to be noted that this study is just context-related with no focus on a company setting, so my thesis will try to utilize it into a more empirical context such that of company x. Furthermore there will be some modifications in the methodology, resulting into little deviations from the one of Van Hassel et al (2022), also taking into consideration the company requirements (further detail in the next chapter). This is in line with the positive lack of standardization of TCO approach stated by Ellram (1994).

2.5 Gap in the literature

Nearshoring studies call out for more empirical findings on the practical process that guides a company into this type of decision and this is where my thesis' purpose is located (Van Hassel et al. 2022). Remko (2020) defines different research pathways for post covid 19 supply chains: in particular he argues that TCO can be a useful model to support global sourcing processes, incorporating different factors with respect to costs. To the knowledge of the researcher, this is the first study grounding the decision making process of nearshoring inside a case company, uncovering and adjourning at the same time empirical patterns and features to be taken into consideration while addressing offshoring-nearshoring decision. Moreover, connections between inventory levels and nearshoring decisions have never been carried out and this work will try to leverage EOQ and MOQ computations to thoroughly address this decision when there is uncertainty on which product line can be better off to nearshore.

Chapter 3: METHODOLOGY

3.1 Research nature and research strategy

The nature of this thesis is an abductive one (Dubois & Gadde (2002); Kovács & Spens (2005)). As a matter of fact, theories and previous methods are the starting point for structuring the process, but in the meanwhile the reality of the company studied can provide interesting insights for the literature, considering that the state of art is still very young and strictly hinged on theory rather than practice. Iteration between theory and empirical data is a central factor because theory needs to be grounded inside the contextual situation of the company and at the same time the company situation can contend some of the theoretical features, changing some aspect of the theory on the basis of the empirical reality. So general theory is malleable in order to reconcile it with company situation and continuously under elaboration (Ketokivi and Choi, 2014).

This research will involve a quantitative methodology from two different methods, thus increasing the validity of the research through triangulation of methods.

Besides, as described in the introduction, a single company case is regarded , therefore it bears the advantage of great depth inside the company setting and its problems (Ozcan et al.(2017)). However it limits generalizability since results are highly dependent on specific features of the case study and entails some biases that will be explained in detail in next paragraph (i.e. researcher bias). A last aspect that has to be highlighted is the exploitation of cross sectional data with both retrospective and real time fashion, as data from current and previous years are regarded.

Methodology's design here described is in line with the scarcity in the state of art of the topic of nearshoring, especially with its decision making process. Indeed starting from the research of Van Hassel et al. (2022), which is one of the few articles delving into the relevant factors and methods for nearshoring in an effective manner, some specific modifications are applied, tailored to the company's reality and requirements. These changes can inform the literature with new or at least more adjourned aspects to take into consideration for further studies and also to align theory to practice.

3.2 Data collection

Data has been gathered through an internship period in into the office of the company located in the Netherlands, with an average presence on site of two times a week depending on the necessities of the student researcher. It started on the 1st of February and lasted around 5 months. Different types of data collection methods have been leveraged to get deep insight out of the company problem and to collect data to be utilized into the research:

- Face to face interviews and meetings with a large number of company members (supply chain team, team category management, CEO and IT team) mainly to get information about the main problem and its root causes, for receiving suggestions on how to efficiently collect data;

- Usage of softwares for collecting data such as Power BI and NetSuite;
- Informal questions and consultations with members of the company

These allowed the student to deepen the knowledge of the problem and the need of the company, giving support for better structuring the methodology of this thesis and improving internal validity.

This approach is in line with the "engaged scholarship" methodology, as described by Van de Ven and Hakkermans (2018). Indeed, as previously denoted, nearshoring decision making has been poorly studied therefore practitioners' practical knowledge is heavily needed to complement the theoretical knowledge provided by the state of art. By doing so, a win-win situation arises, as both parties gets benefited from this collaboration: the researcher can advance theory through the irreplicable knowledge of the counterpart, while the practitioner can receive hints on methodologies for addressing issues appropriately. As a matter of fact, knowledge co-production is at stake (Van den Ven, 2018). Moreover as also stated in this mentioned paper, time spent in research site was positively correlated with the outcome of the research, as it helped raising awareness of the problem and generated more acquaintance of the company setting and the phenomenon of nearshoring itself.

3.3 Data analysis

As already explained the methodology mostly stems from the study of Van Hassel et al. (2022), but two additional steps are taken into account, as advised by the company. In the next paragraphs each phase is explained:

1. Search of suppliers on countries based on advices from companies and fit with company's product assortment.
2. Total cost of ownership analysis in order to thoroughly frame every attribute included into the decision making process underlying any nearshoring opportunity.
3. Questionnaire for understanding the importance of qualitative attributes appointed by the company. These will lead to a final comprehensive methodology of macroeconomic and company's related factors in case of operating in a certain country.
4. Computation of differences between current MOQ from Chinese suppliers and potential EOQ in case of nearshoring, as well as a comparison between the latter and current EOQ in China scenario.

In the subsequent paragraphs, these steps will be explicated in detail.

3.3.1 Search of suppliers based on countries advised by company

The first phase consisted of searching for plausible suppliers in European countries, based on the current product assortment of company x. The research was carried out through websites containing lists of suppliers such as Europages, as well as Linkedin which ended up being useful for contacting representatives

of suppliers. Consulting with the category management team has been fundamental in order to receive feedbacks on the matching between products supplied by those organizations discovered with the research and the company x' products. Additionally, requesting info for availability in operating into a private label agreement was the main requirement, given the company 'setting.

Taking into account different countries' scenario would allow to pursue greater internal validity of the research.

3.3.2 Total Cost of Ownership model

Similarly to what presented into the work of van Hassel et al. (2022), four different type of costs are considered:

- Production costs
- Transportation costs
- Stock costs
- Risk costs

The classification of these costs is tailored to the sub category products for which availability was confirmed from external suppliers. Production costs from current suppliers comprises:

- Startup costs = these are fixed costs (around 200€) sustained because of private label agreement
- Material costs = fixed costs (%)
- Labour costs = fixed costs (%)
- Order costs = fixed costs (around 100€) sustained because of private label agreement

Material costs and labour costs account for the final item prices of products. Inside each subcategory of products there might be large variations in terms of prices due to the volume dimension or the labour needed to produce the various items, but still this is deemed to be a correct methodology as results stemming from too much specificity in classification of products would prove to be pointless from a company perspective: it is useless to nearshore just 5 or 10 items out of thousands provided by the company, unless the items considered are spacious and bulky. This is why overall a certain level of generalizability and approximation is necessary. Regarding prices from external suppliers an average has been computed. As far as transportation costs are concerned, freight and duty costs are considered as well as the carrying costs: this is the cost related to the space needed to carry an item from the departing destination port to the arrival port (Netherlands), therefore the larger the higher the cost would be. On average this is 20%, but to have an accurate calculation the inhouse price has been taken into account.

$$\textit{Inhouse price} = \textit{Average Item price} + \textit{Freight and Duty costs} + \textit{Carrying costs}$$

