



TREBALL FINAL DE GRAU



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1 OBJECTIVE

As a student finishing his/her degree, the first question that appears at your mind is how is the world turning? Which is his/her rhythm? Am I prepared for my real needs?

The contents that we have been studying in the class rooms are based on real situation, but they are still theoretical information that in this moment do not have the opportunity to look at them with our own eyes. So, we question ourselves if that kind of things work as they are taught.

After, we have passed a global pandemic, it's very easy to answer those questions. It's obvious that the world has changed, so we have to adapt our capacity and our knowledge to the need that the society is claiming.

The principal objective of this project is based with what I just explained. A good way to know what I'm facing after passing my university degree in logistics is investigating which is the current situation of competitive environment, what problems is facing and what factors caused them.

I think that is very important, take a job and know what is happening in the sector. It makes you understand certain actions and decisions, and of course, it's a way of giving the best of you.

To do that, I posed three hypotheses that could give me a global vision of what the logistics have been through during the pandemic and which is its situation right now. My principal main is to understand the principal factors, how the logistics how faced the principal problems and what is happening in the actual market.

I reckon that the interest of this project lies in the study of the principal keys that destabilized the global supply chain and which was the response of the professionals and the governments to return the normality to the international logistics under the pressure of the possibility of facing shortage of basic needs.

2 HYPOTHESIS

Hypothesis 1 **Covid19 caused disruptions to the food and healthcare supply chain.**

The food and the healthcare material are part of the basic needs that a human need for life. With a global pandemic, disrupting the supply chain, those needs may have suffered shortage. The resiliency of the logistics operators and their adequacy over an atmosphere of constant change, like the Covid-19 did, could not have been enough.

In case the global supply chain strategies have changed, let's see which were the actions that enterprises, logistics operators and governments took.

Hypothesis 2 **Governments established corridors to maintain the effectiveness of the global supply chain during the Covid-19**

The discovery of a very contagious illness, like the Covid-19, caused governments to take various measures with the aim of protecting the society. One of them was to establish lockdowns and transport restrictions.

To be under a globalized world, where goods can come from any part of the world, the global supply chain needs to move big quantities of items around the globe.

Let's study how the government, under sanitary restrictions, solved the problem maintaining good transportation.

Hypothesis 3 **The enterprises had to change their logistic in response to the demands of the society during the Covid-19**

The demand of the society behaves according to the global context.

It's clear, that Covid-19 has changed the perspective of many things.

The enterprises and the logistics operators should be ready for any kind of change from their customers.

It's interesting to observe how the market changed during the pandemic of Covid-19 and how the enterprises and logistics operator answered to this big change.

3 METHODOLOGY

The first thing that I did, was recollecting general information on how Covid-19 affected the logistics.

Most of this information came from papers that talk generally about the topic or even I have chosen ones where professionals express their opinion (based on facts) or suggest optimal solutions to reinforce the actual logistics models.

Although, that data does not really contribute to my project, it gave me an idea about the progress of the logistics during the sanitary crisis. But it really helps me to start formulating my hypothesis and establishing the scope.

Once I knew which topics I would like to include in my project, I searched for information about them, basically using two sources of information, papers and articles published in web pages.

Papers were not as useful as expected, given the context of the international logistics changing constantly, recent publications were found to already be outdated, and to keep this project slightly updated, I have to reject them. But it helps me draw the progressions that the logistics have experimented with during these two last years.

In response, I extracted the majority of the information from articles posted on web pages or blogs. I tried to choose them very carefully, and select those that were posted on the platforms from international constitutions or reliable organizations.

In addition, the fact that I could witness the sanitary crisis contributed to the drafting of this project. It really helped me take into account some aspects that I included without using a reference, just based on what I could experiment. As a part of the society that suffered from Covid-19, I have seen the effects that have the restrictions, how the enterprises changed their strategies and the shortages of certain items in the society.

The data used in this project comes from different types of sources:

- Online platforms from international and recognized entity like the WHO in sanitary themes or the European Commission in case of legal regulations.
- Main source. I extract the papers mostly in the Transportation Research Part E: Logistics and Transportation review. That journal is international and supported by the Sciences Direct, where professionals on this kind of subject can posted their research.
- Online blogs from enterprises that are dedicated to the logistics sectors like DHL with the aim of searching specific information about what they have done during the pandemic.
- Online newspaper were are useful information like *El Mercantil* that they're really in the transportation sector.

4 RESEARCH

4.1 INTRODUCTION

There have been multiple phenomena during the last centuries that changed our life: wars, natural disasters, nuclear explosions, pandemics, etc. So, the world has had to re-adapt itself, because it's so difficult to think about a constant world where nothing can happen.

Three years ago, a very contagious virus was discovered in Wuhan, China. It's still unclear what could be the origin.

The spread of Covid-19 has been really fast, in just two months after detecting the first case all the globe was facing a sanitary crisis.

Without knowing too much information about this virus, the government started acting, imposing measures that could protect the society. Establishing sanitary measures, lockdowns, restrictions of mobility with the aim to reduce to the minimum the contact with people.

One measure that was also imposed is to restrict the international movement. For a few months, the countries tried to "seal" their territory affecting business trips, holidays and the most important thing, the international commerce.

We live in a world that it's really globalized, and in one way or another, countries depend on each other. Almost all countries trade between them all kind of goods, so, any kind of disruption that affects one point of the global supply chain, can cause the international and national logistics to weaken.

Almost all sectors destabilized for months, they could not receive raw material, send products or suffered shortage of workforce because they contracted the virus.

At this moment, enterprises started to change their strategies with the objective to reshape them and survive the crisis.

Of course, the problems that were facing the enterprises affected the general population. It was complicated to acquire certain products or they had to buy them overpriced. And even worst, the governments were really struggling to buy healthcare material.

Logistics operators were finding many difficulties to transport goods from one place to another. The restrictions from the governments and the illness affecting the humans were two really important factors that disrupted the global chain, this is specially concerning in a globalized world, the supply chain has to work smoothly to ensure the world keeps going on.

It was a real challenge for them to work under new rules and have the obligation to still work just to ensure that society could have access to essential goods.

For that reason, governments and international organizations were hard working on creating safe corridors to ensure that the international commerce didn't stop.

The aim of this project is to observe how the global supply chain suffered from disruptions and what did and do the logistics operators to solve those problems, focusing on the adversities on the essential needs and the change of the in demand.

4.2 THE ORIGIN: CHINA IS THE STARTING POINT

As we all know, the pandemic started in a city called Wuhan, one of the most important cities in China.

Maybe you can think that when we are talking about a pandemic it doesn't matter which is the origin because is a phenomenon that will affect the entire globe.

But it does in fact matter because we are talking about a pandemic that started in one of the world's powers. That means that in one way or another almost all countries will suffer a negative effect rapidly.



Figure 1. Map of China. Daniel Wood

The effect of globalization created an environment of competition, and this goes further than companies. The real contest is between countries. They try to become the most powerful around the globe, and how can this be possible? One approach is inviting companies to invest in you. And this is what is happening in China.

China is offering to the world one aspect that just a few countries in the world could: a massive quantity of workforce. The population registered in 2021 is around 1,41 billion, with over 32,7 (28,7%) million people working in the manufacturing sector. [1]

Another aspect is the value of the wages. The average salary for a manufacturer worker is 54101 yuan/year, which is equivalent to 639,32 €/month. [2]

Countries like India, Vietnam, and Malaysia are offering lower wages for their workforce, which make them a more cost-effective place to manufacture for the companies. But at the same time, these countries can't offer the massive infrastructure that China has, because we are comparing a world power against third-world countries.

Also, these other countries are under stricter environment policies, making it less attractive for companies.

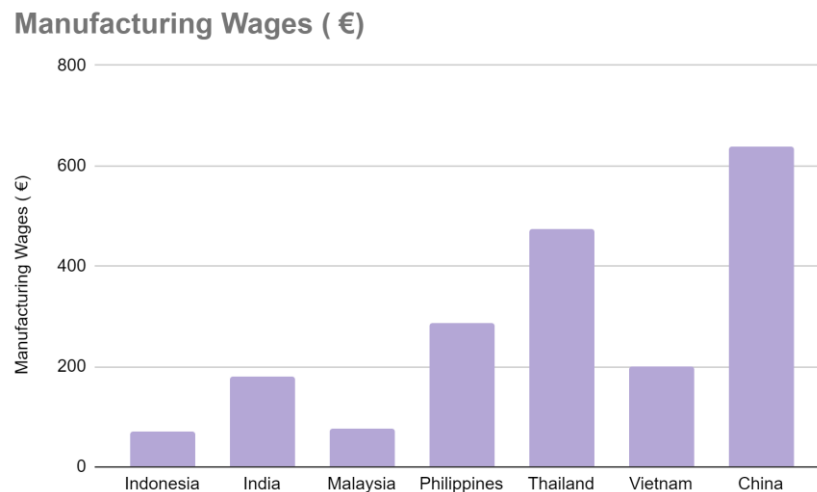


Figure 2. Comparison of manufacturing wages.

China is also special in the position it keeps in the manufacturing process. His principal function is the assembly.

Manufacturing companies receive different pieces that compound an object and they put it all together. Once they assembled the product it is sold to other companies creating a B to B model.



Figure 3. Description of the manufacturing sector.

For better comprehension, these are two examples that show how the automotive and electronics sector work:

As said by Jun Zhan and Siyu Lu in his paper "Influence of COVID-19 Epidemic on China and Global Supply Chain and Policy Suggestions" posted by the Scientific Research Publishing, the electronics sector, there is a "triangle trade". Japan and countries from East Asia provide high quality electronic components, which are sent to China or Southeast Asia for the assembly part. At this point the product is sold to companies from Europe, America, and other regions. [3] An example of a company could be Samsung Electronics (Japan) or Apple (USA).

The automotive sector is very similar. They received the different pieces from other countries, and their mission is the assembly of cars. Currently just four companies are dedicated to this sector in China. They work exclusively for brands like Toyota, Volkswagen, or Hyundai. China embraces more than 80% of the automotive sector related to the assembly of parts.

