



Logistics management in the COVID-19 period: a case study in the food sector

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Abstract

In complex systems such as a food supply chain, where integrated flows of materials and information take place beyond the boundaries of individual companies, a substantial degree of inherent uncertainty cannot be avoided. That uncertainty may increase significantly when unexpected disruptions occur. Evidence of this is given by the recent - and still ongoing - crisis due to the coronavirus pandemic (commonly known as COVID-19), which is expected to create an economic depression even more severe than the 2008 financial crisis. This has been already observed in some economic sectors such as travel and tourism, food and agriculture, retail, healthcare systems and academic institutions.

This paper grounds on a bibliographic analysis of articles and studies that have already been conducted about the impact of COVID-19 on supply chains and logistics processes, with a specific focus on the food systems, with the purpose of gaining a better understanding of this topic and of finding out how it may develop in the coming years. From the literature, a questionnaire was delineated as used as the basis for carrying out an empirical analysis on this topic, by means of an interview with a company working in the food sector. During the interview, the (medium-term) consequences of the pandemic on the food supply chains are investigated, focusing on logistics processes, whose stability has been challenged by numerous factors.

The findings of the interview are presented and discussed, with the ultimate aim to highlight how COVID-19 has contaminated the logistics functions, definitely changing the way of approaching and acting within a supply chain. A series of reflections about the results obtained from the various research studies carried out, providing suggestions for possible future developments are finally presented.

Keywords: COVID-19; logistics; food supply chain; case study.

1. Introduction

The history of the pandemic emergencies of the XXI century dates back to the SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus) disease of 2002 (Cherry & Krogstad, 2004). A virus of the same *beta*-Coronavirus family, namely the MERS-CoV (Middle East Respiratory Syndrome) appeared approximately ten years later, and, contrarily to the SARS-CoV, which was fully eradicated, is still present in some populations, although it is considered to be under

control. At the end of 2019, finally, a last Coronavirus disease, worldwide known as COVID-19, appeared in the Wuhan state of China and was declared to have reached the status of pandemic emergency in spring 2020, causing more than 800,000 infections and 40,000 deaths by the end of March (Ke et al., 2020).

COVID-19 has affected supply chains at an unprecedented speed and on a global scale (Singh et al., 2020) leading to plant shutdowns, disruption of industrial production and, in general, dysfunction of global supply chains. It also had numerous effects on



various logistics processes. One logistic activity that was significantly affected by COVID-19, for example, is transportation (Mashud et al., 2022). Indeed, because of unexpected and unplanned lockdowns, the usual logistics and distribution activities have been altered for several months. As a result, delivery delays, backlogs at container ports, shortages of truck drivers have been observed, often because of the uncertain demand (Twinn et al., 2020). Also, transport tariffs increased in numerous countries (Mogaji, 2020). Inventory decisions were altered as well, resulting in the overall product availability to be compromised, in particular in the food and grocery markets (Mahajan & Tomar, 2020; Singh et al., 2020) and ultimately affecting customers.

Supply chain risks are multifaceted and have been traditionally classified into strategic, operational, financial and disruption risks (Borghesi & Gaudenzi, 2012; Xu et al., 2020; Ivanov, 2020). Clearly, outbreaks due to epidemic or pandemic emergencies (such as the COVID-19) fall into the category of disruption risks, which are typically associated to low-frequency, high-impact events such as natural disasters or man-made devastation (Ivanov, 2019). A typical characteristic of disruption risks is the very rapid and strong impact on supply chain activities and sustainability (Pavlov et al., 2019; Li & Zobel, 2020). Moreover, disruption risks typically generate long-term disturbances whose magnitude is unpredictable. Their spread is unpredictable as well, meaning that pandemics can simultaneously affect numerous systems and related population. In fact, contrarily to other risks, pandemic outbreaks spread to numerous geographic locations, even simultaneously, as they typically begin on a small scale but spread very rapidly; it becomes, therefore, almost impossible to forecast their total duration or impact (Ivanov, 2020).