Carrying costs are thus calculated through subtracting the item price and freight and duty costs from the inhouse price. Unlike Van Hassel et al. (2022), no consideration is posed to different type of transportation mixes because only one will be effectively exploited when Company x sources from Europe, namely through truck (as it is already doing with some current European suppliers). Moreover, for transportation prices in Europe, no value is input as most of current European suppliers are responsible for those leaving no responsibility to company x.
Regarding stocks costs, computation on safety stocks costs are carried out using the classical formula:

$$Safety\ Stocks = z\ value * \sqrt{leadtime\ in\ months} * standard\ deviation\ of\ demand$$

$$Safety\ Stock\ Cost = Safety\ Stocks * Inhouse\ price$$

Finally risk costs are a fixed value, independent from the product and are already included into transportation cost.
For products sourced from external suppliers, production costs were taken from the average price; however in many cases where these were not received (due to confidentiality or simple not replying to request for prices) a different approach was leveraged using the hourly labour costs of countries, retrieved from Eurostat. This presupposes a previous knowledge of share of costs into prices of certain products (material, labour and administrative), requested internally to suppliers. Assuming that share of labour costs is equal across countries for the production of the same products, knowing the share of labour costs on products from internal suppliers can lead. This was advised by the company and the computation derives from the following proportion:

Hourly Labour costs in China : Hourly Labour costs in another country = value of Labour costs for a product line sourced in China : value of Labour costs for a product line sourced in another country

Through this computation a possible forecast on product pricing in a country can be performed, whenever catalogue prices were not deployed from external suppliers. This method was confirmed by comparing the price calculated in this way and the price retrieved directly from a catalogue, almost being equal.
Regarding transportation costs, these are lower in case of sourcing from Europe, thus decreasing the value of the inhouse price. Stocks costs are instead computed using the same formula naturally considering a lower lead time in terms of month. In particular, lead times for different countries are derived from current European suppliers, depending on the size of products. As already mentioned, risks costs are fixed and are included into transportation prices.

So in conclusion, in terms of quantitative costs, the following interesting trade-off is under study, as also mentioned by Ellram (1994): a lower item price characterizing by higher transportation costs and safety stocks (Far Eastern countries) and products with higher item price but lower transportation costs and number

of safety stocks needed, but at the same time overall safety stocks costs will be higher due to considerably higher inhouse prices deriving from higher labour costs (Europe).

3.3.3 Qualitative decision factors

The purpose of the questionnaire is to put under a spotlight all the attributes whose information are not well known and are hard to formalize, thus considering also heuristic based factors referred to the sentiment of decision makers. These factors are summarized by three different notions: value, time and cost (Van Hassel et al. 2022). “Value” is defined as the added value arising from supplying from a certain country; “time” refers to level of shortening of product value chain; “cost” normally refers to the concept of qualitative costs that characterize a nearshoring choice. These factors are analysed thanks to a questionnaire of 16 questions shared to the components of the category management team, the supply chain team and the CEO and COO of Company x. The total number of recipients is 14 people. Each of the question can be reconnected to one of three main pillars explained earlier (just in one question there is a connection to two main attributes). Respondents were asked on the importance for the organization of each of the attribute (replying with a value ranging from 1 to 5, directly correlated with the importance appointed to every factor). On Appendix B detailed information are collocated.

After computing an average of the responses for each question, a classification of these values multiplied by a standardized value taken from reports is carried out. This classification is executed per country. Besides, reports such as Global Innovation Index 2022 or issued by World Bank Group, as well as Swot analysis (Appendix C) are taken as a source for getting objective values on qualitative attributes of countries. In some few cases a rule of thumb method was utilised to compute some qualitative factors in each country (more explanation later in the findings paragraph).

The average values for each of main qualitative factor is significant to generally realise on what country is most fruitful to nearshore. In fact, a weighted sum of the average of each main decision factor can lead to a final classification of countries to further go on with the last phase, related to a products based analysis.

3.3.4 Comparison between MOQ and EOQ and between EOQs

The subsequent and last phase is directed to assess any convenience on the quantities needed to order in case of a different source from the current one. Insights from large differences between MOQ and EOQ can be useful to be collected. Even if it might seems to be approximative, valuable insights can stem from larger differences between MOQ and EOQ, and between EOQs of China and European suppliers. In this way the extent of products benefiting from nearshoring can be visualized, if the results show any, highlighting the potential advantages of keeping lower inventory with a correspondent costs in Europe compared to China. This part of the methodology has been advised directly from the company as it can support the nearshoring decision long with the two aforementioned analysis.

Computing EOQ for products possibly sourced from Europe is done through taking transportation prices from averaging the values of transportation prices of 2023 invoices from European suppliers with EXW incoterm: even though most of European suppliers works in a DAP incoterm agreement (meaning that the products are delivered at a place chosen by the buyer), few operate through a EXW incoterm weighing on financials of the buyer (Company x); therefore averaging the transportation prices from these suppliers can provide an approximation of costs in Europe. Purchasing prices are provided by the company, while item prices are those computed into the TCO analysis.

EOQs are computed through its classical formula:

EOQ= SQRT((2(forecasted demand*2)*(total costs))/(holding costs of inventory))*

Lastly, differences are computed in terms of percentage to give out a reliable value, independent of numeric values which can be influenced by size of product considered.

3.4 Validity and reliability

Internal validity is strongly enhanced through the triangulation of data collection methods (interviews and data softwares) and a triangulation derived from leverage of the questionnaire and TCO analysis. Insights will eventually be context specific and related to characteristics that greatly represent reality. Moreover high level of depth has been guaranteed through various interviews and meeting with different employees and managers working inside the company (Quintao et al., 2020). The main scope of these meetings was to ensure compliance of this work to company's requests. Moreover internal validity was enhanced by sharing the questionnaire to different groups inside the company and enclosing a large number of qualitative attributes to focus on. This naturally comes at the expense of lower external validity due to a lower generalizability given the specificity of the context and possible differences of relevant attributes in other settings. So some characteristics and factors can be biased by the company requirements and specifications. However external validity is not much impaired as many of the attributes under consideration are constituents of every company operating on a global scale. Indeed disruptions bears global effects, therefore the instruments here provided can be useful to some extent at least regardless of the industry and the company setting.

As far as reliability is concerned, it is granted through collection of objective data from internal software (PowerBi, Tradecloud and Netsuite) and through interviews and meetings with employees and managers of the company. Moreover, some data are retrieved from excel files analysed throughout the internship period. By doing so findings will be consistent and credible, even though in some case certain assumptions on data are to be made, given the complexity of the real world. Researcher bias has been prevented by taking into account a possible scenario in which nearshoring is not eventually advantageous for any product, as also mentioned into the fourth research question. Measurement error in the questionnaire is prevented by nearly

replicating the one from van Hassel et al. (2022), with some corrections tailored to the company setting. Non-response bias might be consistent considering the vast amount of questions but, considering the interest of the company into the thesis assignment, it is almost negligible.