Once we know a little about the influence and the power that China has in the world's supply chain, we can analyze the impact of the Covid-19 that suffered.

With all this information you can imagine the importance of an optimal organization of the supply chain.

Logistics are very important; goods and products must arrive at the point where they are needed as quickly and cheaply as possible.

All this data can be summed up by just a number. It was reported in 2021 that 18% of the Gross Domestic Product (GDP) growth was from China, the second country with the biggest growth, behind the USA.

Global GDP 2021

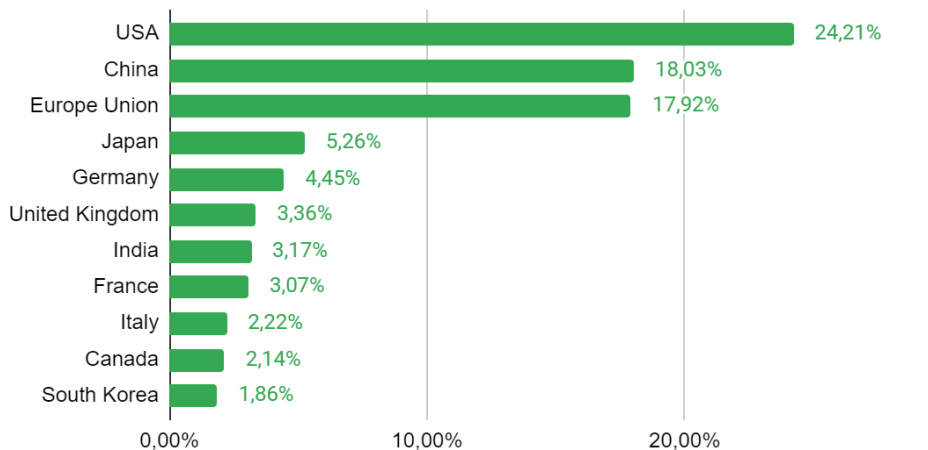


Figure 4. Global GDP 2021 – Main countries

The Santander Bank posted a study in his online blog where the objective is the study of the contribution of China in the world. If we pay attention to the numbers of importations and exportations that China executed from 2016 to 2020 it is impressive. The next graphic shows the quantity in millions (USD) that China experimented with these years, according to World Integrated Trade Organization (WITO). [4]

We can see how the exportations increase yearly even through the pandemic during 2020. Importations experience a slight decrease starting from 2018.

Importations And Exportations Of Goods From China

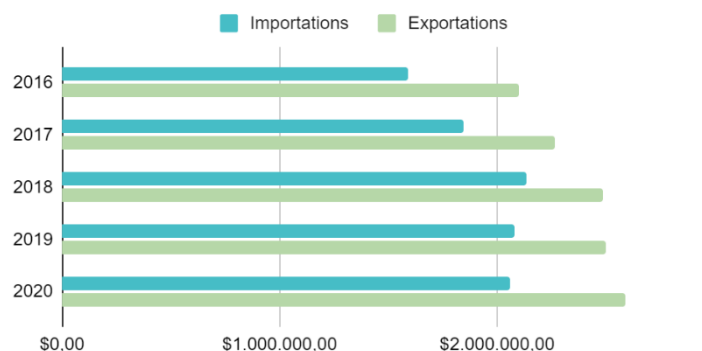


Figure 5. Graphic of the importations and exportations from China between 2016-2020. Source: World Trade Organization (WTO)[4]

We must understand that China is a country that is very involved in the health and safety of its people. At the same time, the population is well “educated”. They follow very strictly recommendations and rules imposed by the government.

At the end of 2019, when the Covid-19 was discovered as a very contagious virus, China declared a lockdown without hesitating. Initially it just affected the region of Wuhan, where the virus started; but then it was all over China.

This action has a direct effect on the factories. All the population was under a lockdown, and the workers couldn't go to their jobs.

For a few months, the situation was instable and full of questions and insecurities, because in these moments companies were losing money because their factories weren't working with stability and didn't know when the work force could return.

It was not until March of 2020 that the factories could begin to work with certain normality but under strict health measurements.

The real impact was detected during these three months, it was a special situation that China stopped its industries, unsatisfying the needs and not providing goods for companies around the globe.

According to the United Nations' list, China is the only country in the world that comprises all the categories related to the industries. This fact guarantees that the situation in China has repercussions to the world exportations.

The association CEPAL (“ Comision Económica para America Latina y Caribe”) published a paper that studied the effects of the Covid-19 towards internacional commerce and logistics. In his publication they could evaluated the change in the volume of the world-wide commerce in the period 2019-2020. [5]

Change in the volume of the world-wide commerce in the period between 2019-2020 (percentage)

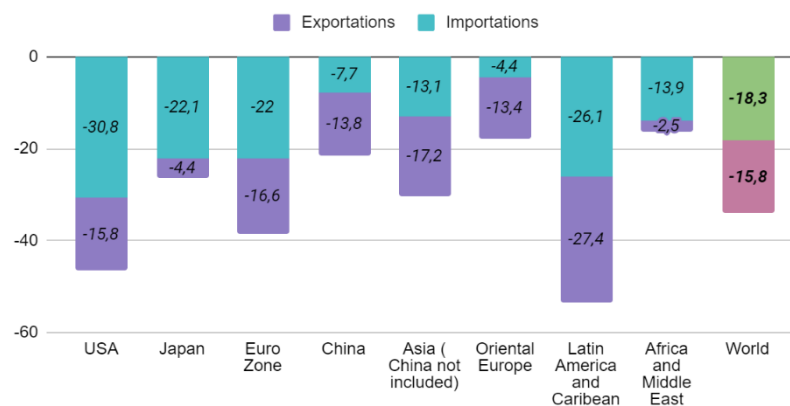


Figure 6. Change of volume of the world-wide commerce in the period between 2019-2020. Source: World Trade Monitor[5]

We can see that all the importations and exportations of all the countries evaluated decreased drastically.

On the one hand, exportations in the USA experience the most significant loss among all the countries. Japan and Europe were the third and the fourth territories most affected.

On the other hand, if we take attention to importations, Asian regions are the most affected followed by Europe and USA.

It is worth noting that Latin American countries and Caribbean were the most affected regions but they were not taken into account because they are not within the scope of this project.

Overall, the most important point is that the USA, Japan, and European countries received a severe blow in both exports and importation.

The influence that China has in the supply chain and its blockade measures led to sending unfinished products and in other cases just the primary product. That has a consequence, as we have seen in the previous table, the supply chain of their customers was severely affected, leading to important disruptions or even stopping the global supply chain.

At that moment the exports from China were insufficient, creating significant delays and shrinking certain demands.

In March of 2020, China's industrial activity was resumed and it begins to recover. You can think that once China started again his activity problems related to the supply chain would disappear, but during this time the focus was somewhere else.

The main problem after the lockdown was that the customers of China (enterprises and countries) were now the ones affected by the pandemic, so the operating rate was still under the expected.

This situation endangered the safety and efficiency of China's supply chain.

This was a boomerang effect. Even though China had resumed its activity, other countries couldn't restore their activity. This led to a decrease in the turnover of importations and exportations that China was used to handling because its customers weren't creating the flow of materials and products. So, the activity of China still decreased, putting in danger the survival of its own companies.

The other aspect of this effect is the position that countries like the USA, Europe, or Japan took. They tried to shut the country, causing a shortage of air transport and shipping capacity. The principal consequence of this act is those customer manufacturers couldn't deliver their products or even receive raw materials.

This was the moment when economists started to worry about the anti-globalization, which increase the actions to protect the national trades; leaving international cooperation and trades tied as Meng Qin, Xiuyan Liu and Xiaoxue Zhou in his paper "COVID-19 Shock and Global Value Chains"[6]

Is there a Substitute for China?. This thought starts when the countries partially locked their border to the rest of the world and began to look for solutions with their own resources.

For instance, it was soon observed that Covid-19 affected the lungs causing the loss of breath capacity. Patients from the hospital where they lived depended on respirators, and the demand for these machines started to increase exponentially.

Companies dedicated to manufacturing respirators found out that they couldn't accomplish the immense demand from their customers, for two reasons: they couldn't manufacture the number of respirators that were needed, and the restrictions from the countries weren't helping in sending the equipment.

At this moment, when the government faced this reality, companies that did not manufacture respirators but had the ability to do so were incentivized to start producing these machines.

In Spain, we saw some companies that took this challenge, for example, Seat - an automotive firm, or Bosch - an appliance firm.

Of course, these activities were just temporary for these companies.

This is just an example to show that all countries needed to use their own resources to accomplish the real demands that weren't possible to bring to the territory.

In one way or another, countries found a solution without relying on others, in certain ways. This is the moment when the economists saw the danger of the anti-globalization movement.

Disruptions that affected international airlines and cargo shipping, made it more difficult for the firms to ensure certain protectionism to the trades.

At this moment, logistics changed, because the needs of people changed, but we should think that the world must still be running and cooperating. This issue will be addressed in further sections.

An article from the online platform *Actividades Económicas* written by Juan David Montoya gathered data from China Economic Review, Atlas MIT, Economy Watch and IMF aiming to collect information about the exportations and importations from China.[7]

In order to understand better the impact that disruptions of the Chinese supply chain can have to the rest of the world, the main exportations that China participates can be seen in the graphic below:

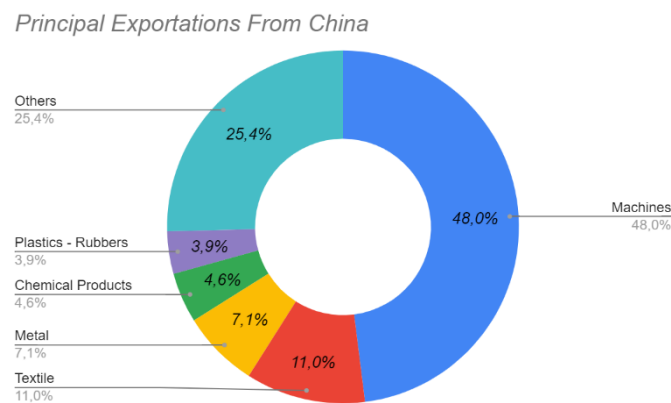


Figure 7. Main Exportations from China.[7]

As we can see, China has a relevant presence in the machinery sector. It is well known that China has important technological equipment and some technological advances come from this country.

