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# THE IMPACT OF COVID-19 ON LOGISTIC SYSTEMS: AN ITALIAN CASE STUDY

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**Abstract:** since the beginning of 2020, a new virus named COVID-19 has rapidly spread to a global pandemic. The world economy has been strongly affected and early evidence suggests that its impact has involved all the sectors and business functions. In such context, logistics activities have been severely affected by the COVID-19 pandemic because of the introduction of new strict prevention rules; moreover, purchasing behaviours of customers have changed and systems had to rapidly adapt to unexpected events. This paper aims to investigate the impact of the sanitary emergency on logistics activities. A logistic provider specialized in the food and fast moving consumer goods sector has been involved in the research in order to analyse its activities and the main changes caused by the pandemic. A quantitative survey has been conducted, combining numerical data and qualitative answers. Results confirm strong effects on some sectors and an economic loss mainly due to the new procedures adopted to face the emergency.

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## 1. INTRODUCTION

In the last decades, an increasing number of disasters and catastrophes has affected and changed the entire world. The number of people involved and the economic, social and environmental impact due to exceptional events has rapidly grown. During the years, many countries have understood the importance of designing resilient systems, which allow for facing unexpected events. The current literature provides some definitions of the concept of resilience, considering different areas of interest. In general, “resilience” is used to describe the ability of a system or a community to adapt successfully to hazardous events (Ponomarov & Holcomb, 2009). Many studies have examined the organisational resilience in terms of capacity of adaptation, ability to anticipate changes or to manage uncertainty, ability to adapt to changes and recover from disruptions (Granig & Hilgarter, 2020). Supply chain (SC) disruptions are disasters that negatively influence the normal flow of goods and materials within a supply chain (Craighead et al., 2017). They have different nature, but all of them cause strong consequences to the global marketplace. Gupta et al. (2016) distinguishes between natural hazards (namely earthquakes, floods, epidemics or any environmental disaster), technological hazards (e.g., airplane crash or radiological release), and human-caused hazards (such as terrorist acts and sabotages). Thus, epidemic outbreaks are forms of disruptions that strongly influence business operations and their performance. The recent coronavirus (commonly known as COVID-19) epidemic has dominated the entire 2020 year and has

completely changed people lives with severe consequences on the global economy. All the markets, sectors and business have been forced to rapidly adapt to the new challenges. Some authors have started to publish evidences that show a significant impact on supply chains and logistic systems (Tang et al., 2020).

This paper aims at contributing to the current literature with a quantitative study about the effects of the COVID-19 emergency on industrial logistics. In particular, a logistic provider has been involved in the research in the attempt to analyse its activities and the main changes caused by the pandemic. The chosen company deals with distribution of food and fast moving goods, and it provides logistic services to the large-scale distribution. For such reason, the company involved has never stopped its activity during the lockdown period, but rather, it has been forced to adapt its organization to continue working. A quantitative survey has been conducted, combining numerical data and qualitative answers. Firstly, the research has focused on the strategic and economic effects on the business, starting from the first Italian COVID-19 patient detection. Then, the main actions implemented to face the crisis have been investigated.

The rest of the paper is organized as follows. Section 2 presents the current literature focusing on COVID-19 pandemic effects in logistics. Then, section 3 analyses the context and describes the structure of the survey. Results are presented in Section 4, while the last section summarizes the main outcomes of the study and outlines possible future developments.

## 2. LITERATURE REVIEW

In the last years, the importance of performance and its implication on logistic systems during catastrophic events have been widely studied (L'Hermitte et al, 2014). Many discussions concern the humanitarian logistics literature (Farahani et al., 2020), while very few papers have studied logistic operations or designed models on industrial logistic resilience during and after disasters. The COVID-19 pandemic spread has recently led some researchers to address such topic. Ardjmand et al. (2020) have proposed an optimization model to solve a manual order picking problem with the aim of containing the infection spread; the warehouse activities of a real logistic company have been studied and different solutions have been tested to this end. Other studies have discussed the food supply network organization and reconfiguration due to the pandemic; some researchers focused on hubs location and capacity (Perdana et al., 2020), others on distribution processes and transportation (Chen et al., 2020).