Chapter 4: FINDINGS

4.1 Search of suppliers based on countries advised by the company

To have a thorough and comprehensive research, different scenario countries were under the magnifying glass of this thesis project:

- Middle European countries, namely Germany and Italy : these are high cost countries but further analysis can be insightful when considering the high prices attached from these sources and the simultaneous lower lead time, which impact the safety stocks level required. Higher transparency and quality of the production is an additional noteworthy feature.
- Eastern European countries, namely Romania, Poland and Czech Republic: conversely to the middle European countries, these are low costs countries (even if not as low as China) characterized by a lower quality of productivity. However overall quality has been increasing in the last few years.
- India: this place is already a source for some of the Company x's products and can be complemented with other products in order to reduce the overall costs of transportation through consolidation services. Moreover, as stated from a member of the Supply Chain team, the port of Mumbai is a strategic commercial point for the global market, therefore can be considered more for supplying products.

Other plausible geographical zones such as North Africa has been left out due to the lack of traceability of contacts and suppliers on the internet and on Europages website. Based on the findings of this phase, the 2 subsequent phases are constructed relying on prices received from external suppliers and inherent characteristics of each country to compute into the qualitative analysis. The graphical classification is carried out mainly per category type, which represent the smallest grouping of products inside the organization; in some cases classification is made per subcategory, an intermediate level of products grouping, signalled with an asterisk (Table 8). In this manner, higher specificity is achieved along with more realism of the data. A swot analysis related to each selected country is displayed into the appendix C.

Category type	**AUTOMOTIVE**	**WOOD WORKING**	**WOOD WORKING**		
Subcategory/product type	Tyre service*	Band saw machine	Sanding machine 230V		
External suppliers	Supplier 1 (India)	Supplier 3 (Italy)	Supplier 5(Italy)		
	Supplier 2 (Poland)	Supplier 4 (India)			
Category type	**WORKSHOP**	**WORKSHOP**	**WORKSHOP**	**POWER TOOLS**	**POWER TOOLS**
Subcategory/product type	Tool trolley	Workbench	Hoisting and lifting *	Milling cutters	Drill bits
External suppliers	Supplier 8 (Germany)	Supplier 8 (Germany)	Supplier 11 (Czech Republic)	Supplier 14 (Czech Republic)	Supplier 14 (Czech Republic)
	Supplier 9 (Poland)	Supplier 9 (Poland)	Supplier 12 (India)	Supplier 15 (India)	Supplier 17 (Italy)
		Supplier 10 (India)	Supplier 13 (Romania)	Supplier 16 (Germany)	
Category type	**POWER TOOLS**	**HAND TOOLS**	**SAFETY**		
Subcategory/product type	Saws	Chisels and gouges*	Safety* (Personal protection)		
External suppliers	Supplier 18 (Italy)	Supplier 20 (Czech Republic)	Supplier 17 (Italy)		
	Supplier 19 (India)	Supplier 17 (Italy)			

Table 8: *own composition*

All of these are group of products, with the exception of wood working type where single machinery are taken into account given their size and relevance in terms of revenue.

4.2 Total Cost of Ownership

In Table 8 results from cost analysis in Automotive category product are shown.

	AUTOMOTIVE		
	Current supplier	*Supplier 1 (India)*	*Supplier 2 (Poland)*
PRODUCTION COST	*Startup costs (fixed)*	200€	200€	200€
	Material costs	[107,9€]	[70,08€]	[435,8€]
	Labour costs	[22,23€]	[8,76€]	[54,48€]
	Average price	222,26€	87,6€	544,76€

	Order costs (fixed)	100€	100€	100€
TRANSPORTATION COST				
	Freight costs and duties	17,09€	6,74€	4
	Carrying costs	50,53€	19,91€	108,95€
STOCKS COSTS	*Average safety stocks costs*	19882,19€	6093,05€	15039,8€
TCO	*Sum of average price+ fixed costs + transp.costs + stocks costs*	**20472,06€**	**6503,79€**	**19005,47€**

Table 9 : *own composition*

For the sake of completeness the remaining results are displayed later but in a compressed way since computations and formula used are always the same.

Labour costs were provided by current suppliers in percentage, in this case is 10% and can differ largely depending on the category of product. This data was useful to have an overview on the prices of countries whose supplier did not provide any catalogue prices. For instance thanks to the information on hourly labour costs retrieved on Eurostat and on the internet in general a projection on other countries labour costs was possible to make (Table 10), thus also on prices, assuming the same proportion of costs (realistically constant regardless of country).

	China	*India*	*Poland*	*Italy*	*Germany*	*Romania*	*Czech Republic*
Hourly Labour rates	5,15€/h	2,01€/h	12,5€/h	29€/h	39,5€/h	9,5€/h	16,4€/h

Table 10: *Eurostat and Statista*

So as explained in the 3.3.2:

*Labour costs in India=Labour costs in China*Hourly labour costs in Inda/Hourly labour costs in China= 22.23*2.01/5.1=8.76€*

*Average price in India= Labour costs in India * 100/ share of labour costs for that product' category= 8.76€*100/10=87,6€*

However, in those few cases where a catalogue for prices has been received, average prices of items are considered, without computing the formula aforementioned. Freight costs and duty prices are a percentage of price and is assumed to be equal in China and India but is negligible in Germany where almost every current supplier include transportation costs into item prices (DAP incoterm); regarding other countries, transportation costs are based on the average from the latest invoices from current suppliers. Carrying costs are instead computed by subtracting the freight and duty costs from the inhouse price and are included into all scenario as they are independent of the country.

The most substantial part is made up by the stock costs. On table 11 related calculations are provided, also given the small number of items enclosed in this subcategory.

Standard deviation of last year sales	Z value (Depending on service level)	Lead time in China (months)	Average lead time in Europe (months)	Lead time in India (months)	Safety stocks China	Safety stocks India	Safety stocks Poland
14	1,88	6	1	3,8	65,34	58,44	26,68
12	1,88	6	1	3,8	53,73	48,06	21,94
31	1,88	6,27	1	4,07	145,07	130,44	57,95
4	1,88	6,27	1	4,07	17,86	16,06	7,13
15	1,64	6,27	1	4,07	60,95	54,81	24,35

Table 11: *own composition*

Lead time in Europe has been computed from the average lead time of current European suppliers. Since the largest part of suppliers are located in China, overall lead time gets much longer as it is more convenient to compile different orders including different lead time in a unique container to decrease transportation costs: this is the main reason of very large lead times in China with respect to Europe where a considerably small group of suppliers are situated (see also paragraph 1.2). Regarding lead time in India, average lead time form current Indian suppliers has been computed (4 suppliers out of total 136 Asian suppliers). Formula of safety stocks has been described in 3.3.2, as well as safety stock costs' requiring the average of the numeric values here exposed multiplied by the total inhouse price, namely the sum between average price and the transportation costs (Table 12).

