Preliminary Analysis of Changes in Logistics Processes to Assess the Impact of a Pandemic

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Abstract. The article analyzes possible changes in logistics processes during the COVID-19 pandemic. It is probable that the fact of the pandemic and the decisions taken by the states – restrictions, quarantine – affected the logistics processes, adjusted them and encouraged the adoption of new decisions. Most of the measures taken had signs of crisis management and were adopted quickly, presumably without sufficient time for detailed discussions. Virtually all of the methodological texts analyzed focus on the premise that logistics processes should not stop at both the transport of goods and strategic goods and the mobility of people, but logistics processes should be complemented by measures that minimize the risk of infection. The work analyzes the works of scientists and, after evaluating the analyzed recommendations, formulates the preconditions for qualitative research – an expert survey. The study confirmed that significant changes have taken place in the global logistics supply chain, which has been affected by the stagnation of product production and the increase in demand. Logistics is expected to adapt to change and more successfully withstand subsequent pandemic waves.

Keywords: Logistics / Processes / Market / Economics / Impact / Pandemic / COVID-19

1 Introduction

The spring of 2020 will enter World History as the start of a global COVID-19 pandemic that has had a far-reaching impact on logistics activities. The impact of the pandemic has been and is being felt in both global logistics supply chains and local markets, which are directly related to the Last Mile issue. In the public sphere, the term was particularly often referred to as “Intermittent logistics supply chains” – which was often misunderstood as stopping transport and logistics processes within the supply chain itself. It is assumed that production has stopped due to the increased demand for the products concerned – usually personal protective equipment – and the exposure of workers to COVID-19 virus and disease. In any case, it must be acknowledged that the logistics processes have changed quite significantly in several respects. First, they became more tense, accelerated, and affected by circumstances that were caused by the epidemiological situation. Secondly, increased demand has necessitated the use of non-conventional modes of transport, such as the very frequent replacement of maritime and
rail transport by air. However, air transport was severely affected, especially in the first weeks of the pandemic. Thirdly, the aspect of safety and security has become especially important in logistics processes - the need to use face masks when communicating with colleagues or customers, to use disinfectant fluid, to react appropriately in case of illness of employees and others.

Analyzing most of the sources are related to the recommendations provided by international and local transport and logistics organizations on how to deal with a pandemic situation and what measures to use. Therefore, in preparation for this publication, a study was conducted in the autumn of 2020, an expert survey to identify key changes in the logistics supply chain related to the pandemic. In part, the survey’s results confirmed the assumption that disruptions in logistics processes are directly dependent on fluctuations in demand for goods, quarantine measures, and business shutdowns. On the other hand, it has been observed that some processes have returned or are returning to relatively normal operating conditions, while others, such as passenger transport, may have long-term changes.

2 General Situation Analysis and Regulation

Quarantine, restrictions, production shutdowns and the threat of high disease rates have a direct impact on business, which, in turn, force transport and logistics. Moreover, this is already causing very serious problems, especially concerning passenger transport, the mobility of the population and the possibility of crossing borders. The Organization for Economic Co-operation and Development (OECD) in its publication “The territorial impact of COVID-19: Managing the crisis across levels of government” first confirms the fact of the crisis and analyses how the disease affects various areas of society. The regional and local impact of the COVID-19 crisis is highly heterogeneous and has a strong territorial dimension, with important implications for crisis management and policy responses. Health and social impacts: In some regions, especially in more vulnerable regions, such as deprived urban areas, the incidence and mortality rates are higher than in others. A more affected and vulnerable population. Economic impact: The regional economic risk of a crisis varies depending on whether the area operates in global value chains and specializes in specific sectors, such as tourism, at least in the early stages. Fiscal Impact: The crisis is increasing expenditures and reducing revenues for subnational governments, and although its impact on subnational finances is not uniform, it is expected to be long-lasting [1].

Based on the experience of previous pandemics and emergencies, public authorities have raised the issue of possible restrictions on the movement of goods and people, in particular by analyzing whether the virus can be transmitted to cargo, goods surfaces, remain viable and thus spread. In its recommendations issued on 29 February 2020, the International Health Organization nevertheless questioned whether a total ban on the movement of people and goods would be sufficiently effective and lead to much more problematic consequences and lead to the collapse of systems without the supply of the necessary materials or tools. Moreover, restrictions can lead to disruptions in the delivery of necessary assistance and technical support, disrupt the activities of businesses and have negative socio-economic consequences for the countries affected by
them. However, in some circumstances, measures to restrict the movement of people may temporarily have a beneficial effect, in particular, if the area is not actively connected to foreign countries and is not adequately prepared to respond to an outbreak. Such restrictions should only be imposed based on a thorough risk assessment, be commensurate with the public health risk, be short-lived, and reviewed regularly as the situation evolves [2].