While a pandemic emergency can cause dysfunctions to any logistic systems, the food and beverage supply chain is somehow unique and particularly critical, as it fulfils the basic needs of humans. Also, food and beverage production is among the greatest industries in the world. In Europe, the agri-food supply chain generates approximately 75% of the bioeconomy turnover and enrolls 80% of the manpower of the continent (Klitkou & Bolwig, 2019).

Researchers have analyzed business disruptions and their management in the context of the food and beverage industry (e.g., Bruzzone et al. 2013; Sharma & Singhal 2018). Obviously, the latest studies have also investigated the impact of the COVID-19 pandemic on the food supply chain. One typical topic of interest is the impact of disruptions caused by the pandemic on food security (Deaton & Deaton, 2020). Other authors have investigated the impacts of the pandemic on food supply chain resilience (Hobbs, 2020), at the same time discussing the demand increase caused by “impulse” purchase. Empirical research on the impact of COVID-19 in the food supply chain, however, is still limited. The available studies (e.g., Ali et al., 2022;

Khan et al., 2022) typically do not refer to European countries, which instead are worth investigating, being among the biggest producers of agri-food products.

On the basis of the considerations above, this study proposes an empirical analysis of the impact of COVID-19 on logistics processes of a real food company, working in Italy. The chosen research methodology, detailed in section 2, is the case-study based research, using a questionnaire. Results are presented in section 3. Implications, final considerations and suggestions for future research are delineated in section 4.

2. Methodology

2.1. Case study-based research

The analysis made in this paper is empirical in nature and grounds on an interview with some representatives of the logistic department for a company operating in the food industry. The company was contacted in October 2021, therefore in a period in which the pandemic emergence was still quite strong, for asking the availability of being investigated as a case study and replied positively to this request. Interviews represent a main source of data collection in case studies, and are, in fact, a very effective way to gather a certain amount of empirical data, especially when the phenomenon of interest is not particularly frequent - which is also our case, since the pandemic crisis was a representative event of a unique, extreme or extraordinary situation.

From a technical point of view, the case study methodology was chosen as a suitable tool for studying the “how” and “why” specific phenomena are observed in a given context. The purpose of a case-based analysis is not to generalize the case under examination to other contexts or companies (which is unfeasible), but rather to understand the targeted phenomenon (in this case, the COVID-19 impact on logistics activities) quite accurately in its uniqueness and complexity. Indeed, a case study can accurately describe the existence of one or more phenomena allowing them to be examined in rare or extraordinary circumstances.

2.2. Questionnaire development

A questionnaire was designed to be used as a track for conducting the interview. It consisted of one question for profiling the respondent company plus six open questions focused on the COVID-19 pandemics. These latter questions were delineated starting from some evidence available in literature about the impact of COVID-19 on logistics processes. The interviewee was asked to elaborate on the six questions and the considerations made by the interviewee were used as a starting point for the development of further insights and research ideas.

The six questions concerning the impact of the COVID-19 pandemic on the company are listed below; a brief explanation of the underlying rationale and of the evidence taken from the literature follows each question.

Question 1: How did the volumes handled vary during the pandemic? How was it possible to maintain the social distancing and, if so, at the same time ensure that the required volumes were more readily available?

Rationale: with the outbreak of the pandemic, demand for goods and services became extremely volatile. While in some contexts, the demand for finished products decreased compared to the normal operating conditions, the demand for other products has instead experienced great growth (Nandi et al., 2020). Similarly, while the production of some goods has been discontinued, the production of different goods has increased. Overall, fluctuations were observed at both demand and supply sides. Demand in the food, pharmaceutical and IT sectors has clearly increased. On the contrary, there was a deflation in demand for luxury goods such as in the textile and automotive sectors; not to mention that the scarcity of many raw materials, which have become almost unavailable, such as in the IT sector microchips and semiconductors from China, had repercussions on the entire network of supply chains in which it was difficult to maintain a continuous flow from upstream to downstream for all actors involved. Indeed, the COVID-19 pandemic originated in China and immediately affected the exports of Chinese companies, thus drastically minimizing the availability of supplies within global supply chains (Ivanov, 2020).