	Inhouse price China	Inhouse price India	Inhouse price Poland	Safety stocks costs China	Safety stock costs India	Safety stock costs Poland
Item 1	281,84€	111,08€	657,71€	18360,36€	5758,69€	17438,5€

Item 2	15097,35€	4735,25€	14339,3€
Item 3	40760,41€	12940,9€	37881,2€
Item 4	5017,77€	1593,08€	4663,33€
Item 5	17126,11€	5437,33€	15916,4€

Table 12*: own composition*

Average from safety stock costs column will result to be the values to consider in the TCO analysis:

Average safety stock costs China=(18360,36€+15097,35€+40760,41€+5017,77€+17126,11€)/5≈19272,4€
Average safety stock costs India=(5758,69€+4735,25€+12940,9€+1593,08€+5437,33€)/5≈6093,05
Average safety stock costs Poland=(17438,5€+14339,3€+37881,2€+4663,33€+15916,4€)/5≈18047,76€

It can be denoted that safety stocks are decreasing in case of shorter lead time related to European countries but at the same time are increasing when item prices are higher. Depending on the final effects of these two factors safety stocks will be higher or lower than the current scenario. In the next table a final classification of countries per each category product analysed is provided, summarizing results from other categories, fully displayed in Appendix D (Table 13 and 14). The remaining specific computations for the other categories can be requested directly to the researcher.

AUTOMOTIVE (tyre service)	**WOODWORKING (Band saw machine)**	**WOODWORKING (sanding machine 230v)**	**WORKSHOP (tool trolley)**	**WORKSHOP (workbench)**	**WORKSHOP (hoisting and lifting)**
India	India	China	China	India	India
Poland	Italy	Italy	Poland	China	Romania
China	China		Germany	Poland	China
				Germany	Czech Republic

Table 13*: own composition*

POWER TOOLS (Milling cutters)	**POWER TOOLS (Drill bits)**	**POWER TOOLS (Saws)**	**HAND TOOLS (Chisels and gouges)**	**HEALTH AND SAFETY (Safety)**
India	Czech Republic	India	China	China
Czech Republic	China	China	Czech Republic	Italy

China	Italy	Italy	Italy
Germany			

Table 14: *own composition*

It is important to highlight the different lead times per product category and per European territory (table 15):

LEAD TIMES (Months)	*Germany and Czech Republic*	*Poland, Italy and Romania*
AUTOMOTIVE		1
WOOD WORKING		1.5
WORKSHOP	1.5	1.75
POWER TOOLS, HAND TOOLS, SAFETY	0.3	0.5

Table 15: *own composition based on Power Bi and NetSuite data*

An additional lead time of 0.25 (7 days on average) is considered for further countries from the Netherlands in accordance with current data of transportation lead time from an internal Italian supplier.

Drawing from results of Table 12,13 and in Appendix C:

- It is evident that India is in most of the cases the best choice in terms of costs, given such low hourly labour costs, paired with a low impactful increase of inhouse price due to freight costs and duties, as well as carrying costs
- Conversely, Germany present a peak value of labour costs that isn't counterbalanced by decreasing lead times and transportation costs (often included in prices in case of DAP incoterms). This is why is always classified as last in price wise, but further consideration related its inherent better qualitative features will be described.
- Italy is always generally more costly than China's scenario, with the exception of band saw machine in woodworking category product (Appendix D1) whose known cost is significantly lower as it should be based on computations on item prices for other countries. This represents a fruitful and convenient opportunity for the company to nearshore, even though only one sole item is concerned and also with a slight seasonal demand (high coefficient of variation).
- Czech Republic is always more convenient than China and Italy, despite considerable labour cost. Indeed, with production of small parts such as power tools' items, lead time are significantly lower than China. This makes safety stocks cost much fewer than China's even though inhouse price is

definitely higher. This is why Czech Republic does not stand in upper position in the case of hoisting and lifting' related products (winches, chain hoists and lifting tables), mostly characterized by larger lead times when sourced from Europe (≈1 month).

- Having very low labour costs, Romania seems to be an even more plausible solution for hoisting and lifting products, the unique category in which research has been carried out due to lack of suppliers 'contacts overall the net.
- Poland is relevant in this research only for workshop and automotive product. Since lead time is not as irrelevant as it is for tools, costs are tendentially higher than China's, with the exception of automotive in which lead times are 0.75 lower than workshop.

Overall bigger products are more convenient to nearshore in case of very low costs such as India or Romania as these tendentially make nearshoring feasible in all cases considered; while other countries are beneficial only in some cases depending on specific features like lead time or precise values of prices based on catalogue received (in case of Supplier 3) that make final price differ from computations on 3.3.2. Germany represent a sort of extreme case where significantly high value of labour costs make a nearshoring process never convenient in terms of costs. This is why additional analysis on qualitative attributes is necessary.

4.3 Qualitative attributes analysis

Statistics from questionnaire are displayed below.

Total recipients	14
Respondents	11
Completed questionnaires	9
Uncompleted questionnaires	2

Table 16

9 completed questionnaires out of 14 are taken into consideration, constituting a satisfactory collection of data among people of company x with interests linked to a nearshoring process. The 2 uncompleted responses are overlooked to ensure more reliability of data. Besides, a number of responses of more than the half of the total recipients makes these results as valid, also considering that:

- the CEO and a colleague from the Management team of the organization successfully participated into it, probably being the most capable people in terms of managerial decisions;
- moreover in the article from van Hassel (2022), the questionnaire is not conceived to be forwarded to a lots of people since a nearshoring decision mostly rest with the most skilled people in terms of managerial ability, given its complexity. Nonetheless, in this research it has been destinated to a larger sample of people which still are from departments strictly related to the supply field (3.3.3)

Classification of countries based on attributes of cost, value and time are showed below in table 16, with more specifications on Appendix E.

Cost	***Value***	***Time***
China	Germany	Germany
Czech Republic	Czech Republic	Czech Republic
Poland	Poland	Poland
Germany	Italy	Romania
India	Romania	Italy
Romania	China	India
Italy	India	China

Table 17: *own composition*

As expected, Germany stands overall in the highest position among the rankings thanks to its overall high indexes. On the other hand India, which was at the top into TCO analysis, lies more or less among the lowest ranks. What is seemingly unexpected is the China standing on the top position of qualitative costs: this is attributed to the question 14 about cost efficiency of consolidation order service. As a matter of fact, this question has been inserted as it is relevant to company x, which benefits from costs advantages when consolidating different orders from different suppliers which reside in the same country (also explained in 1.2). Values assigned to each of the country can be misleading as it is mainly based on rule of thumb since there are no defined ways to compute it: specifically it is assigned a maximum value of 100 to China where the largest amount of suppliers is located, 10 to countries with no suppliers (Czech Republic, Poland, Romania) and intermediate value to Germany, India and Italy (respectively 45,30 and 15) where some internal suppliers already exists. This is deemed to be an accurate way to compute this peculiar attribute, relevant to company x's context, after having it discussed with the supply chain team of the company.

Now based on different weights for each of the three qualitative decision factors a final classification of countries can be defined, as also explained by Van Hassel et al.(2022). Here it is assumed an equal share of importance, appointing 33% to each of the three decision factors (Table 18).