Because of the newness of the topic, a research gap exists on pandemic impacts in supply chains and logistics and their response to emergency (Queiroz et al., 2020). In the last year, some simulation studies have also been presented for modelling uncertainties in supply chains. Ivanov (2020) has tried to predict the COVID-19 epidemic outbreaks on the SC performance by means of simulation, providing some general guidelines as a result. Singh et al. (2020) implemented a simulation model to reproduce a real Indian food distribution network during pandemic; different levels of disruption have been inserted and their impact on the delivery lead time has been evaluated. Early pandemic effects on logistics in Northern Europe have been analysed by Hilmola et al. 2020 using a survey; implications on logistic activities (inventory and transportation) have been presented. Grida et al. (2020) have proposed a framework for analysing the impact of the prevention measures implemented to limit the spread of the epidemic on supply, demand, and logistics. Four companies working in different supply chain fields have been asked to express their perception on that; results have shown that the demand is the most influenced aspect by the COVID-19 prevention policies (76%), while logistics accounts for 23%. Other researchers have estimated the global trade volumes with optimistic and pessimistic scenarios for year 2020 (Xu et al., 2020); these analyses show respectively an average decrease from 13% to 35%. Finally, some researchers have investigated the main changes and trends in consumers' habits, especially in food sector. Borsellino et al. (2020) have reviewed the outcomes from other researches in terms of food-purchasing behaviour during and after the COVID-19 lockdown. A statistical analysis in the German food retail logistics has been proposed by Loske (2020); the author analysed the correlation between the transport volumes and some variables linked to the COVID-19 spread, with interesting findings on behaviour caused by panic buying.

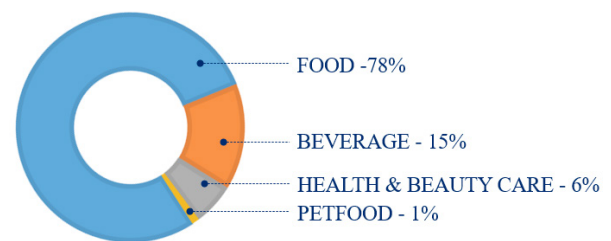
## 3. RESEARCH METHODOLOGY

The research methodology adopted in this study consists of a survey based on a real case study. An Italian logistic group

has been contacted and involved in this research for analysing the effects of the emergency caused by COVID-19 on its activities. The research has been conducted from June to September 2020, i.e. starting from the end of the strict lockdown period. A questionnaire has been designed and used as a guideline to understand the implications of COVID-19 on the system and identify the main aspects to be analysed. Specifically, the questions aimed at investigating the impact of the pandemic on the business and at recovering the information about the main solutions adopted to face it. The questionnaire has been articulated into two sections. The first one includes questions used to understand how the business processes changed and why. The second section of the questionnaire includes more general open-ended questions, focused on the actions implemented to rapidly adapt to the emergency. The structure of the questionnaire was designed with the help of a key account manager. Then, several managers with different roles and responsibilities have been involved in the study with direct interviews.

### 3.1 Context analysis

The company involved in the study is an Italian logistic provider, leader in logistic services for the grocery and fast moving consumer goods fields. For such reason, its activities have never been stopped during the lockdown. The company's distribution network consists of 9 hubs, which directly serve the mass distribution with point-to-point or multi-point deliveries. Then, 39 transit points supplied by the hub reach all the local delivery points. Moreover, the company directly manages 21 factory warehouses. The transport fleet consists of numerous vehicles, with different size and capacity, and the distribution is organized considering two main flows. The primary distribution flow directly connects the hubs and the major delivery points (such as distribution centres, supermarkets, and hypermarkets); on the contrary, the transit points supply products to retailers and local facilities managing smaller quantities (secondary distribution). The main sectors in which the company operates are shown in Figure 1.



**Figure 1: reference sectors.**

For each sector, the company provides massive and neighbourhood services reaching thousands of delivery points, using different distribution channels. The amount of delivery points is shown in Figure 2, in which the two columns indicate to various types of customers reached. It is evident from Figure 2 that for some sectors (i.e. beverage, health and beauty care and pet food) the company directly

reaches small shops, avoiding intermediate retailers or wholesalers.



**Figure 2: distribution channels and quantities.**

### 3.2 Questionnaire development

After a preliminary context analysis, a questionnaire has been developed considering the business of the company and its work schedule before the pandemic. As already introduced, questions have been grouped in two sections. The first one aims at examining the main changes due to the economic and sanitary emergency, but also the main implications caused by the new regulations imposed by the Italian government for counteracting the COVID-19 crisis. The analysis has been focused on three key aspects, relating to the impact of the COVID-19 emergency on:

- consumer demand, in terms of volume per sector and flow of distribution;
- service level;
- company's turnover.

The answers provided during the interviews were supported by numerical data provided by the interviewees. In particular, the data retrieved refer to the first six months of the years 2019 and 2020, organized in working weeks.

The second part of the survey has been based on general questions relating to the crisis management. In particular:

- How did the company reorganize its activities?
- What measures have been introduced to protect the employees?
- How did the relationship with costumers change?
- Were there any specific emergency situations? If yes, how did you manage it?