Question 2: What changes to the organization of the company have been introduced or implemented because of the pandemic emergency (e.g., introduction of automation, diversification of transport modes, local sourcing vs. global sourcing, re-layout of plants and activities, smart-working, digitization, sanitization of environments, preventive measures for distancing and safety, etc.)?

Question 3: Have these changes seriously affected production costs?

Rationale: as this paper investigates the impact of COVID-19 on logistics activities, it must be acknowledged that these latter for sure have been severely affected by the pandemic, but most importantly, they have changed because of the containment and prevention measures implemented by governments for protecting the health of citizens. Restrictive measures could include (depending on the country) national border closures, lockdowns as a result of social distancing policies, supply blockades, elimination of international travels and trade activities, labor shortages and the need to adopt

solutions aimed at maintaining physical distancing in production/logistics facilities. As a result, the pandemic emergency had a dramatic impact on international trade in every sector (Chowdhury et al., 2021). Although the social distancing practices imposed by governments have affected the business continuity and performance of companies, these latter have continued their activities respecting the health protocols by adapting to the new working condition and naturally introducing changes to the organization of the business that may concern both safety measures for the health of the workers and the potential change in demand.

Question 4: Which changes will be retained, and which will be abandoned post COVID-19? What are the goals and improvements to be made in the future?

Rationale: most of the studies published in the last two years focus on the impact COVID-19 currently has and will have on global supply chains by causing simultaneous disruptions at multiple nodes of the system. Studying the causes of stress at certain logistics nodes has led experts to reflect instead on the measures taken by individual companies to mitigate the effects of the pandemic and on how to act to prevent future high-impact, low-frequency catastrophic events. The pandemic has also forced companies to re-organize themselves to deal with what has been one of the greatest social, economic and humanitarian crises of recent times by adopting structural changes that, it is not certain, will survive when the pandemic is eradicated. Of course, being an unexpected event that had never been tackled before, just as not all the measures taken have been successful, certainly others have brought improvements, which is why they will be maintained.

Question 5: What company's strengths and weaknesses emerged during the COVID-19 emergency?

Rationale: Ivanov (2020) has presented the results of a simulation study on the impact of COVID-19 on global supply chains. His study demonstrates that simulation can be effectively used to evaluate and predict the impacts of outbreaks (caused by the COVID-19) on supply chain performance and offers an analysis to observe and predict both short- and long-term impacts of outbreaks on supply chains along with managerial insights. The same study is also useful to identify the successes and failures of risk mitigation strategies and outbreak recovery policies. Similar considerations were recently reached by Rinaldi et al., (2022) in their review study. Assuming that that supply chain could not be prepared for an event such as the COVID-19 pandemics and were facing this challenge for the first time, it is evident that not all the countermeasures taken could have been successful.

Question 6: Over the past two years, how has the perception changed: A) of distance and presence

interaction? Which one is more efficient today? B) of the distance of destinations in the real and digital worlds? Will there be a revision of delivery systems as a result of COVID-19? Will supply remain global become closer or will there be a combination of the two? C) of nature in relation to both environmental aspects (health of the planet) and personal aspects (physical health)?

Rationale: the COVID-19 pandemic has led to a structural change in the economic systems, including modifications to the fundamental parameters that govern them. A structural change is a profound fracture that determines a before and an after, and which substantially affects the behavior of economic actors by having effects on the possibilities of coordination between different economic activities (Alderighi, 2021). According to Alderighi (2021), there have been changes in the structure of the economic system that may be useful in understanding the permanent effects caused by the pandemic on economic activities. These structural changes concern:

- the perception of the effectiveness/efficiency of interaction in distance/presence;
- the perception of proximity/distance of real-world and digital-world destinations;
- the perception of nature, in terms of environment (planet) and health (personal).