	Equal share of importance
COST	33%
VALUE	33%

TIME	33%

Table 18

Thus a final classification is made possible thanks to this breakdown:

FINAL WEIGHTED CLASSIFICATION
Czech Republic
Germany
Poland

table 19: *own composition*

3 total countries are taken into consideration to allow for extensive analysis on products considered in this thesis, as well as China situation that is the current scenario and is not to be omitted in order to be in line with the research questions. This ranking asserts how Czech Republic and Poland are rapidly developing economically speaking, featuring increasing indexes in terms of different aspect favourable for companies to operate, mainly represented by a steady growing GDP (*Poland: GDP change 2022 | Statista*, 2023; *Czech Republic: GDP in 2028 | Statista, 2023).*

4.4 MOQ and EOQ comparisons

In the fourth and last phase the study become more product specific grounding the nearshoring decision also on the basis of MOQ and EOQ, looking into largest differences between:

- MOQ and possible EOQ from European suppliers;
- Actual EOQ from current situation and Europe scenario.

To compute EOQs different factors are included in the various computations:

1. Forecasted demand per item. This is given as it was calculated directly by the supply chain team of the company;
2. Purchasing costs in Europe and China. These are given as well, computed from the supply chain team as well and are based on the number of items included in each shipment. Of course they are higher in China rather than in Europe.
3. Transportation costs for both scenarios. They are given for the Chinese situation while for Europe, an average of the transportation prices from latest invoices from current suppliers in Italy and in Germany has been carried out. However in Germany's scenario, transportation price is equal to 0 as in most of the cases the incoterm is DAP. While in cases of power tools, hand tools and health and

safety products, transportation prices are equal to 0,5 (averaged derived from transportation prices from current European suppliers of smaller components).

4. Costs of items, taken from the TCO analysis for Europe (either drawing from 3.3.2 or from directly requesting prices to external suppliers).
5. Risk related costs, a fixed value amounting to 20%.

These two last value concur to create the holding costs standing at the denominator of the formula while the first three are on the numerator.

MOQs from current suppliers are taken from Netsuite software varies depending on supplier and volume.

Similarly to the TCO results, detailed values of computations are provided here for Automotive products while for the remaining only a summary is displayed into Table 20.

	Total number of forecasted demand	***Purchasing costs Far East***	***Purchasing costs Europe***	***Transportation price per stock Far East (China and India)***	***Transportation price Poland(Average based on invoices)***	***Costs item Poland (Taken from Table 8)***	***Costs item India (Table 8))***	***EOQ China***	***EOQ India***	***EOQ Poland***	***MOQ***
Item 1	115	100	33,33	22,54€	4€	544,76 €	87,6€	25,18	56,69	12,53	108
Item 2	357	30	10	3,07€	4€	544,76 €	87,6€	56,42	51,92	13,54	200
Item 3	40	30	10	16,53€	4€	544,76 €	87,6€	10,37	20,72	4,56	50
Item 4	109	100	33,33	19,7€	4€	544,76 €	87,6€	26,66	54,63	12,23	112
Item 5	158	30	10	1,42€	4€	544,76 €	87,6€	60,94	33,7	9,02	100

Table 20: *own composition*

Subsequently the average of each type of EOQ is executed and the percentage of each difference with the overall average of MOQ and EOQ are executed:

MOQ and EOQ differences in India %=86,47/130=66,52%

MOQ and EOQ differences in Poland %=119,62/130=92,01%

Differences between EOQ China and EOQ India %=-7,61/35,91=-7,61%

Differences between EOQ China and EOQ Poland %=25,53/35,91=71,1%

These computations are carried out for all of the remaining categories studied, resulting into a total of 23 computations(Appendix F). Larger differences can give hints on which products are more likely to be advantageous to nearshore. By doing so a further cross checking is made to better fine tune the nearshoring decision , as advised by the company.

4.5 Final decision on category products for nearshoring

Final results from these 3 analysis are enclosed into the framework below (Table 21) with explanation of signs provided on table 22.

Subcategory or Product type	*China*	*Germany*	*Poland*	*Italy*	*Czech Republic*	*India*	*Romania*
Tyre service (Automotive)			●				
Band saw machine (Wood working)				○			
Sanding machine (Wood working)	×						
Tool trolley(Workshop)	×		●				
Workbench (Workshop)	×						
Hoisting and lifting (Workshop)							○
Milling cutters (Power tools)		Φ			●		
Drill bits (Power tools)		Φ			●		
Saws (Power tools)	×					○	
Chisels and gouges (Hand tools)	×				●		
Health and safety (Safety)	×						

Table 21: own composition

Best decision according to TCO and qualitative factors	*Symbol*
First or second best decision according to TCO and EOQ/MOQ	○
First or second best decision according to qualitative and EOQ/MOQ	*Φ*
First or second best decision according to all verifications	●
No nearshoring decision is best choice	×

Table 22: *own composition*

Two main decisions have been provided per product in order to highlight possible opportunities and pathways in terms of decision making. For example, should a supplier be contacted directly by the company in the future, lower prices can be attained throughout the real negotiation process, which is not been part of the work here due to large times required.

CHAPTER 5: DISCUSSIONS

The possibility of studying the reality of a company case has been fruitful for generating theory on post covid 19 period, inherently to the under researched topic of nearshoring. This has been effectuated through a triangulation of methods that could simultaneously provide findings for the company and for the theory (Ketokivi & Choi, 2014). Now, based on the findings exposed into the last paragraph, generation of suggestions for the company is going to be carried out, as well as theory generation through propositions formulation, to adjourn and simultaneously extend the scant theory on the topic of nearshoring. Lastly managerial implications, alongside with limitations and future research avenues will be described.

5.1 Implications for the company

Findings shown on table 20 bear the following practical advice:

- Looking at the overall results displayed in appendix F1 and F2, Germany seems to be always the best country in terms of EOQ quantities as it benefits from lower purchasing costs and transportation costs due to its geographical proximity. However, TCO depicts an inconvenient situation due to very item prices derived from high hourly labour cost, especially for the largest products such as workbenches and tool trolleys. In this case, an intermediate solution like Poland is seemingly beneficial especially for tool trolleys (Table 20), provided that lower item prices can be requested among polish suppliers.
- Regarding woodworking products here considered, it seems that nearshoring is not a beneficial solution as Italy is not among the best countries in terms of qualitative attributes, even though in TCO methodology and EOQ/MOQ differences is found to be convenient in the case of band saw machine.
- In hoisting and lifting products, Romania is apparently good in terms of costs thanks to its low hourly labour costs, as well as EOQ and MOQ's computations but it is not qualitatively attractive.
- As far as milling cutters and drill bits, Czech Republic is a remarkable country for nearshoring as it succeeds to reach better outcomes in all of the analysis, while saws are seemingly better off stay among Chinese suppliers. Germany is convenient as well but not notably convenient.
- Chisels and gouges are not economic to nearshore according to TCO, but very large differences can possibly be present in Italy and Czech Republic, even though the former is not qualitative attractive for any of the three main pillars (Cost, Value and Time).
- Lastly, for health and safety products, Italy can be a good solution according to TCO analysis and differences in EOQ and MOQ, but similarly to the previous point is not qualitatively convenient.