For the purpose of this study, we interviewed four people overall. Three of them were from the headquarter of the company under examination. One of the interviewees was the warehouse manager and provided quantitative data useful to answer the first part of the questionnaire. The second and third interviewees were employees working in the warehouse and they were asked about the work organization during the COVID-19 period (qualitative part of the questionnaire). As will be highlighted in section 4.2, the warehouse manager of a facility located in Lombardy, a region in northern Italy, was also interviewed; this facility was closed for some months in

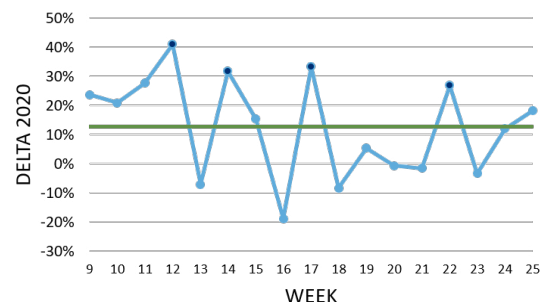
2020, because Lombardy region was severely damaged by the COVID-19 emergency. This manager was interviewed to gain additional insights about the management of logistics facilities in the COVID-19 period.

## 4. RESULTS AND DISCUSSION

The results obtained from the interviews, properly elaborated for understanding the economic and organizational consequences of the pandemic, are presented and discussed in the next subsections.

### 4.1 Survey results: section one

Starting from the first section, the first outcomes concern the impact of the sanitary crisis on the company's business. As far as the volumes are concerned, two different analyses have been performed, focusing on the type of distribution flow and the volumes distributed, with particular attention to the sectors mainly affected by the crisis. Figures 3 and 4 show the trend of the primary and secondary distribution flows regarding the tons distributed by the company in the year 2020 compared to 2019. In particular, the graphs depict some weeks starting from the first week after the detection of the first Italian COVID-19 patient, on February 21<sup>st</sup> (week 8 of 2020). The delta 2020 value (y-axis) has been calculated by comparing the flow volume in tons of year 2020 to year 2019 and highlighting the increase/decrease. The green line represents the average delta calculated over the considered period. Overall, for the primary transport an average increase of 13% has been observed, mainly due to some peaks observed during the lockdown period (Figure 3). Such situations correspond to specific events that have probably led the consumer to buy more quantities of products or the big stores to expect an increase in sales. In particular, week 12 was the first week of strict lockdown; in that week, the highest increase compared to the previous year (+41%) was registered. Week 14 was instead the week before Easter; week 17 was the week of the Italian partial reopening, while week 22 marked the end of the lockdown period.



**Figure 3: impact on the primary transport.**

The secondary transport flows instead experienced an average decrease of 10% in volume. From Figure 4 it can also be appreciated that the events just described (lockdown or Easter) had less impact on such distribution flow. The reason can probably be found in the severe rules that forced many small shops to close, together with some facilities from the ho.re.ca. (Hotel, Restaurant, and Catering) sector. In fact,



focusing on the goods handled with the secondary transport flow, it is easy to detect some product categories which were strongly affected by the crisis; for such products, the stock level decreased drastically.

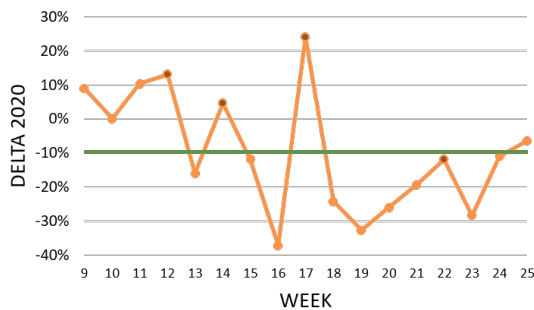


Figure 4: impact on the secondary transport

Figure 5 shows the impact of the pandemic on the product volumes across the different categories managed by the company, considering the two distribution flows. Once again, the years 2020 and 2019 have been compared, considering the period March 1-June 30.

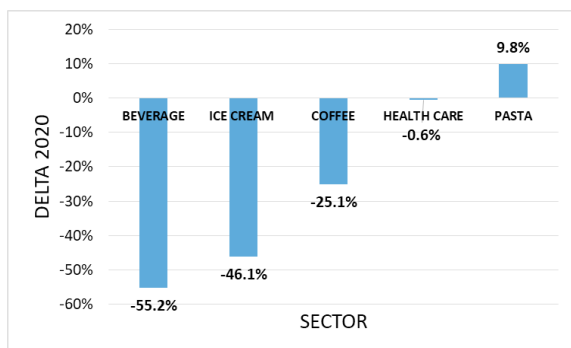


Figure 5: impact on volumes distributed per sector.