In relation to the first aspect, the author states that there has been an increase in the perceived effectiveness of remote interaction and a decrease in the perceived efficiency of in-presence interaction. Over the last 2 years, indeed, tele-working has grown significantly, as has the use of video-conferencing platforms and the spread of clouds. Also, the pandemic has enabled an unprecedented digital literacy process that has led to the removal of certain preclusions on the use of new ICT tools that in many cases were unjustified. It follows that, even in the light of an increase in the perceived effectiveness of remote interaction, tele-working will (probably) remain a way of working even as we will move to a combination of face-to-face and remote working. If this is true, there will also be significant effects on transport (less mobility), on real estate (reduced demand for commercial building especially in the centers of large cities and thus a reduction in prices per square meter) and on housing location (housing further away from workplaces, less frequent commuting, but over longer distances). Business travel will also tend to decrease.

As far as the second aspect, Alderighi (2021) highlights a change in the perception of what is near and what is far: destinations in the real world are further away than before and those in the digital world, understood as places where one can carry out activities or buy services, are closer. Indeed, the pandemic has led to a different perception of the possible difficulties of obtaining resources, especially from distant areas. In addition, trade agreements

concluded by various countries have shown that the introduction and modification of duties and/or trade restrictions can have significant impacts on the organization of production. Here again, the pandemic has played an important role, so much so that some governments have put the issue back on the political agenda. It is assumed that global SCs will tend to become less global, so trade between countries belonging to different continents will tend to contract compared to the pre-COVID situation. Maritime transport, at least over long distances, will suffer.

Finally, as far as the third aspect, Alderighi (2021) notes that there has been a change in people's perception of nature, environmental aspects (health of the planet) and personal aspects (physical health). This trend has been going on for many years, but in the wake of the pandemic, it has gained new and greater public attention. For example, the World Health Organisation on 5 June 2020 stated that *COVID-19 is a reminder of the intimate and delicate relationship between people and planet*, thus highlighting that deforestation, loss of biodiversity, degradation of the eco-system and certain human interventions on the planet are increasing the frequency, risk and spread of epidemic diseases. This is why environmental issues have received new attention, with a shift from the public sphere (protecting the health of the planet) to a private sphere (protecting the personal health). The trend towards changing people's diet in the direction of consuming more vegetables and less meat is well known.

3. Results and discussion

The company interviewed, as recalled earlier, belongs to the food & beverage sector and in particular, to the dairy production industry. The interviewee is the company's operations manager. He manages a team of employees and coordinates their work for ensuring the production of high-quality products, on time and in the quantities required by the market at the same time guaranteeing the safety and ergonomics of the workplace. The interview with the operations manager was conducted by the authors of the paper in November 2021 and lasted about one hour. The point-by-point reply to the six questions concerning the impact of the COVID-19 pandemic on the company is illustrated below.

Question 1: The company experienced an increase in the volumes demanded, and the same happened to many other companies in the food sector. This increase was observed in particular the initial phase of the pandemic, when, due to a psychological effect on the masses, consumers stocked up on food products, causing changes to the market demand and habits. The consumers who used to buy a certain product found themselves deprived of that product, which forced them to shift their choice to another item of the same line. Thus, the change in demand and volumes can be attributed to the change in consumption and stocks of customers who, in turn, changed their habits

exactly in response to the emotional state of fear induced by the pandemic crisis.

Question 2: Changes to the organisation of the company certainly include the safety measures set up for ensuring for social distancing. In the production lines, production areas were delimited by measuring the distance between workstations, which were marked off with signs. With respect to other moments of possible crowding, such as breaks and shift changes, the maximum capacities of rooms and break rooms were reduced and the entry and exit times of employees and entire departments were staggered. Wherever possible, smart working has been introduced. In addition to the daily sanitising practices following the working day, extra sanitising practices carried out by an external company at weekends were added. Weekends were chosen for those activities for ensuring that there was no impact on the lead time for order processing. On the other hand, the number of employees and the usage for transport activities (including intermodal transport) remained unchanged. Within the supplier pool, suppliers were re-evaluated according to distances and new needs, so the multi-sourcing policy was adopted.