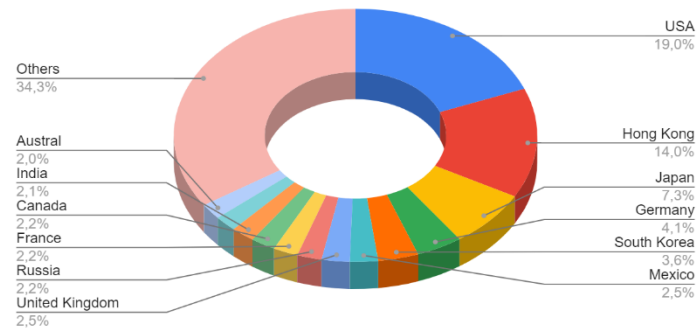
Textiles are also an important sector. Many textile firms around the world, have a presence in the manufacturing line of China. An example of an enterprise could be Inditex, Armani, or Prada.

Goods like metals, plastics, or chemical products are exported as manufactured products. China imports raw materials and in its factories, they manipulate these materials to transform them into a product.

But which countries or enterprises receive Chinese exports? There are a few countries that are great customers of Chinese products.

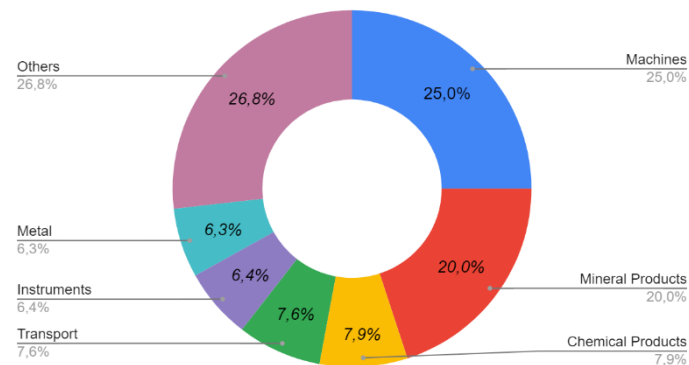
Like I said before, China is a manufacturing country, raw materials production and exportation is not relevant compared to finished or semi-finished products. They do not have great mines or oil plants; they just assemble.

So, in this logistics and commerce world, China is also a customer.

Principal Costumers Of China*Figure 8. Main Costumers of China.[7]*

The principal importations that China received are the next ones.

Importations correlate to exportations. If we begin with the fact that China is a manufacturing country, the raw materials have to be used for the products that they sell to the world.

Principal Importations To China*Figure 9. Main Importations to China.[7]*

This information helps us understand why the fact that Wuhan started the pandemic is so important

China is the factory of the world. If one of their sellers or customers fails with the activity or flow that they used to do, consequences will affect around the globe.

The main thing that will receive the impact is the supply chain, the logistics, the transportation, etc. In a world that is already globalized a failure of this kind, is a serious problem.

In summary, in order to make clear the importance of China in this pandemic, let's refresh the principal consequences why the supply chain fails and destabilizes.

The first reason is that China was the first country affected, making all its factories close and cancelling all demands from their customers.

The second reason was the lockdown that applied to most countries to protect the population from the, at the time, unknown virus and its effects. Therefore, firms couldn't import or export certain products, creating a shortage.

Finally, the third reason was that once China restarted its activity the world wasn't ready yet. The manufacturing sector of China suffered these consequences because although they could begin their activities with normality its customers weren't creating the flow of demand that makes Chinese factories conduct their normal business. It was a situation of a fish eating his own tail.

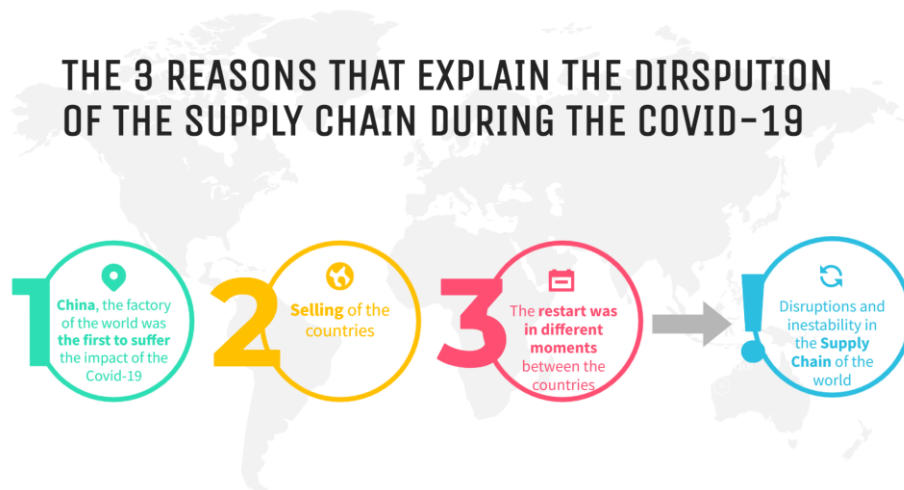


Figure 10. The 3 main reasons that explain the disruptions of the supply chain during the Covid-19

We must understand that we live in a globalized world. We depend on others, and the mission of the supply chain and the international logistics is exactly this one, to make the world work and satisfy the needs of people. The reasons explained above show how the supply chain can fail and its effects in the whole world.

4.3 FOOD AND HEALTHCARE SUPPLY CHAIN DISRUPTIONS

4.3.1 Food Disruptions

As customers, if we think about supermarkets or local shops during the pandemic, we didn't see them out of stock. You could buy any product you wanted. Even culinary practices became an entertainment. If you had a social media account you could see how many people posted their own creations.

I would dare to say that most people learnt how to bake bread. At this moment we really could notice that many supermarkets ran out of any kind of flour, but the reason was just the high demand of this product.

But on the other side of the shelves, the companies, even little local shops, were struggling with the problem of bringing food to their customers.

The principal reason was what I explained before, the great problem that was suffering the global supply chain. Collaterally other problems started to appear, that made the food supply chain a real challenge.

About a problem that I mentioned before, once more it appears in this section: transport restrictions.

The decision of the governments to seal their territory was a measure that wasn't helping to make the supply chain flow. And food is also included.

In a globalized world, food products can arrive from any part of the world, even if the product is from the region.

For example, in Spain we have two types of bananas. One comes from the Canary Islands and the other one from South America. As a consumer, the biggest difference is the price, the foreign product is cheaper than the national one. So, on certain occasions you will choose the Canarian one.

This is just an example of how the international food market works.

These restrictions made it impossible to buy products from other countries, and forced in certain ways to consume more national items.

On the other side of the coin there are the enterprises which also sell their product to the exterior.

They couldn't get an income from the foreign part, because they weren't allowed to sell.

As you can imagine, this action had a real consequence on the prices, which I will talk about later.

Meanwhile, the logistic firms that carry essential products like food or healthcare, were able to work with normality. This action was essential for supplying the people with their basic needs. But this measure just has a national scope.

The second problem that appears is because the Covid-19 affects the people.

Workers from the food industry contracted the illness, that means that the enterprise did not have enough work force for all their tasks.

That has made appear many effects:

1. The first one is that the product cannot be manufactured, so the factory does not deliver it. They cannot satisfy the demand from the customers and the food does not arrive at the supermarket. The main reason that can happen is shortage of resources like raw materials that did not arrive because of transportation restrictions.
The benefits of the company decreased, because it couldn't generate enough product. That is a critical point for the survival of the company.
2. When a worker contracts an illness, they have the right to take an illness permit to overcome the virus and still have the same income. At that moment, if you contracted Covid-19 you had to stay at home for 15 days. That rule was imposed by the government.
For the enterprises this is a huge problem. Because, on one hand their workers can't be available for two weeks, and on the other hand they have to pay a worker that is not generating an effort in the industry with the help of the government.
3. Related to the previous point, in the food industry we can differentiate between the animal part and processed products.
Processed products do not have any problem if you do not transform the raw material into a product during a short period. But, if during this period the material is not consumed, the enterprise can experience a waste of raw material; which means losses.
But animals need to be taken care of every single day. The problem appears when you do not have enough workforce to do all the tasks. The response of this is that you may need to sacrifice some animals.
4. In case an enterprise has international deals or customers, they do not have the capacity to transport their products due to the international restrictions that are imposed by the government.

All the points that I explained have something in common, the victims are the industries and their workers. Industries cannot create the income that they used to, and this reflects in the wages of the employees and the supply for the supermarkets.

John A. L. Cranfield, in his article "Framing consumer food demand responses in a viral pandemic" suggests that practically 80% of the cost of producing many fruits and vegetables is destined to the wages.[8]

Of course, all these news and consequences, arrived at the ears of the society. Rumors of possible shortage of food, put the people on alert. The panic over the people was already installed.

At the beginning of the pandemic, when the lockdown was established, many people started to buy food desperately. That created a huge demand on the supermarkets.

For example, an effect of the Covid-19 illness are stomach disorders. People started to buy a massive quantity of toilet paper. Javier L. Velasco published in the journal "Heraldo" that just in a week the demand for this product increased 25%. [9]

Other examples could be the rice and pasta with increases between 259% and 335%. [10]

Supermarkets in order to guarantee that their shelves were full of product, made many agreements with logistics firms for supply products. These businesses experienced an increment of demand of 12%, during the second week of March 2020.

The sudden increment of demand around the world was translated into prices.

Consumers started to notice that supermarkets were sneakily increasing the prices of their products.

That effect on the prices had different reasons. This is the impact that the logistic firms were facing during the pandemic.