The second analysis has been focused on the quality of the service provided by the company during the critical months of 2020. As a first step, the key performance indicators (KPIs) used to measure the service level have been identified. In this respect, the company usually computes two KPIs. The delivery accuracy is calculated as the number of packages successfully delivered over the number of packages expected to be delivered, while the punctuality reflects the ratio between the number of “on time” deliveries and the total number of deliveries. Figure 6 displays the performance of the company against these KPIs in 2020, with a comparison to 2019, taking into account the period from week 9 to week 25. Results highlight a decrease in the delivery accuracy during the first weeks of the lockdown, with a gradual return to the values of the previous year after the partial reopening. The reasons for these outcomes could be manifold. First, the new rules applied by the company to guarantee the social distancing between the workers involved in the loading/unloading phase could have slowed down these activities; this effect probably decreased with the resumption of the usual controls. Also, the increased flow volume

observed in some weeks could have made it difficult to carry out accuracy checks on all the shipments.

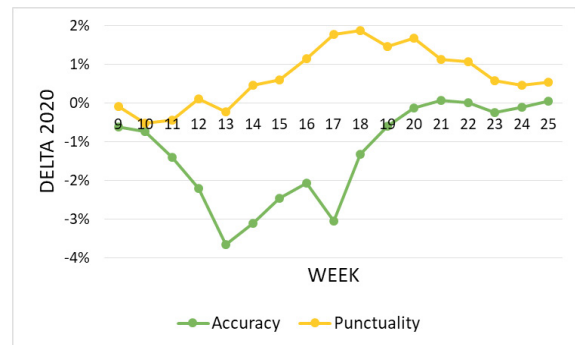


Figure 6: impact on service level

The punctuality has instead registered a slight increase in performance compared to the same period of 2019. In this case, the result is probably due to the reduction in the secondary transport flows, which are the main responsible for late deliveries.

The last analysis investigates the economic effect of the crisis, trying to understand the main factors that influenced the economic outcomes of the company. In this respect, Table 1 summarises the impact of different factors, in the form of actions/events, on the company’s turnover, focusing expressively on those actions/events that have targeted the handling activities inside the warehouses. The impact on turnover has been calculated either as the cost increase or a loss of sales compared to 2019. To be more precise, introducing “environmental sanitization practices” or buying specific “PPE for workers” obviously involve additional costs for the company, which accounted for 1% and 0.8% of the turnover, respectively. “Absenteeism”, instead, involves a loss of sale, as having less employees at work means being less able to satisfy the customer’s requests. The increase in absenteeism for 2020 compared to 2019 was found to be 2.7%, with a corresponding loss of turnover. It is also interesting to note that the measures with the highest impact on the company’s turnover were “Actions and procedures carried out with the aim of guaranteeing the social distancing” and insurance policies (i.e. “Policies to pay the exposure to risk for workers more exposed”).

Table 1: impact on turnover – handling activity

Activity	Impact on turnover
Environment sanitizing	1%
PPE (personal protective equipment) for workers	0.8%
Shift reorganization to limit the groups of workers into contact	1.8%
Absenteeism	2.7%
Overtime increase due to the absenteeism	1.8%
Actions and procedures carried out with the aim of guaranteeing the social distancing	4% -7%
Policies to pay the exposure to risk for workers more exposed	3% -7%

**TOTAL 15%-22%**

Table 2 summarises instead the impact on the turnover related to the distribution activities. In particular, the table reports the main actions or effects caused by regulations or procedures adopted to counteract the emergency. Again, depending on the activity, the impact on turnover was determined either as the cost increase or a loss of sales compared to 2019. The most impactful activities were found to be the “Reduction in full load transport” and the “Increase in waiting time at the loading points”; both activities involved loss of turnover for 2.8% compared to 2019. As for the former activity, the decrease in full load shipment is the consequence of the lower volumes shipped in some months of 2020, which means less sales of products. The increased waiting time at the loading points, instead, is the logical consequence of lower workforce available or increased safety measures applied by the company.