Question 3: As it is reasonable to expect, extra sanitization measures and the introduction of additional personal protection equipment (such as gloves or hand sanitizers) had a negative impact on the company's production costs. The company is therefore evaluating strategies for reducing these costs. As an example, the company is pondering the adoption of process automation solutions (so as to reduce the personnel and relating cost), as well as a major technological change of packaging, from HDPE to PET.

Question 4: For sure, the COVID-19 pandemics made it possible to evaluate the introduction of new products in response to new consumer needs and to reorganize some company activities, so the pandemic was a driver to initiate necessary innovations for the company. In the production area, for obvious reasons, practices such as smart working have already been largely curtailed, while the focus will be on maintaining extra disinfection operations in the workplace for a long time to come.

Question 5: The strengths were primarily those mentioned above, i.e., the opportunity to introduce new items with the aim to start a process of product and packaging innovation. Business continuity was ensured as well, thanks to the adaptations implemented by the company.

Question 6: Of course, in production activities, the physical employee presence is more effective than remote working. In line with this, smart working has been reduced to a minimum today, although it will remain essential for activities such as meetings and gatherings. As far as sourcing, local sourcing was certainly favored in the first phase of the pandemic, whereas multiple sourcing is currently the preferred

company's strategy, for ensuring high service levels to customers. Regarding the perception of nature (in terms of environmental and personal health), the company is currently planning various innovation projects to implement environmental sustainability. For example, the packaging innovation project is aimed precisely at this. Looking at the personal health, COVID-19 (as a pandemic emergency) has certainly revolutionized the perception of life, leading people to re-evaluate various aspects, such as its volatility. For sure, at the beginning of the pandemic, there was a general feeling of risk exacerbated by the initial absence of personal protection equipment. Nonetheless, the interviewee, as a department manager, had always to maintain a sense of calm and reassurance among the staff precisely to ensure firstly the psycho-physical health of the employees and secondly the productivity of the department.

4. Conclusions

Grounding on a bibliographic analysis of articles and studies that have been conducted about the impact of COVID-19 on supply chains and logistics processes, this paper has proposed an empirical analysis, using a case study-based approach, whose aim is to gain a better understanding of this topic. From the literature, a questionnaire was delineated as used as the basis for carrying out an empirical analysis on this topic, by means of an interview with a company working in the food sector.

From the answers provided by the company interviewed, some trends can be delineated and analyzed. For sure, the resilience of many companies was challenged during the COVID-19 emergency. In general, supply chains were faced with an unprecedented situation and, more importantly, they realized that their resilience was not strong enough to withstand such a crisis. Indeed, pandemics are a special case of supply chain risks that are characterized by the existence of long-term, propagating disruptions and high uncertainty (Ivanov, 2020). During these long-term disruptions, companies have failed to respond with responsive and efficient solutions. Responsiveness has become the key factor in enabling companies to respond quickly and economically to disruptions (Xu et al., 2020).

A company's resilience is typically evaluated in terms of flexibility and elasticity. Flexibility is the managerial ability to change the internal choices very quickly, e.g., to adapt the production to the market demands. On the other hand, this capacity depends on the structure of the enterprise, i.e., what at the structural level is called elasticity. Without elasticity or flexibility, there can be no resilience. In order to ensure structural elasticity, it is necessary to make investments in innovation that allow the structure to have room to adapt. Studies in literature have emphasized that the resilience of companies during a pandemic derives from the levels of innovation that the company itself had at its disposal. As an example, a

high level of automation of operational tools allowed for interpersonal distancing and digital systems allowed for the construction of a valid information network. Overall, innovation, depending on the sector considered, is a main factor to guarantee resilience in terms of strategic flexibility and structural elasticity.