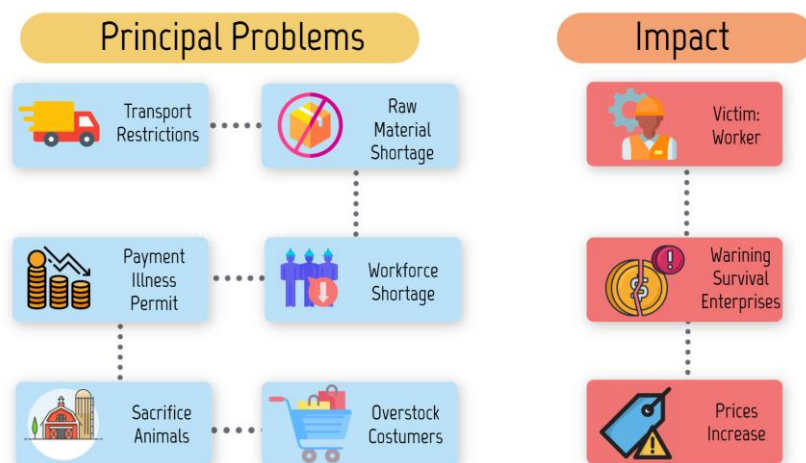


Figure 11. Summary of the principal problems and the impact in the food industry caused by the Covid-19

The first thing was the price of the freight or cargo. The 30th of January 2020 the price of the freight had a value of 1,732\$, and had been increasing until 4,911\$ in April 2021. In just over a year the price had increased 2,8 times.[11]

The increment in demand affected logistic firms since they did not have capacity to accomplish all the requests.[12], [13]

The active containers were insufficient, cargo ships did not have the enough space and containers for all customers. Also, the transport restrictions from the government stopped many containers which had been inactive during the lockdowns.

Moreover, working in these conditions created bottlenecks in harbors or logistics spaces. The logistic activity was not flowing.

All these reasons made logistic firms increase the prices of their services, and supermarkets had to reflect this rise into their prices.

The World Bank published in April 2020 that, organizations like Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD) and World Food Programme (WFP) stated that “the pandemic is already affecting the entire food system” [14]

The effectiveness of the Just-In-Time strategies in the food sector were falling, there was delay and over demand. [15]

Covid-19 has shown that the food system is vulnerable under changes.

Jhon G.Keogh revealed that there is a need to rethink the existing food system resilience. [16]

At this point, the real challenge for logistic firms, governments and even supermarkets were to turn the supply chain into an accessible, available, affordable and stable system. The conjunction of these conditions is the response to guarantee to the final customers that the supply chain is doing its job. [17]

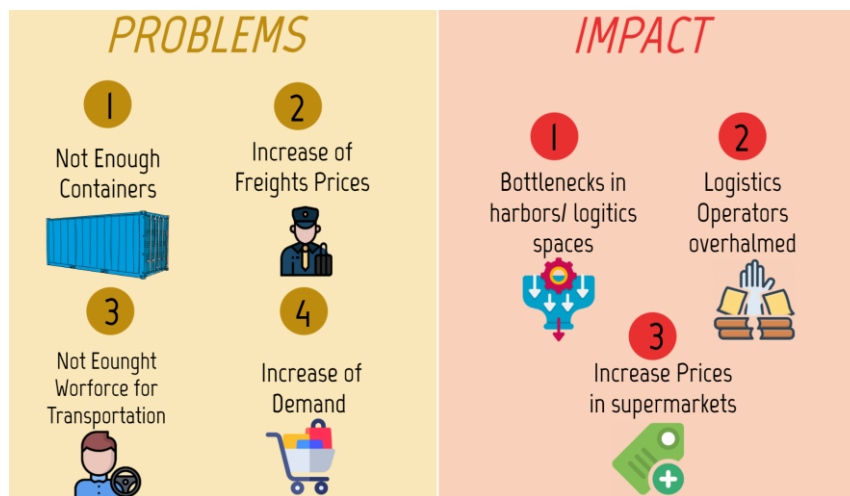


Figure 12. Infographic about the problems and the impact that the logistics dedicated to the food sector suffered due to Covid-19

4.3.2 Healthcare Disruptions

The other side of the “basic needs” is to ensure the correct functioning of the sanitary system, and unfortunately it suffered a direct impact.

We do not have to forget that Covid-19 is an illness, even at some point it was an unknown virus that made people sick or, in some cases, caused death.

The disruptions in healthcare material that the world experienced are totally related to the situation in China at the beginning of the pandemic, explained chapter number two. So, we have to take into consideration all the information.

Nowadays and before the pandemic, China has been and is a major supplier of active pharmaceutical components. That includes raw material for the production of pills, painkillers or other medical supplements. Specially products like paracetamol, antibiotics such as tinidazole and erythromycin, progesterone and vitamin B12.

Furthermore, it is a world referent in the production of personal protect equipment (PPE) like face masks, disposable gloves or aprons and eye protection. [18]

The covid-19 disease, as we well know, is very contagious and, in some cases, deadly. To ensure a correct and protective attention to the patients and the sanitary staff, medical suppliers and PPE are really necessary to face the illness.

The healthcare equipment experienced shortages in critical moments.

The World Health Organization (WHO) reported that 90% of the countries surveyed in a study admitted that they suffered disruption of essential health services during Covid-19.[19]

Hospitals can run thanks to its qualified personnel, but do not forget that they are also humans and can be infected, like in the industry. Even these people were more exposed to contracting the illness because they were continually working with infected patients.

This was also a problem in the healthcare disruption, many sanitarians couldn't go to attend patients in critical circumstances because they also contracted the virus.

The WHO published that 35% of the countries surveyed had to face workforce challenges.[19]

At this moment, the sanitary department was dealing with two big problems: the sanitary material was scarce and they did not have enough workforce to take care of the people that were in a critical situation.

Moreover, we can add that the hospitals have to overcome their own capacities and many of them have to treat patients on the aisle or even chairs.

To put a solution at the capacity of the hospitals, the military logistics get in. In some strategic points, event halls or even pre-conditioned hospitals were built.

The government also took part with the shortage of PPE and sanitary machinery. Like I said in the chapter number two, the government called out national industries to collaborate with the aim of manufacturing sanitary tools.

There are some examples of relevant companies in Spain that take this aim as an objective.

Grupo Puig is a catalan company dedicated to creating perfumes for important firms like Prada or Carolina Herrera. During that period, the enterprise stopped the production of perfume and started to produce hydroalcoholic gel. Repsol, a fuel distributor, or L'Oreal, a hair product firm, made the same. [20]

Diseños NT, a national textile industry, changed its production for the creation of face masks. His capacity of fabrication reached 80,000 face masks per day. [21]

Also, do not forget how Bosch and Seat collaborated together for the fabrication of respirators.

If we centered the look on the logistic support, for instance, Airbus, a European aircraft producer, created an aerial bridge between France and Spain. DSV, a logistic firm, created a direct connection between China and Spain.

Iberia, an aircraft company, helped the government to repatriate Spanish people who were stuck in some foreign country.

These are just a few examples of how the companies changed his perspective and collaborated with the government.



Figure 13. Summary of the problems and the solution in the healthcare.

The interesting aim that the international logistics faced related with the healthcare disruption was the transport of the vaccines.

As you well know, some important firms of the pharmaceutical sector, achieved the most anticipated thing in that moment, a vaccine against Covid-19.

The vaccine had to arrive to all countries around the globe, and the supply chain had to be ready to transport and ensure the safety of them.

There are a few pharmaceutical firms that have accomplished the creation of the vaccine. The industries or the production point are located depending on where the firm is established.

These are the actual firms that competed in this task: Pfizer (USA), Moderna (USA), AstraZeneca (UK), Janssen (USA). Those firms are approved by WHO and the European Medicines Agencies (EMA).

We can find out that other pharmaceutical brands also created a vaccine, like Spunitk (Russia) or Sinopharm (China). But they are a little controversial and not all the countries allow the vaccination with these last two firms.

Once the vaccines were approved, countries started to create deals with the pharmaceutical firms to ensure a certain number of vaccines for their own population. Also, the contracts specified the period during which they had to be released.

This is when the logistical challenge begins. All the vaccines have to be kept cold, once they leave the industry. [22]

The cold chain is a difficult task, because refrigerators where the product is kept always need an electrical source. And sometimes, depending on the point where you need to arrive, it is difficult to ensure a point of feeding.

Moreover, the duration is not infinite in some vaccines. They have to be consumed in a certain period to ensure the effectiveness. The times of transportation are also relevant.

Pfizer's vaccine has to be consumed in 15 days and has to be kept between -25°C and -15°C.

Moderna's vaccine has 30 days of duration in temperatures between 2°C and 8°C. For a longer duration, it can also be kept for 6 months in -20°C.

The rest of vaccines just need a refrigeration between 2°C and 8°C.

As you have seen the vaccine has its own condition, and the supply chain must respond adequately.

Cold chains are very sophisticated, because the ideal temperature always remains the same, and the infrastructure is very expensive. Moreover, the temperature should constantly be monitored and up-to-date records for traceability.[23]

If at some point of the supply chain there is not the needed equipment, like cold chain trucks or boxes, or there are deviations in temperature, it is no longer possible to guarantee the quality of the vaccine.

Furthermore, the government acted to ensure that corridors or logistics activity areas worked coordinated.

The short duration of certain vaccines and the long distances between the factories and other countries, practically forced planes as the main transportation tool. For this instance, many air-crafts companies decided to collaborate like Emirates or Swissport.

Of course, prepared and specialized transport companies take a major part; which own their own planes. An example could be, UPS, DHL, FedEx or Atlas Air. [24]

Once the vaccines arrived in the country, there were two options.

The first one, is when the pharmaceutical firm has its own logistic zone at the country of destination. The vaccines are delivered at this point, and then the military force takes them for the distribution.

And the second one, is when the pharmaceuticals do not have a logistic zone. So, the military force of the country takes the vaccines directly.

This is a general description; each transportation firm has their own proceedings depending on the context where they are.

Just to have an example, let's look at DHL logistics procurement. [25]

They create three archetypes end-to-end. The next infographic describes perfectly which were their actions depending on the context they faced.