5.2 Implications for theory

The possibility of studying the reality of a company case has been fruitful for generating theory on post covid 19 period, inherently to the under researched topic of nearshoring. This has been effectuated through a triangulation of methods that could simultaneously create confer revised findings for the company and for the theory. Consistently with Ellram (1994), TCO analysis revealed to be insightful to check eventual trade-offs in costs. Specifically, it effectively represented the trade-off between higher prices and shorter lead times, thus entailing less safety stocks. Noteworthy to say is the explication of the ongoing of certain costs across different countries and territories, providing detailed data for comparing different scenarios. This method gets even more insightful when considering the current period subsequent to the covid 19 disruptions. Differently to what found by Chen et al. (2022) , van Hoek and Dobrzykowski (2021) and van Hoek (2020), transportation costs are not as prominent as they claim, since these does not generate such a spark in costs to make nearshoring always convenient; indeed, freight and duties costs are getting back to usual values and does not take a toll on overall costs.

Proposition 1: transportation price is a low impactful factor to leverage when making a nearshoring/offshoring process with respect to other factors.

Another crucial theoretical finding to stress is the relevance of share of labour costs with respect to the final prices plausibly sourced into a country. Final price then would impact on the final value of stocks costs, also affected by the value of lead time. Based on findings displayed on 5.1, products with higher value of share of labour costs (30-20%) are seemingly more beneficial to nearshore: this is the case of power tools. Indeed these products require an higher percentage of labour (30%) with respect to the average of the products analysed (15%-20%). Conversely those products with a low share of labour costs such workshop tools hardly resulted to be positive to nearshore because of even higher final item price, due to the strong reliance of this computation methodology on labour costs.

Proposition 2: the higher the share of labour costs into final prices of supplied products, the higher the convenience to nearshore the products.

As can be clearly denoted from appendix D, stock costs represent the largest part of total costs when analysing the supply chain of a product. These depend on inhouse prices and on lead times. In this company case, lead time in China is considerably high due to dependency on few suppliers for a large number of items; jointly with the convenience of consolidating the orders for cubing out cargos, it contributes to raise total lead time. Therefore, higher redundancy in suppliers can be beneficial because by spreading the sources of the products there is no time waste to start the production batch for all the products ordered. For instance, average production lead time of internal German suppliers is relatively much lower than the one of Chinese suppliers. Higher flexibility is attained, improving supply chain resilience of the company, should a new disruption occur (Miroudot, 2020). Significantly low production lead times can bear huge nearshoring

advantages in relatively low labour cost country such as Czech Republic and Poland, as denoted from the findings showed in 4.5. These results are conflicting to those inferred by Tomlin et al (2016), who stated that larger diversification led to slower recovery. In this company case instead, it could lead to better responsiveness and robustness against disruptions given lower lead times derived from geographical proximity and supplier diversification.

Proposition 3: the higher the supplier diversification towards mid-low cost European countries, the higher nearshoring advantages in terms of flexibility and safety stocks needed.

This study overall inform theory by providing empirical support to the decision making of nearshoring whose phases have been defined by Bals et al.(2016). This has been attained by applying the methodology ideated by van Hassel et al. (2022). Indeed, as also mentioned by Boffelli et al. (2020), elements on the how of nearshoring are clearly missing in the literature, so these findings shed lights on that by firstly contradicting findings from Chen et al. (2022) , van Hoek and Dobrzykowski (2021) and van Hoek (2020), who stated that transportation prices are the most relevant element to consider when embarking on nearshoring. Moreover it expands the theory boundary of decision-making by hinting on the possible importance of labour costs onto the nearshoring convenience, never mentioned in any article to the knowledge of the researcher. Lastly, with the third proposition this study effectively gives suggestions for nearshoring in terms of safety stocks, one of the most important factor to account for in nowadays dynamic scenario. In this way a prominent bridge between empirical findings and theory has been created.

5.3 Managerial implications

First of all, during the recent turbulent times, these findings can be supportive to any decision maker in the field of supply procurement, thanks to a more adjourned frame of cost related situation across countries. Although this is a specific company case, the large variety of decision-making tools deployed here can be utilized in other contexts and industries to provide hints on where advantages lie in terms of supplier selection country, striving to enclose every information to thoroughly address a possible nearshoring opportunity. Furthermore, uniqueness of context does not constitute a problem for TCO analysis to be applied in another situation, considering also other idiosyncratic characteristics. Besides, should item prices be always known directly, a more precise estimation of total costs and of EOQ/MOQ differences can be carried out.

5.4 Limitations and future research

This thesis bears many pros, mainly connected to the novelty of the field of study and the methodology leveraged. Nonetheless it has various limitations to be highlighted. First, being a company case, generalizability is not fully granted as there are some specific characteristics (e.g. Make to order strategy instead of a more classic Make to stock strategy) which make these findings strictly relevant for this specific strategy: indeed with a MTS strategy, lead times would be necessarily lower because suppliers can store

products for a customer in advance without addressing an entire production batch for a customer. Secondly, item prices from external suppliers were computed through a particular method which is not heavily reliable in all cases, even though some verifications on matching the real values with those computed in this way has been put into place (paragraph 3.3.2). However, there were some cases in which this calculation methodology largely differed from real price values. Thirdly, on TCO an approximation of prices through average was necessary since a large number of items was concerned in some cases (especially in power tools); this could have affected the final value of stock costs by under or overestimating the price value based on the variance of all item prices enclosed into a subcategory analysed. Fourthly, for some products, a vaster country selection could have been put into practice, so that at least 2 different scenarios could have been studied. Lastly, in the analysis for qualitative attributes, some factors have been inserted as they were strictly relevant to the company case, while others have been overlooked based on those utilised by van Hassel et al. (2020) ; besides, computation for a couple of indexes was based on a rule of thumb as explained in 4.3.

Taking cue from these limitations, different avenues of research become available:

- This methodology, especially TCO analysis, can be employed with more accurate values of item prices supplied by external actors, increasing so the reliability of the research. For instance a longer working period inside a company could be necessary to attain that.
- Nowadays' nearshoring trend can prove interesting insights even in territories other than those selected here, such as North Africa or other Far Eastern countries such as Vietnam and Malaysia recently undergoing to an increasing nearshoring phenomenon.
- This research could be effectuated into other specific context in order to analyse discrepancies in costs and qualitative attributes depending on the setting. For example a context impaired by the recent disruption of Ukraine-Russia war.
- As stated by Bals et al. (2016), there are two phases related to a reshoring or nearshoring decision, decision making and implementation. This study only focuses on the former. Therefore addressing the latter can be insightful also with regard to the first phase.

CHAPTER 6: CONCLUSION

The recent major disruption of covid 19 has generated panic and chaos among companies operating on a global scale, augmenting the necessity of strengthening the resilience of supply chains. Studying scenarios for nearshoring constitute an attracting challenge for any company willing to relocate any part of its supply chain closer to the country of origin. As a matter of fact, disruptions are creating advantageous opportunities that companies should be prepared to seize. This study fits right into this purpose also given the scantness of research related to decision making process in nearshoring (Van Hassel et al.2022). The company here analysed is indeed open to any nearshoring opportunity to better deal with problems of availability of products stemming from long lead times subsisting among Chinese suppliers, causing mismatches with the demand during disruptions. Besides, better transparency and lower dependency can be potentially attained.