Other strategies suggested in literature to counteract possible unavailability are multiple-sourcing and increased stock level. The former was applied by the company investigated, although countermeasures used by companies were mainly reflection of Government security and prevention policies, thus reflecting responsive approaches and remediation measures taken by individual governments in response to COVID-19. By applying these measures, companies were able to recover the capacity of their operations as quickly as possible. A change of mentality within companies can nonetheless be observed: whereas before COVID-19, resilience was a well-known concept but never addressed, it is now placed among the priorities of reorganization. By the way, resilience, flexibility and sustainability are all concepts that are currently being revamped in literature, even in combination (e.g., in the LARG – lean, agile, resilient, green – models; Bottani et al., 2022). Further analyses, which could be again in the form of an empirical study, could address the whole set of concepts in the pandemic era.

We recall that the ultimate focus of the analysis was on logistics activities. Logistics by itself has evolved in recent years (e.g., because of the influence of Industry 4.0 technologies – El Hamdi & Abouabdellah, 2022), and in line with this, it could be stated that COVID-19 has merely been a catalyst for an evolution that was anyway inevitable. However, what emerged from the interview is the difficulty in fully forecasting the “post-Covid logistics”. It is nonetheless reasonable to assume that COVID-19 changed the geography and distribution of supply chains globally, meaning that, in the future, there will be the need for designing strategic locations of supply chain players.

Most of the studies conducted between 2020 and 2021 focused on the impact that COVID-19 had (and is still having) on global supply chains. Understanding this impact has led many academics to focus instead on measures taken by supply chains to mitigate its effects by providing solutions that direct future management choices towards preventing catastrophic events of similar magnitude. This involves a more proactive approach of companies, which in turn, could stem from digitalization and automation of various logistics processes, so as to reduce the presence of operators at work, thus enhancing product traceability and security and limiting human interaction.

Preventing the risk of supply chain disruptions is a costly investment. Nonetheless, such investment also generates benefits by ensuring the flow of products from upstream to downstream in the supply chain and allowing companies to continue selling their products (and therefore generate revenues). Relating to this

latter aspect, it is important to observe that not all contexts have seen an increase in the demand for finished products, as for the food sector. Other companies, unfortunately, have not been able to survive the effects of the lockdown on production and consumption, at least in Italy. What is sure, however, is that COVID-19 has completely revolutionized the consumer’s habits both in terms of the demand for the products and, most importantly, of the methods of purchasing those products. Social distancing and lockdowns have impacted the activities of physical shops, leading to a decrease in point-of-sale sales worldwide, resulting in a resort to e-commerce. Companies have tended, depending on their sector, to rely more on their online distribution channels. Obviously, companies that pre-Covid relied on both online and in-store sales were better able to meet the challenge posed by COVID-19, while companies that did not have this dual distribution channel learnt its importance. The need to rely on online buying and selling made them discover the convenience and simplicity of this practice, which will be maintained in the future. As far as retailers are concerned, there will certainly be a need to review their role within the product distribution processes in the future.

Overall, the results of this study suggest that logistics activities were severely affected by the pandemic, which caused simultaneous disruptions at several nodes of the supply chains, changed the consumers’ behaviour, and caused a shift towards online purchasing. Companies must therefore show readiness and responsiveness in order not to lose their competitive advantage within the supply chain. Studying the impact of COVID-19 on logistics activities, however, is a relatively new topic (even because of the newness of the COVID-19 pandemics itself) and therefore further analyses should be undertaken in the coming years, to check how research will go on, as well as to start evaluating the long-term effects of the pandemics (which are not visible at present). It could be argued that given the significance of the COVID-19, future research on the more general theme of risk management in supply chain could not ignore the consequences of the pandemic emergency. It will be, therefore, interesting to evaluate upcoming research on the basis of which to conduct a survey on a wide sample of companies to investigate whether the proactive intentions of future management choices have proven to be efficient and, in general, to study how the subject will evolve in the future.

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