**Table 2: impact on turnover – transport and distribution activity**

Activity	Impact on turnover
Fleet sanitization	1.4%
Reduction in full load transport	2.8%
Increase in waiting time at the loading points	2.8%
Policies to pay the exposure to risk for workers more exposed	1.8%
<b>TOTAL</b>	<b>8.8%</b>

#### 4.2 Survey results: section two

The second part of the survey allowed to identify some practical actions that the company has adopted to quickly face the crisis. The first activities have been implemented with the aim of enabling the execution of the daily working activities, assuring safe and healthful working conditions for workers. In particular, the following organizational measures have been defined:

- smart working in rotation (from March to June, 37% of employers regularly at home);
- complete and continuous IT assistance for the workers at home;
- work shift reorganization with defined and fixed access to the company’s site;
- closure of company canteen and distribution of singular meals to the workers on site;
- definition of new procedures to avoid compresence of workers in aisles, loading/unloading docks or common areas;
- rules and general recommendation following the precautionary principle intended to guarantee the physical distancing between operators.

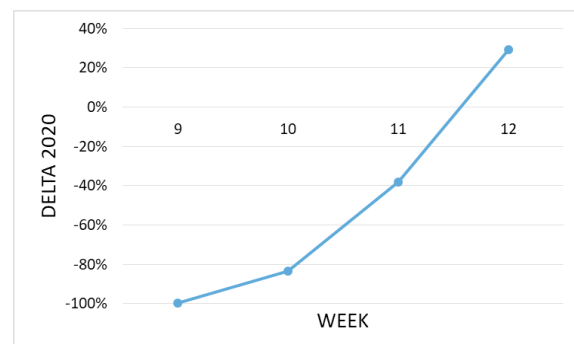
In addition, a specific safety protocol was released and adapted to the Italian regulations and specific guidelines were defined to prevent the virus spread. Examples of these guidelines are: measurement of the body temperature,

distribution of PPE for workers on site, cleaning and disinfection of the workplace, health monitoring and management of symptomatic individuals.

Concerning the relationship between the partners, the customers have accepted a temporary revision of the business agreements. Some requests of cooperation have been introduced by the company; in particular:

- revision of the logistic costs for the emergency period (+1%);
- service level monitoring, but waive of the penalty linked to it;
- revision of the responsibility, considering the new procedures and the participation to the tasks;
- stock level update and updated planning for the second trimester of the year.

Finally, the company had to manage and solve a temporary emergency, due to the closure of a transit point for ten days. The closed site is located in the northern region of Lombardy, adjacent to the little town where the first Italian COVID-19 patient was detected. During the interview, the site manager has explained that the sense of uncertainty and the growing fear have led to the decision to provisionally close the site. Moreover, the warehouse was located in the first Italian “red zone” and many employees came from that area. This was why the company had immediately decided to suspend the work in presence for all the residents in this zone. At the same time, many other employees refused to go to work, fearing for their safety. Similarly, the carriers also refused to enter the red zone and reach that site. For all these reasons, two days after the first Italian COVID-19 case, the warehouse was closed. In the following days, the company outlined specific actions to safeguard the workers’ health, at the same time guaranteeing the right execution of the working activities. Meanwhile, many products were moved to other warehouses; in particular, a new site located in a nearby region (200 km away) was opened and used to this end. Figure 7 shows the impact of the closure of the warehouse on the tons of products distributed, compared to the previous year. It is evident from this figure that the company needed some weeks to restore the normal working conditions, as highlighted by the negative values in the first part pf the graph.



**Figure 7: impact on volumes distributed – transit point located in red zone**

## 5. CONCLUSIONS

This paper has provided an investigation of the impact of COVID-19 pandemic on logistics activities. A major Italian logistic provider was analysed by means of a questionnaire and case study for understanding the main implications of COVID-19 on the logistic services, in terms of volumes, service level and economic aspects. Moreover, a second part of the survey has been focused on the investigation of the new practices, organizational procedures and measures implemented to react to the crisis. In quantitative terms, numerical results show that all events/factors relating to COVID-19 (such as new procedures adopted to guarantee the social distancing) and taken into account in the evaluation had an impact on the economic outcomes of the company. Also, COVID-related events have changed the food purchasing behaviours and the perception of the food availability by the final customers, which also affected the company's turnover.

Although one company only has been investigated in this study, some results could be generalised. For example, it is reasonable to expect that many logistics companies will apply procedures like sanitization of their fleet of vehicles or will have experienced a decrease in full load shipments. Moreover, some practices could also be applied by companies working outside the logistics contexts; this is, for instance, the case for supplementary insurance policies, or shift reorganization to limit contacts among workers. Hence, having an idea of the impact of these policies on the company's turnover could be useful for better and more conscious decision-making. At the same time, it is certainly important to get more general results; hence, our ongoing research is intended to extend the survey to more companies, with the aim of comparing and evaluating the actions adopted to face the pandemic across various sectors. Empirical analyses could be applied to this end and could also be extended to evaluating the worker's perception about the pandemic.

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