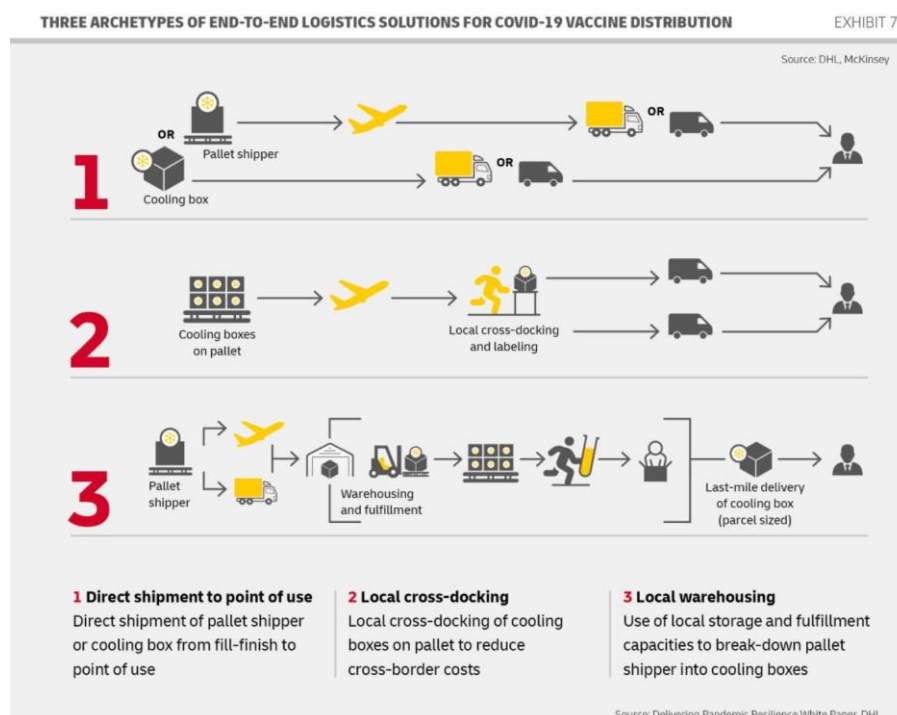


Figure 14. The three archetypes of end-to-end logistics solutions for Covid-19 vaccine distribution. Source: DHL.[25]

In conclusion, food and healthcare supplies are really necessary for the survival of the population; governments, enterprises and logistics have to collaborate together to ensure that every person has these two things covered.

The disruption that the supply chain suffered has shown us that we are vulnerable to any kind of change, and now we need to focus on the research of more resilient methods. However, the effort that we have seen with the vaccine's supply chain demonstrated that logistics can be ready for any kind of challenge.

4.4 CORRIDORS

As I mentioned before, one of the biggest problems that the international and national logistics were facing was the transport restrictions.

The governments also knew that all society depends on the transportation of goods, principally food and healthcare.

But, at the other side we found the enterprises that belong to other sectors that also were supplying demands. These demands are not part of the essential needs that a person should have, but they also should be supplied.

The national and international administration couldn't let enterprises stop the activity; this is the reason why the corridors were created. Their mission was to track a safe route along the countries to ensure the supply of all the demands and avoid the impossibility for the industries to transport their products. Corridors were just for the use for carriers.

Besides, it was also a sanitary measure. Total and partial lockdowns and displacement restrictions were present during over a year, so the corridors helped out controlling the movement of the population.

The transport section from the European Union (EU) administration launches an invitation for all the member countries to create "green rails". [26]

This petition was sustained by the idea of the creation of safe corridors, where carriers could drive without legal or administration impediments and a guarantee of health security.

An example of what demands this statement made are:

- The administration traits must to be reduced
- The inspection of the truck must be done avoiding contact with the carrier.
- The road restriction must be removed.
- The carriers needed to dispose of safety spaces during the journey.

As you can see the measure has the objective to create efficient roads and protect the carriers. It's important to ensure or at least try to ensure a free-covid road because the workforce is needed to supply the demand, and large administration processes could slow down the activity.

But other measures have been adapted in front of the different type of transportation that we used these days. So, in that case, the EU understands that each type of transport needs different conditions for a fluent work.

A paper posted in the online platform of the European Commission, named "Transportation during the pandemic", specified which measures was taken by the EU for keep the freight continually moving. [27]

They really specified which is the aim of these decisions. They want to make the supply chain started working with normality again, and one of the most important things is to ensure the on-time arrival of the sanitary material at the hospitals and the food at the supermarkets. The commission also declare that the measures are applied for all the logistics operators, where the content of the containers do not have reliance. So, it destined for all kind of goods.

Furthermore, another objective is to reduce the costs of the freight in the European territory and ease the regulatory burden.

Next, I'm going to explain which are those decisions for every type of transport:

LAND TRANSPORT

The European Commission has adopted four measures for a great functionality of freight transport in Europe:

- Crossing between countries of the EU should take less than 15 minutes. Including necessary certifications.
- Corridors are open to any type of good.
- Countries should lay down the transport restrictions wherever possible. In case that statement cannot be accepted, transport during nights and weekends should be a solution.
- Reduce at maximum the paper work.

RAIL

To make more fluent the national and international commerce in the European territory, the rules on leaving of charges of the railway infrastructure will be laid down temporary. If it's necessary this measure can be extended as long is necessary.

AVIATION

The measures have been taking to facilitate the air freight in Europe:

- Enable air freight from outside the EU to enter the European territory.
- Remove night curfews for aviation.
- Passenger aircrafts can be used as a cargo only in case is extremely necessary.

SHIPPING

In this case, the EU just mentioned the traffic of waste shipments. It's important to maintain that service fluent for a proper management of the waste.

Even, more important, into a sanitary crisis given the increase of sanitary waste.

These are all the measures that the EU has taken for a fluent supply chain in their territory. It's just an example, each country has decided their own measure.

Of course, at this moment, all that measures have been laid down and regulation of the transport came to the normality.

As an anecdote, I had done my university internships at an enterprise called Gergonne, located at the industrial polygon of Vilanova del Camí, Anoia, Barcelona. His principal activity was the creation of foam pieces for the motor sector.

My position was at the Quality department, but I spent one day at the Logistic department.

The responsible of this area told me that during the pandemic they were worried because any transport company could deliver their products, and the same happens with the raw material.

The association "Unió Empresarial Anoia" (UEA), during the lockdown, helped out enterprises from the zone to find out these "green rails". So, many enterprises, like Gergonne; which didn't join this association, started to cooperate with the UEA.

With this information I would like to highlight that the association compromised with the national industries and the safety of the workers, they really collaborated together to ensure that the supply chain was working well.

I imagine that happens in other regions of the country.

4.5 MARKET'S RESPONSE

The rapid recovery of China, turned into international commerce.

When other countries were still facing the first effects of the pandemic, China restored its industries.

At this moment, many countries had problems with the shortage of goods, especially food and healthcare supplies. While these countries tried to use their own resources to produce goods, it wasn't enough, China was the first option for supplying all the needs that were required.

That had an important impact on international transport.

International logistics were practically invaded by cargo ships full of exportations from China.

The Chinese product was taking protagonism around the globe, and made a point in his favor. Countries like the USA or the European Union, were depending on these exportations, for a short period.

This is the moment when China takes advantage of international commerce and competes strongly with other countries such as the USA or Russia, a world power.

4.5.1 E-commerce

The word e-commerce comes from the abbreviation of electronic commerce, which means to buy something or contract a service through the internet.

The brand has their own website where you can consult the products that they have, the prices, the specifications of each article, etc. To make it even more practical you can download the app of the brand on your own mobile phone or tablet.

Just reading a short definition of what e-commerce is, you can find out which are the words that really define it, facility and commodity.

You can buy whatever you want from your sofa or the train to your home.

If you have the application, you can constantly receive notification about new products, sales, restock of that product that you want.

And one of the most important things is that they sent the article to your own house. You do not need to go to the store or a post office.

The context of lockdowns or the attempt to avoid contact with other people, made e-commerce an important tool for buying products.

It is an easy way to buy things, knowing anything you want to know about it and just pressing the button "buy now", in a few days or even hours you will receive it.

As you can imagine during the pandemic, e-commerce experienced an important surge.

Although, before the apparition of the Covid-19 it was also something very common, but people still liked to see things or try them on, making customers buy from the physical shops.

Without forgetting that the elder people that do not have the knowledge of buying things via the internet.

A change of the international scenario, forced people to use this channel for the acquisition of goods such as clothes, electronic devices, food, tools for the house, books, things for your pet, etc.

Many brands developed a really good structure for electronic commerce. Even today it is not strange to see some shops that just work online. A good example could be Amazon, airlines, digital banks like Imagine Bank from La Caixa, etc.

Just to give it a little more shape, let's show the evolution of e-commerce comparing sales from 2018 to 2020. This is researched from the United Nations Conference on Trade and Development (UNCTD). [28]

The first point that this article talks about is related to the Small and Medium Enterprises (SME). The study consisted in the visualizations of how the online purchases increase from the SME changed during the years 2018-2020.

The next graph shows the online retail sales of selected countries during the years 2018, 2019 and 2020.

The first thing I will highlight is the fact that each year the sales increase. Especially if we compare the year 2019 and 2020, the increment is bigger. This fact can be attached to the apparition of the Covid-19 and the consequences in the market explained before.

Something that we could expect is that China is the country with more sales, and it's followed by the USA. The reason is simple: China is the factory of the world and the USA has a big presence in the manufacturing sector.

The next countries that have great values are the United Kingdom, Korea, Australia and Canada consecutively. But if we compare their numbers with the two countries mentioned before, the values are less shocking.

With this information we can conclude that online retail sales have a big presence in the world-wide commerce and the appearance of lockdowns and sanitary restrictions has accelerated his evolution.

Online Retail Sales (USD billions)

	2018	2019	2020
Australia	13,5	14,4	22
Canada	13,9	16,5	28,1
China	1060,4	1233,6	1414,3
Korea (Rep.)	76,8	84,3	104,4
Singapore	1,6	3	3,2
United Kingdom	84	89	130,6
United States	519,6	598	791,7
Economies Above	1770	2038	2494,3

Figure 15. Table Online Retail Sales of Selected Countries.[28]

The next graphic explains a little bit better why China and the USA have this important presence in e-commerce.