Based on suggestions of Remko (2020) and van Hassel et al. (2022), a TCO analysis has been effectuated to clearly understand which factors are relevant to this decision, as well as their relative weight onto it. Along with this analysis, a questionnaire for qualitative attributes and a comparison between EOQs and MOQ has been carried out to support such complex decision. In conclusion, it turns out that transportation times does not represent an efficient factor to leverage when making a decision on nearshoring, opposed to the stock costs and lead time. Moreover based on the computation utilised in this thesis, products with higher share of labour costs are less likely to bear benefits in case of nearshoring. In terms of countries, Czech Republic and Poland seems to be the most effective choice in terms of costs and qualitative attributes, in line with their recent economy development and growth. Although this is a single company case, at a first glance these findings might seem to have problems with generalizability, however it is important to stress that the methodology allows for large reusability regardless of the context and company's specificity. This work thus can open the discussion for future researches and findings on a empirical up trending topic like decision making of nearshoring, which has instead very few reflections on the world of research.

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APPENDIX

Appendix A

CLASSIFICATION LETTER	TURNOVER	SALES
A	50% of total turnover	50% of total sales
B	30% of total turnover	30% of total sales
C	15% of total turnover	15% of total sales
D	5% of total turnover	5% of total sales

Appendix B

Question number	Question: How important are these factors to COMPANY X when making a decision on which country to supply from?	Qualitative decision factor related to the attribute
Q1	Low labour costs	TIME
Q2	Low transportation time	VALUE
Q3	Education level	VALUE
Q4	Political stability	VALUE
Q5	Transparent and stable legislation	VALUE
Q6	Efficient and correct government	COST
Q7	Favourable taxation and fiscality	COST
Q8	Sensitivity of fraud/ respect of laws	VALUE
Q9	Ecological consideration	COST
Q10	Ease of launching new activities	TIME
Q11	Well established logistics network	TIME
Q12	Ease of access to credit	TIME
Q13	Cost efficiency of consolidation order service	COST
Q14	Diversification of suppliers' risk	TIME
Q15	Likelihood of natural disasters	TIME
Q16	Frequency of walk-in visits to suppliers	VALUE and COST

Appendix C

Strengths	Threats
-Large pool of workers with low labour costs -Extensive market -Growing GDP	-**L**arge turnover of labour -Transition time are long thus a global disruption can bear detrimental effect -Social and environmental sustainability efforts are not always put in practice

Opportunities	Weaknesses
-Notwithstanding the pandemic, transportation costs are now coming back to the normality -consumer market is growing -it is easier to outsource or offshore to growing countries such as Vietnam or Malaysia	-large pool of workers available also means large unemployment -Chinese government is reputed to be overly restrictive on a manifold of operating aspects - Large geographical distance from Europe, with thus less possibility to make visits

Fig C1 Swot analysis of China

Strengths	Threats
-Strong global economy with the largest GDP in Europe -High quality infrastructure and education system -Strong R&D -High geographical proximity	-strong reliance on global trade can pose severe challenges in case of economic downturns -Aging population demands more skilled labour, leading to skill shortages - Possible infrastructure disruptions due to large lead times
Opportunities	**Weaknesses**
-Lying in the centre of Europe it can provide strategic opportunities in terms of collaborations and trades -Significant technological advancement in engineering, especially in the automotive -Closeness to the Netherlands is favourable to quality checks and transparency	-;Low market capitalization -Complex regulatory environment -Very high hourly labour costs -aging population

Fig C2 Swot analysis of Germany

Strengths	Threats
-skilled labour with not significantly high labour costs -Strategic geographical location -strong manufacturing industry -First in the world for meeting ISO 9001 quality certificate	-It is not benefiting from a high GDP growth rate as the other European countries -Demography' challenges due to low birth rate and increasing number of people leaving the country
Opportunities	**Weaknesses**
-Opportunities in innovation and technology which is still low but on a growing trend -Closeness to the Netherlands is favourable to quality checks and transparency	-Political instability due to changing governments -Low investments on infrastructure (% of GDP) -Regional disparities between the North and the South

Fig C3 Swot analysis of Italy

Strengths	Threats
-Strong expertise and capabilities in metallurgy and automotive -Low unemployment rate -Overall low labour costs also thanks to low tax rate	-Low unemployment rate is partially due to shortage of workforce -Failure to meet international commitments by transitioning to low carbon economy -Corruption perceived level is quite high
Opportunities	**Weaknesses**
-Closeness to the Netherlands -Rising GDP, with large part coming from manufacturing industry -Efforts towards sustainable development by 2030	-Labour costs are higher when compared to other Eastern European countries -Transportation infrastructure is not balanced across the country in terms of quality

Fig C4 Swot analysis of Czech Republic

Strengths	Threats
-Low labour costs -Strategic geographical location between Asia and Europe -Strong compliance to ISO 9001 quality certificate with skilled workforce as well	-Low labour costs are often associated with poor working conditions -Frequent earthquakes, possibly undermining the supply chain -high inflation rate
Opportunities	**Weaknesses**
-Unexpected recovery of the economy after the Covid 19-shock -Robust investments in sustainable infrastructure, education and local development	-High perceived corruption levels -Persistent poverty -Low GDP

Fig C5 Swot analysis of Romania

Strengths	Threats
-Quite low labour costs -Strong labour productivity growth -Skilled and large workforce	- Demography' challenges due to low birth rate and increasing number of people leaving the country - Increasing personnel costs --Increasing economic inequality -Closeness to Ukraine might represent a risk due to the Ukraine Russia conflict
Opportunities	**Weaknesses**
-Fast growing economy, soften by Covid 19 -Significant potential in terms of renewable energy development	-Significant polluting emissions levels with no commitment to become carbon neutral by 2050 -Covid 19 negatively impacted the economy of Poland

Fig C6 Swot analysis of Poland

Strengths	Threats
-One of the highest developing countries in the world -Low labour costs -Growing population contributing to a large domestic market and workforce	-Social and environmental challenges -Political instability -Possible infrastructure disruptions due to large lead times
Opportunities	**Weaknesses**
-Given its cheap labour costs, there is large room for investments -Strong globalization and liberalization of the economy	-Infrastructure challenges -Widespread poverty -Large geographical distance from Europe, with thus less possibility to make visits

Fig C7 Swot analysis of India

Appendix D

WOODWORKING (band saw machine)

		Current situation (China)	Supplier 3 (Italy)	Supplier 4 (India)
PRODUCTION COSTS	*Startup costs (fixed cost)*	200€	200€	200€
	Material costs	308,75€	Prices received directly through a catalogue	121,68€
	Labour costs	47,5€	Prices received directly through a catalogue	187,21€

	Order costs (fixed cost)	100€	100€	100€
	Average price	475€	980€	187,21€
TRANSPORTATION PRICE	*Freight costs and duty*	44,7€	4	17,62€
	Carrying costs	190€	392€	74,88€
STOCKS COST	*Average safety stock costs*	8485,37€	7638,03 €	2063,16€
TCO	*Sum of average price+ fixed costs + transp.costs + stocks costs*	**9495,07€**	**9314,03€**	**2642,87€**