This table has a lot of information. First of all, value which enterprises with a model B2C generated more benefits in e-commerce. Then, shows the Gross Merchandise Value (GMV) of these enterprises during 2018-2020, and which is the percentage of change.

As we can see eleven of thirteen enterprises are located in China or the USA, this fact explains perfectly the values of the previous table. Four belong to China and eleven to the USA.

We can notice that the top 4 in 2019 and 2020 haven't changed. The brand that earned the most is Alibaba that also includes AliExpress, the second one is Amazon, the third one is JD, a sports brand, and the fourth is Pinduoduo and online grocery shop in China. The other ones changed their position.

Something that is really relevant in this table is the increment of the GMV during the years in mainly all the enterprises. These ones are in the industry of e-commerce, internet media or re-tails.

But if we pay attention, companies whose earnings do not increase in 2020, are the ones dedicated to mobility and vacancies. Airbnb, Expedia and Booking are platforms dedicated to the booking of flights, apartments and journeys. Uber is an online taxi platform.

That data makes sense, because of the presence of Covid-19 and all the restrictions, people didn't have the possibility to travel or even to go outside their home.

Top B2C e-commerce companies by GMV, 2020

Rank by GMV		Company	HQ	Industry	GMV (USD billions)			GMV Change (%)	
2020	2019				2018	2019	2020	2018-19	2019-20
1	1	Alibaba	China	E-commerce	866	954	1145	10,2	20,1
2	2	Amazon	USA	E-commerce	344	417	575	21	38
3	3	JD.com	China	E-commerce	253	302	379	19,1	25,4
4	4	Pinduoduo	China	E-commerce	71	146	242	104,4	65,9
5	9	Shopify	Canada	Internet Media & Services	41	61	120	48,7	95,6
6	7	eBay	USA	E-commerce	90	86	100	-4,8	17
7	10	Meituan	China	E-commerce	43	57	71	33	24,6
8	12	Walmart	USA	Consumer goods retail	25	37	64	47	72,4
9	8	Uber	USA	Internet Media & Services	50	65	58	30,5	-10,9
10	13	Rakuten	Japan	E-commerce	30	34	42	13,6	24,2
11	5	Expedia	USA	Internet Media & Services	100	108	37	8,3	-65,9
12	6	Booking Holdings	USA	Internet Media & Services	93	96	35	4	-63,3
13	11	Airbnb	USA	Internet Media & Services	29	38	24	29,3	-37,1

Figure 16. Table of the top B2C e-commerce companies by GMV.[28]

Finally, the study from the UNCTD presents a table where we can see which countries have more sales in e-commerce.

According to the previous tables that we have already seen, it's not strange to find out that the USA is at the top with a value of 9580 billion dollars, followed by Japan with 3416 billion dollars, China with 2604 billions dollars and Korea 1302 billions dollars. As I said in the other chapter of this project, these three countries have a predominant presence in the manufacturing sector. European countries also have a presence in this list, like France with 785 billion dollars, Germany 524 billion dollars, Italy 432 billion dollars and Spain 344 billion dollars.

Then, the total value is separated into two categories, B2B and B2C sales. In all cases, B2B commerce is bigger than B2C. A reason for this could be that big businesses buy an enormous quantity of products from other company to transform them into one product and then sell it to the final customer.

E-commerce sales: Top 10 countries, 2019				
Rank		Total e-commerce sales (USD billions)	E-commerce sales B2B (USD billions)	E-commerce sales B2C (USD billions)
1	USA	9580	8319	1261
2	Japan	3416	3238	178
3	China	2604	1065	1539
4	Korea (Rep.)	1302	1187	115
5	United Kingdom	885	633	251
6	France	785	669	116
7	Germany	524	413	111
8	Italy	431	396	35
9	Australia	347	325	21
10	Spain	344	280	64
Economies Above		1770	2038	2495

Figure 17. Table of E-commerce sales - Top 10 countries in 2019[28]

4.5.2 The Last Mile

As I commented before, the last step of e-commerce is when a transport enterprise, or in some cases the same brand, gives you the product at your home. That action is called “the last mile” Behind that idea, there is a huge logistical coordination.

Just to show up to what point the logistics are developed, I will take the example of an Amazon purchase. Which are one of the most advanced in the context of “the last mile”.

When you are interested in some product and you click on it, it always appears which day you will receive the product in the address that you indicated.

In case you “slide” or buy it, you will receive an email that confirms your purchase.

Then, Amazon will report to you each movement that your product is making: the shipping, the moment that the delivery man started the route of your product and how many stops the delivery man has to make before the delivery of your product.

Even, which is something really cool, you can see from a map the movement of the delivery truck. Amazon, is giving you every detail of the tracking of your product, and you can know exactly when you will receive it.

This is what it consists of “the last mile” concept.

The main objective is the delivery of the product from the logistical center to your house through an optimum process.

It is not a new concept, but thanks to the new technology developments the way to accomplish the objective has changed.

The customer's requirements are more strict over time. When we buy something, we want it as soon as possible and the speed of the response can be a point of differentiation between brands.

The chain that follows “the last mile” is so simple, it just has five steps:

1. The order made by the customer, entered in the centralized system of the enterprise. It's an effective way to keep track of all the commands.
2. The goods that need manufacturing or products from a supplier arrive at the warehouse, and are prepared for the delivery.
3. The tasks for the delivery man are designated, depending on the route that the system has already prepared for each person. The assignment and the route are important for cost-effective logistics solutions.
4. All the items that go to the trucks are scanned, with the objective to keep a traceability over the product.
5. Each carrier has his own truck and a route map to follow for the delivery of the products.

Figure 18. Summary of the point that explained how the Covid-19 affected the Last Mile.[23]



Figure 19. Route map of "last mile" process

Despite the last mile process being automated, it's very personal because each product has a different destination. So, you can't create a general model, the final delivery made the model be unstable.

The apparition of the Covid-19, affected mostly to this last step of delivery.

The journal from the National Library of Medicine posted a paper that has the aim of identifying how the coronavirus intervened in the last mile, written by M. Suguna, Bhavin Shah, S. Karthik Raj, and M. Suresh.[29]

They made a list about every aspect that the last mile has suffered since the Covid-19.

How the Covid-19 affected the Last Mile



Figure 20. Summary of the point that explained how the Covid-19 affected the Last Mile.[29], [30]

4.6 POST COVID ERA

We have already seen how a virus can change the "natural" movement of the logistics around the globe, but we have to answer so many questions yet.

Will the pandemic change the logistics? Will the virus disappear and we can return to how it was before? Will we have to change strategies?

These are hard questions to answer right now. We are still living with the virus; thanks to the vaccines we can live with it.

Otherwise, other disruptions will appear because the vaccine is not "the solution" and we have to protect the society.

Something that I can tell is that things do not seem easier although we have been dealing with the virus for two years. Other problems have appeared that have a great impact over the supply chain, that are not related with the virus.

The world keeps moving and social and economic conflicts do not help to find out that normality that the society used to live in.

Just to take a look at what the world has been facing if we take a look in these instant moments.

Irene Liñán poster en articule lamed "Las disrupciones en la cadena logística amenazan con repliarse de forma recurrente" in the Mercantil online newspaper.[31]

She explained which problems are facing and faced the supply chain since the detection of Covid-19.

Irene pointed out six disruptions around the globe and explained how it is affecting the supply chain. Let's take a look at them.

The next map points where the disruptions are taking place, and then I explain the causes and the consequences of each one.



Figure 21. Infographic about the principal Post-Covid Problems

English Channel - (December 21th, 2020 - January, 8th, 2021)

The English Channel has suffered changes and disruptions due to Brexit, the separation of the UK from the European Union (EU). If we also added the effect of the pandemic, the disruptions are assured.

The principal consequences were kilometric retentions, delays on the delivery road transportation, constant lockdowns, cancelation of ferries, the waiting time increase, the carriers weren't under a minimum of services and collapse on the custom house.

These aspects made it difficult for the logistics companies to exchange products or raw materials between the UK and EU.

For the English country was a critical moment, because they really depend on this channel to import and export articles with the rest of the world.

Spain - (March 14th - April 2th, 2022)

Just to look over what is happening at the national scope.

Many strikes and even stoppages had been presented by the drivers during two weeks in Spain.

The reason for these protests was the low wages of the drivers, the bad work conditions that they are exposed to and the increase of the fuel prices.

That provoked disruptions over the port activity and the national supply chain, and supermarkets lost millions of euros.

Finally, the committee that represents the drivers obtained a reduction over the price of the fuel thanks to the collaboration with the government.

Conflict Ukraine-Russia - (February 24th, 2022 - ?)

It's obvious that a conflict between two developed countries will affect the global supply chain, and if we think that the market is so globalized even worse.

Just to understand the impact, Ukraine is one of the principal countries that export wheat and sunflower oil. On the other side, Russia is very important for the exportation of energy, fuels and mining.

The EU, to punish the Russian attack over Ukraine, imposed sanctions on Russia. This affects the exportations, increasing the energy and fuel prices and the raw material from the mining sector suffers shortages.

Maritime transport companies also turned their back to Russia and eliminated their activity in these territories, like Maersk and MSC.

Suez Canal (Egypt) - (March 23th - March 29, 2021)

The disruptions over the Suez Canal in Egypt, were provoked by a cargo ship called “Evergreen” that had been stuck in the canal for 7 days. This canal represents the direct connection between Asia and Europe.

The principal effect of this disaster was the delays of the containers filled with any kind good like semiconductors for the technological industries and basic needs.

A domino effect was inevitable, the global supply chain was disrupted.

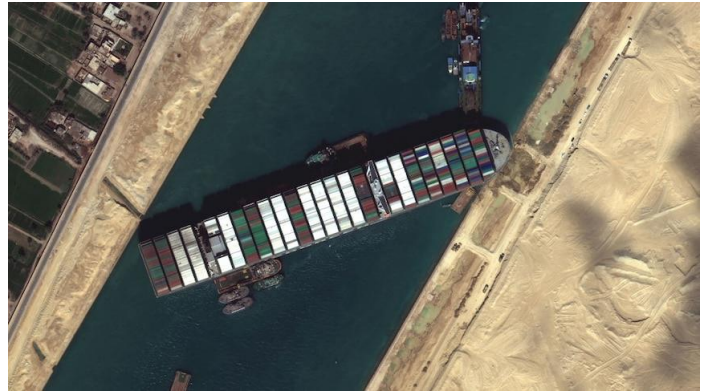


Figure 22. Capture of the cargo ship Evergreen in the Suez Canal. Satellite image (c) 2021 Maxar Technologies.

Shanghai and Shenzhen (China) - (March 19th - ?) / (March 13th - March 20th 2022)

Shanghai and Shenzhen are two principal cities dedicated to the manufacturing sector.

A new outbreak of Covid-19 over these cities led to new periods of lockdowns, affecting the industrial activity.

At this moment, Shanghai is just operating at 25% of capacity.

The consequences are quite obvious, delays at the demands, collapse of containers and cargo ships at the port provoking a global supply chain interrupted.



Figure 23. Cargo ships waiting in Shanghai. MARINE TRAFFIC

The effect of globalization, and the fact that China is the industry of the world, can collapse the global supply chain in case these countries suffer an internal disruption.

If we take a look at how the global supply chain it's been affected by all the problems mentioned before, the vision is not very positive.

Just to confirm with data about the global problem, the economist Stefan Gerlach posted an article at the online platform EFG talking about the index of supply chain disruptions.[32]

He indicated that the data that he posted was taken from the Federal Reserve Bank of New York platform in March 2022.

These studies have the mission to offer a realistic vision on how the supply chain is struggling during 2020- 2022. To give a global vision, the scope is over the eurozone, the USA, Asian countries and a global scenario.

For a better comprehension of the next graphics, the index value can take negative and positive values. The higher is the value the higher is the pressure, where the country cannot handle the demand creating disruptions on the supply chain. If the value is negative, that means that the demand is under the capacity of the country.



Figure 24. Global chain disruptions. Source: NY Fed[32]

The first thing that we can visually see is that in general the value of the pressure is far from the stability.

The higher point was detected during the appearance of the covid-19, a very logical effect because of the global lockdown specially on the Eurozone and the USA.

Then, it seems that it was controlled, even reaching a negative value for Europe and the American country, when the pandemic it was roughly under control

After that, the pressure index was very instable. Even at some periods the behavior of every country is very different, for example at 30-Sept-2021 Japan was under so much pressure but the rest of the countries seemed stable.

We do not know which is the value after 31-Jan-2022, but if we take account of all the problems that are facing the supply chain the pressure should be high.



Figure 25. Supply chain disruptions. Source: NY Fed[32]

The dynamic of this graphic is very similar to one from before.

If we look closely, at the beginning 31-Jan/31-Mar 2020 we can see how pressure under China is pretty high if we compare it with the rest of the countries. This is because of the earlier lockdowns that China imposed, when the rest of the world was still working with normality. And then, his pressure decreases while the value of the others increases due to the fast recuperation of China that I mentioned before.

Subsequently the values follow the behavior of the previous graphic, the values of each country at some moments match but at some moments are different.

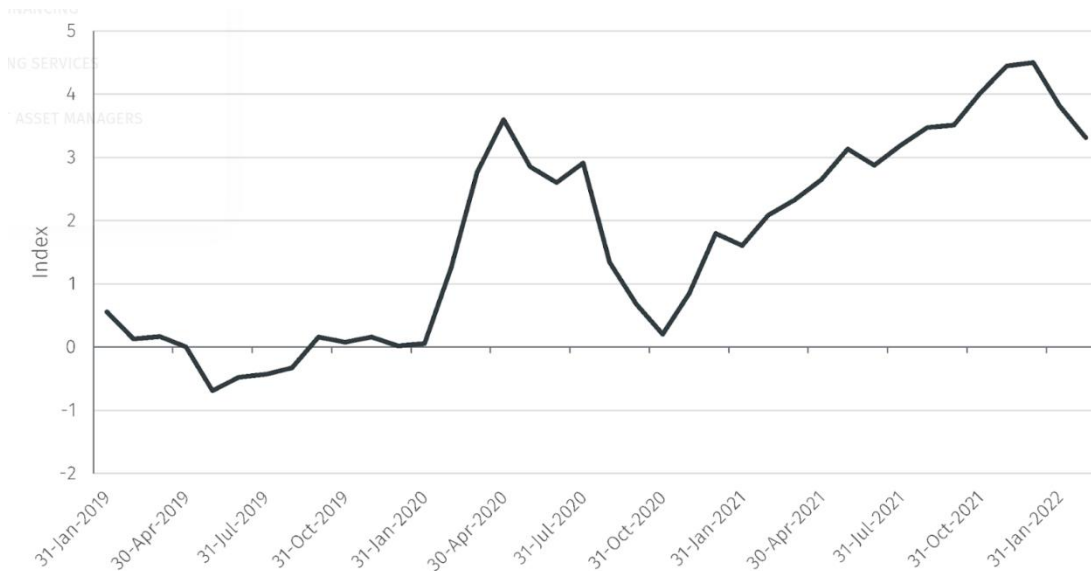


Figure 26. Global supply chain disruption. Source: NY Fed[32]

Finally, just to remember a global activity. This graphic shows the world wide dynamic.

In this one we can easily see how the appearance of the Coronavirus really affects the pressure under the global supply chain. And after, we roughly learn how to live with the virus. The pressure seems to be low, but then increases again.

These huge increases detected during the period 31-Oct-2021 and 31-Jan-2022, could be caused by geopolitical tensions.

We can see that the pressure under the global supply chain is not stable and seems to be increasing in the next months. It's clear that the Covid-19 and the global social, sanitary, political and economic disruptions is a common factor in the irregularities of the supply chain. Just because we live in a very globalized world, if some country presents an irregularity, it will affect the rest of the globe.

All this information makes us think about the global logistics response taking in account all the problems that they are facing.

In this case, there are two options for response. The first one, is to try to deal with the problem as best as possible and still use traditional methods that have been working since now.

Or the other option, give a twist to the traditional method and create a response according to the "new reality".

We have to admit that the world is constantly changing, and logistics are very present in our daily lives, because in a way or another, goods flow around the globe. So, if we want the logistics to improve and work efficiently, it must adapt his method of work according to the global context.

And this is what is happening, the logistics and the supply chain have changed their traditional methods to responses appropriately to the current needs.

A new reshaping of the logistics is actually happening. It is something undeniable that the logistics will be reshaped with the aim to be prepared to be more resilient under an atmosphere of high changes. [30], [33]

Based on these ideas, I present a list that can summarize the conversion that the logistic sector is working on.

1. **More presence of technology.** The enterprises are likely to invest in new technology, with the objective to improve process and efficiency in their systems. Being on the spot with technological resources is important to preserve the survival of the company in the market. These kinds of tools are so helpful for the optimization of internal operations, for example optimal use of the warehouse or a software for the routing map.
2. **More inventory.** Until now, the most famous practice was the Just-In-Time operation, that consisted of receiving the products on demand allowing reduced cost on the stock. But the appearance of the Covid-19 has changed this mentality. The companies are increasing their inventory just to ensure, during a certain time, the capacity to still sell in case the supply chain gets stuck for a while.
3. **Reshoring.** The enterprises are demonstrating the attitude to reshoring their industries closer to their principal points of sales, and do not have big structures in just a few points around the globe. Nearshoring logistical points will help to have more control over the internal supply chain and reduce or even avoid big transactions via air or ocean transportation.
4. **The last mile.** Related to the last point, “the last mile” will be more effective and faster. If the logistical points increase, the time to arrive at the last customer will be reduced. Creating more internal points, make it easier to deliver products to the customer in less time and incidents will decrease.
5. **Picking.** When we talk about picking, it is the task to prepare the commands in the warehouses and is one of the processes that can use more time to be accomplished. During the Covid-19 the demand has been fluctuating, and sometimes the companies faced being overworked. In order to create a flexible system and manage those points of excessive work, automatization is key.
6. **Internal and external traceability.** Increasing the inventories and the logistical points is very important to create a more sophisticated system to track every product and have real-time information. That will work in both ways, the company will have more control over their products for optimized processes and the customer will now have more information in real-time of his product.

7. **Mistrust over “Third-party logistics” (3PL).** We understand the term 3PL as an outsourcing company that controls distribution, warehousing and the fulfillment of services at the supply chain management and logistics.
The big brands or enterprises will decrease the contraction of 3PL principally for the possible fluctuation of the demand and the inability to sign up for a long period. And, if we add the new creation of logistical points the impact over the 3PL will be negative.
8. **Reverse logistics.** We have to assume that there are defective products or devolutions from the customers. It's necessary to create an effective return for this situation.



Figure 27. Summary of the improvements for the logistics after the Covid-19.

Nowadays, the customers can buy products via shops or the internet and in the same way, they can get them via shop or delivery at home. So, the internal and external logistics have to be connected to ensure an effective distribution.

5 CONCLUSIONS

It's undeniable that the apparition of the Covid-19 has affected the functioning of the whole globe, forcing the society to adapt to new measures and constant changes. This sanitary crisis that changed our lifestyle in a drastic way.

As a part of society, enterprises have also experimented so many changes in a very short period. Governments, with the aim to protect their people had taken measures and try to seal their territory just to avoid spreading the virus. But that action has many negative repercussions and the people and companies were constantly searching the way to recover from that situation.

China is where the first case of Covid-19 was detected. It was the first country establishing sanitary measures, including: lockdowns, quarantines and closing enterprises. Is important, to keep on mind the position that China keeps on the global supply chain; is one of the most important countries in the world in the manufacturing sector, and it's principal focus is the assembly of products. His mission is to receive the raw material and transform it in a product to deliver to the company (B2B).

To be in the middle of this chain and mainly have all the globe as your customer, if any disruption happens, the world stops running. And this is what just happened.

The companies experimented a brutal change of volume, they import raw material or export product because of the mobility restrictions imposed by the government.