FIG D1 TCO Analysis 230 V Band Saw machine of Woodworking product category (full computation)

WOODWORKING (230 v sanding machine)

	Current situation (China)	*Supplier 5 (Italy)*
TCO	**22007,96€**	**56804,70€**

FIG D2 TCO Analysis 230 V Sanding machine of Woodworking product category

WORKSHOP (Tool trolley)

	Current situation (China)	Supplier 8 (Germany)	Supplier 9(Poland)
TCO	**10679,06€**	**23733,08€**	**14247,31€**

FIG D3 TCO Analysis Tool trolley of Workshop product category

WORKSHOP (Workbench)

	Current situation (China)	*Supplier 8 (Germany)*	*Supplier 10 (India)*	*Supplier 9 (Poland)*
TCO	**34554,91€**	**124218,97€**	**9392,15€**	**53827,97€**

FIG D4 TCO Analysis Workbench of Workshop product category

WORKSHOP (Hoisting and lifting)

	Current situation (China)	*Supplier 11(Czech Republic)*	*Supplier 12 (India)*	*Supplier 13 (Romania)*
TCO	**7680,88€**	**10681,39€**	**2375,59€**	**7003,31€**

FIG D4 TCO Analysis Hoisting and lifting of Workshop product category

POWER TOOLS (Milling cutters)

	Current situation (China)	*Supplier 14 (Czech Republic)*	*Supplier 15 (India)*	*Supplier 16 (Germany)*
TCO	**760,56€**	**679,58€**	**435,1€**	**939,99€**

FIG D5 TCO Analysis Milling cutters of Power Tools product category

POWER TOOLS (Drill bits)

	Current situation (China)	*Supplier 14 (Czech Republic)*	*Supplier 17 (Italy)*
TCO	**938,11€**	**941,63€**	**1431,51€**

FIG M TCO Analysis Drill Bits of Power Tools product category

POWER TOOLS (Saws)

	Current supplier (China)	*Supplier 18 (Italy)*	*Supplier 19 (India)*
TCO	**1764,7€**	**2901,58€**	**792€**

FIG D6 TCO Analysis Saws of Power Tools product category

HAND TOOLS (Chisels and gouges)

	Current supplier (China)	*Supplier 20 (Czech Republic)*	*Supplier 17 (Italy)*
TCO	**762,45€**	**776,48€**	**1135,48€**

FIG D7 TCO Analysis Chisels and gouges of Hand Tools product category

HEALTH AND SAFETY (Personal protection)

	Current supplier (China)	*Supplier 17 (Italy)*
TCO	**1861,76€**	**2886,41€**

FIG D8 TCO Analysis Personal protection of Health and Safety product category

Appendix E

Question number	Average score	Country values*average score						
		China	*Romania*	*Germany*	*Italy*	*Czech Republic*	*Poland*	*India*
Q1	**4.2**	*386,53*	*357,65*	*160,78*	*229,69*	*312,37*	*337,97*	*406,81*
Q2	**3**	*99,9*	*165*	*276,9*	*232,5*	*232,5*	*232,5*	*111*
Q3	**3,8**	*263,34*	*174,04*	*236,36*	*227,24*	*228*	*232,18*	*156,18*
Q4	**3,3**	*233,97*	*233,97*	*269,94*	*228,03*	*269,94*	*252,12*	*203,94*
Q5	**3,6**	*154,44*	*196,2*	*303,84*	*207*	*273,24*	*241,56*	*149,4*
Q6	**3,11**	*198,17*	*139,99*	*245,77*	*181,37*	*218,7*	*179,82*	*180,44*
Q7	**4**	*300*	*340*	*260*	*280*	*340*	*324*	*340*
Q8	**3,3**	*146,85*	*183,48*	*285,45*	*172,59*	*242,88*	*198,33*	*150,48*
Q9	**3,56**	*103,24*	*185,48*	*137,41*	*173,37*	*168,39*	*114,63*	*59,45*
Q10	**3,8**	*318,06*	*270,03*	*336,03*	*264,02*	*301,83*	*300,01*	*254,03*
Q11	**3,9**	*283,14*	*194,22*	*390*	*306,54*	*295,62*	*270,27*	*205,14*
Q12	**2,8**	*162,12*	*243,18*	*209,27*	*104,64*	*209,33*	*225,48*	*243,18*
Q13	**3,7**	*370*	*37*	*166,5*	*55,5*	*37*	*37*	*111*
Q14	**3,4**	*136*	*340*	*289*	*306*	*340*	*340*	*278,8*
Q15	**2**	*8,32*	*118,76*	*105,2*	*62,5*	*187,5*	*94,8*	*2,08*
Q16	**3,4**	*68*	*187*	*313,82*	*263,5*	*263,5*	*263,5*	*119*

APPENDIX F

CATEGORY PRODUCT	*DIFFERENCES BETWEEN MOQ AND EOQ GERMANY %*	*DIFFERENCES BETWEEN MOQ AND EOQ ITALY %*	*DIFFERENCES BETWEEN MOQ AND EOQ CZECH REPUBLIC %*	*DIFFERENCES BETWEEN MOQ AND EOQ POLAND %*	*DIFFERENCES BETWEEN MOQ AND EOQ INDIA %*	*DIFFERENCES BETWEEN MOQ AND EOQ ROMANIA %*
BAND SAW MACHINE		*70,68%*			*-25,2%*	
OSCILLATING BELT SANDER		*82,41%*				
TOOL TROLLEY	*93,02%*		*86,7%*			
WORKBENCH	*95,15%*			*90,3%*	*56,22%*	
HOISTING AND LIFTING			*77,7%*		*-7,6%*	*72,07%*
MILLING CUTTERS	*97,7%*		*95,85%*		*78%*	
DRILL BITS		*95,88%*	*94,52%*			
SAWS		*96,77%*			*79,87%*	
CHISELS AND GOUGES		*90,84%*	*87,82%*			
HEALTH AND SAFETY		*97,69%*				

FIG F1 Differences between MOQ and EOQ of countries in percentage

CATEGORY PRODUCT	*DIFFERENCES BETWEEN EOQS GERMANY*	*DIFFERENCES BETWEEN EOQS ITALY*	*DIFFERENCES BETWEEN EOQS CZECH REPUBLIC*	*DIFFERENCES BETWEEN EOQ POLAND*	*DIFFERENCES BETWEEN EOQ INDIA*	*DIFFERENCES BETWEEN EOQ ROMANIA*
BAND SAW MACHINE		*35,54%*			*-41%*	
OSCILLATING BELT SANDER		*80%*				
TOOL TROLLEY	*80,18%*		*62,22%*			
WORKBENCH	*88,58%*			*77,13%*	*-0,92%*	
HOISTING AND LIFTING			*72,88%*		*-0,31%*	*66,03%*
MILLING CUTTERS	*89,15%*		*80,07%*		*-5,5%*	
DRILL BITS		*86,27%*	*81,67%*			
SAWS		*83,51%*			*-2,9%*	
CHISELS AND GOUGES		*84,03%*	*78,75%*			

HEALTH AND SAFETY	*89,11%*

FIG F2 Differences between EOQs in China and other countries analysed in percentage