When China seems to be recovered, the rest of the world wasn't ready yet. So, until certain stability was installed in the majority countries the world cannot be restarted.

A direct impact was detected over the supply chain related with the basic needs, food and healthcare.

On the food industry, one of the main problems was the lack of workforce, because the increase of infections due to the virus.

Moreover, due the transportation restrictions, they could not buy raw material or deliver their product.

All those problems put in danger the survival of the companies, and the increment of the prices over the food products was inevitable.

At the other side, it was the healthcare. The biggest problem was the shortage of material and equipment. Although national enterprises were dedicated to create sanitary products, most of these items came from China.

To counter this effect, in Spain, many enterprises take the challenge to change their products and start to create basic equipment, like respirators.

The real challenge in the healthcare sector begins with the apparition of the vaccines.

That product has something very particular and difficult to keep, the temperature that it should be preserved.

We can find different models of vaccines made by diverse companies, but most of them must be kept it between the -25/-15 degrees Celsius. That fact means that for their transportation a cold chain is required, and a very optimal one, because if the vaccines are not kept between this temperature the effectiveness is lost.

The biggest problem that confronts the supply chain of the vaccines is that keeping the refrigeration staff in some zones is something complicated.

But it has been seen, how important it was that companies from the logistic sector were able to achieve that challenge with the aim to save lives.

The **Hypothesis 1**, been related with the food and healthcare disruption due the apparition of the Covid-19 has been accepted because the increase of the prices of certain products, the increase of the agreements of logistic operators created by the panic of the society and the declaration of the WHO that said that mainly all the country suffered from shortage of sanitary material.

The government with the objective to restore the global supply chain, and avoid the shortage of certain products, established certain corridors.

The European Union, just to make sure that their connection with inner and outsider countries were safe, published a measure for the logistics operators just to help them reestablish their services with normality. Based on the creation of safety infrastructures for truckers and some advices just to avoid contracting the illness.

The **Hypothesis 2**, mentioning the certification of corridors to maintain the effectiveness of the global supply chain, has been also accepted because it's clear the intention of the governments like the European Union of implementing measures over any via of transport with the aim of protecting the drivers and increasing the efficiency of the international logistics under an instable situation.

The enterprise, under an atmosphere of constant challenge, does not have another option but to search for new strategies to survive the pandemic. Two protagonists take the stage in that case. One of them was and is the e-commerce. In that moment, because of the restrictions, the only way to acquire some products was online. For that reason, many brands, medium and small business started to improve their online platforms. The customers could buy the products easily and, in a way where they can avoid any contact with another person and make it arrive at your home. As a result, the concept of “last mile” started to gain force. The efficiency of this step was very important for the delivery companies, because their aim is to deliver the product to the customer as fast as they can just to keep them satisfied.

The **Hypothesis 3**, referred to the change of the market’s demand, it’s clear that the society has to change the way of buying things. The e-commerce was the online alternative for the acquisition of certain products, so the enterprises using the resources of the e-commerce has to change their strategy and improve the “last mile” to satisfy the demand under the regularities of the pandemic.

After two years of uncertainty and restrictions, at this same moment it seems that the society has already passed the sanitary crisis. Right now, the knowledge about the Covid-19 is better and the tools to fight against the virus are also already created. But we passed the sanitary crisis at 100%? Or there are some issues pending?

In 2022, the global supply chain is still disrupted by the coronavirus. News outbreaks in China, are still stopping the total recovery of the logistics operators and the enterprises located in that country.

Furthermore, other logistics problems have appeared that are not really contributing in the mission of working in a fluent supply chain.

An aspect like the Brexit has collapsed the English Channel and certain customs facilities between United Kingdom and the European Union has disappeared.

In Spain, due the fuel prices and the work conditions, the transport sector has been declared on strike until the government offers them a solution.

The war in Ukraine, promoted by Russia, is disrupting the supply chain of certain products that European countries really depend on them.

Finally, the collapse of a cargo boat in the Suez Channel, has delayed so many deliveries between Asia and Europe.

All these conditionings do not appear at the same time, otherwise they have been disrupting the global supply chain constantly.

The enterprises have already learned the lesson, with all the disruptions that the supply chain has suffered. So, they are remodeling their strategy to start focusing on being more resilient under any global problem. One of these measures proposed is to relocate more logistics centers near their principals’ customers, and do not depend on just one big warehouse.

Of course, the presence of the technology will be an essential key to accomplish their mission.

To sum up, the apparition of the Covid-19 has disrupted the life of the society in many ways. The global supply chain has been really affected, because the big dependence between the countries. Companies have already seen how the pandemic affected their business and now their main objective is to be more resilient.

6 RESULTS

In accordance with my research presented previously, I'm going to evaluate the hypothesis formulated at the beginning of this project.

Hypothesis 1 **Covid19 caused disruptions to the food and healthcare supply chain.**

In a globalized world, where we can buy a product from anywhere of the world, any kind of disruption in some point it will affect all the supply chain. It was really appreciable in the food industry and the healthcare sector. Many problems affected directly to them.

Entities like FAO, WFP or IFAD admitted that the pandemic was affecting the entire food system. At the same time, the prices of certain products like the pasta or the rice experimented an incasement of 335% and 259%.

Moreover, the overstock of the society provoked by the panic in the case of the food, the logistics contract also increases a 12%.

The prices of the freight and the cost of the fuel have been increasing 2,8 times in a year, affecting at the pricing of the logistics operators and consequently at the supermarkets.

While, in the sanitary sector the hospitals were struggling with the shortage of sanitary material, while the WHO published that the 90% of countries suffered disruptions of essential health services.

With this fact I can conclude that the Hypothesis 1 can be accepted, because the food sector and the healthcare suffered disruptions during the pandemic.

Hypothesis 2 **Governments established corridors to maintain the effectiveness of the global supply chain during the Covid-19**

With the aim to make the global supply chain more fluent, the governments from the European Union, established certain measures.

His principal objective was to offer drivers sanitary safety and avoid the shortage of workforce in the transportation.

The creation of safety point and published sanitary recommendation to avoid the contact with other people and contract the illness, were measures that many countries adopted.

Also, the instructive that the European Union made for all the vias of transport declare the intention of creating an efficient and secure corridor for the international commerce.

This evidence makes clear the intention of the governments to create safe deliveries for the drivers and ensure that the global supply chain works. The Hypothesis 2 is accepted.

Hypothesis 3 **The enterprises had to change their logistic in response to the demands of the society during the Covid-19**

Imposing transport restrictions and lockdowns made society unable to go outside and buy their needs in a shop or a shopping center.

During those moments, if someone wanted to acquire certain products, not food or healthcare items, it had to be bought through online platforms.

For that reason, the increase of the e-commerce was brutal and the companies really focused their strategy of survival in that matter. For example, Walmart experimented an increase of 72,4% in online shopping during the period of 2019-2020, Amazon accounted for a 38% or Alibaba reported an increase of 20,1%.

If we focus on the exportations from the countries that came from the e-commerce, the USA sold \$194,7 millions more in 2020 if we compare it with 2019 data, or China that increased \$180 millions.

Also, the delivery requirement from the customer is really fussy, because they want the product as soon as possible and in good conditions. So, the concept of "last mile" also takes importance just to satisfy the customers.

However, the Covid-19 also impacted over that concept, collapsing the logistics operators for the density of the demand.

Taking into account this information, it can easily admit that the demand during the pandemic changed. The Hypothesis 3 is accepted.

7 GOOD PRACTICES

As a student of a **Bachelor's degree in Industrial Organization and Logistics Engineering**, I would like contribute to this project certain with aspects that I considered as a good practice with the objective of giving my opinion about which actions can be taken to improve the impact of Covid-19 on logistics.

1. Information towards the costumer

When the costumer is buying a product, he/she will always want to know all the information about it.

I think is very important to update the costumer about every characteristic, condition or movement about the product.

The enterprises should develop a system that could share the state of the product at each moment. To be transparent for a costumer is key for gaining their confidence and ensuring the permanency as a costumer.

2. Delivery times

The accomplishment of the delivery times that the costumer received from the enterprises is a differentiator factor.

The costumer when acquiring a product, wants it as soon as possible and to know which times is going to take the delivery.

An enterprise that cannot offer to his costumers a fast delivery and do not respect the delivery time could make loss costumers.

3. Use of technology

The 4.0. industry is already here. An automatized system at the warehouses is a reality.

The technology helps the enterprises to optimize their "know how" and help the worker to be more efficient or even do tasks that the humans cannot do.

The digitalization and the use of updated programs is something key to ensuring the survival of the enterprises in the market. It will help to improve some aspects, for example, the creation of more efficient routes, more sophisticated control over the stock or the substitution of a manual process.

At the same time, let's try to not to forget that the workforce will always be something necessary and irreplaceable

4. Think about the environment

It's undiscussable that the transport it's something that really creates pollution because the trains, boats, planes, and trucks are still using fossil resources.

It's time to start replacing the little things that are already in the market to decrease that impact on the environment. A good option, could be the use of an electric van for the inner deliveries or the optimization of the cargo ships, plan or railway.

For the packaging of the products, rethink that aspect, and try to use eco-friendly products.

Indeed, this way of thinking is already present in the enterprises, but it's still too much to do, and it's important to not to forget that aspect.

5. Do not depend on just one supplier

Covid-19 has taught us that depending on just one or two suppliers or distribution channels is not a good idea.

In case of one provider just broke up or suffered from disruptions, it will impact directly to your own business. So, it's a great idea to dispose of several suppliers to guarantee a great functioning. Sometimes that dependence it's due to the prices that the supplier or the distribution channel offers for the services or *the products*. But, anyway, it's not a good option to use just one.

6. Think about the national services and products

The power that China, the USA or even Japan in the world offering good products and services for a very competitive prices, has made us forget about which option we have around us.

It's true, that when we are thinking about something national its price is a little higher than the big and international companies.

But, like I said before, it's not a good idea to relay on big companies. It's important to support the national income and make it visible to the rest of the world.

The confidence that can offer you and his value is not comparable to the one with a foreign company.

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