Relevant recommendations on the organization of the logistics technological process, the protection of workers’ health and the customer service process have been made by most international transport and logistics institutions. Measures for states, airport operators, airlines and other airlines in the air transport industry are designed to ensure a consistent and predictable travel experience. They will also contribute to the efficient, safe, secure and sustainable growth of passenger and freight transport by air and reduce the risk of COVID-19 transmission between these groups and between them and the general public [3].

It should be noted that, in line with OECD provisions, it is emphasized that governments also ensure the continuity of public services in times of crisis by adapting and protecting their staff where necessary. Citizens expect basic public services such as water distribution and sanitation, waste collection and management, street cleaning and hygiene, public transport, public order and security, and basic administrative services to be smooth, and the proper provision of many of them is essential for pandemic management [1].

Summarizing, in all cases, it is considered that the transport of goods must be ensured without restrictions, with the understanding that strategically important goods intended for the health care system may also be transported. Therefore, a lot of attention is paid to the hygiene of drivers’ working conditions – the use of sanitizers, face masks, avoidance of contacts, work in the cab for one and other. When faced with passenger transport, the situation becomes more complicated. However, even here, the focus is on several key issues, namely surface disinfection, the use of sanitizers, ventilation and air filtration in the cab, disposable face masks and gloves, shift work and the cross-contamination possibility elimination.

3 Relevant Logistical Problems of Theoretical Analysis

In scientific texts that analyse the issues of logistics, the problem of the last (first) mile is often encountered. It is a complex problem that covers many aspects – technological solutions for the collection/separation of shipments, routing, optimal routing and cost reduction, and the problem of Green Logistics. This problem is analysed by Min Zhou et al. and others in providing solutions related to consignment delivery optimizations. It is argued that e-commerce retailers welcome the self-service parcel delivery service as an effective “last mile” delivery solution, and consumer uptake behaviour is a key point in adapting to this emerging technology. Empirical results show that expected performance, waiting time, social impact, and facilitative conditions are positive factors, and perceived risk negatively influenced behavioural intentions [4].

It has been observed that the intensity of the transport modal shift has changed since the onset of the pandemic. In response to the growing demand for health care
goods and the need to ensure fast delivery, air transport has been used more intensively. It should be noted that additional opportunities for the use of air transport have arisen due to the reduction of passenger traffic and the reorganization of passenger cabins to transport small loads. However, fundamental problems in air logistics, such as flight delays, have also become relevant. Studies have been conducted on the cost of delays to airlines, passengers and the public. Yulin Liu et al. note that there are no delay prices or similar concepts for cargo flights. Because night flights play an important role in providing the Next Day service, which is provided by most major carriers, the Federal Aviation Administration (FAA) requires research to assess the impact of flight delays on cargo and package carriers. The focus is on two elements of the analysis to achieve this goal. First, the authors use logistic regression models applied to the historical data set to understand the factors that determine late deliveries. The authors found that flight delay (arrival time) at the destination airport and land allocation distance are two important factors in timely delivery. The authors also perform random effect models and airport-specific models to capture the heterogeneity of packages taking place in different regions. Second, based on random effect models, the authors predict the percentage of package delivery delays at different flight delay levels. The results show that in those key market regions, flight delays can account for 22–38% of total package delivery delays [5].

In most European countries, the introduction of quarantine measures and the restriction or non-recommendation of the movement of people from home to outlets has led to a significant increase in courier services. The need for courier services has increased significantly and this has caused the need to plan courier routes, cover the served area, and minimize time costs. Max Gath argues that in addition to group and mass traffic, another area of challenge for logistics planning and control is urban courier, express, and parcel services (CEP services). This case study was carried out in collaboration with tiramizoo GmbH at its headquarters in Munich, Germany [6].

One of the more detailed works analyzing the impact of quarantine on the Spanish city of Santander is presented in an article published in May 2020 by Alfredo Aloi et al. The authors have made detail analysis how quarantine measures changed the behaviour of the population and their internal mobility in the city. Emphasis is placed on the overall reduction in transport flows (private cars) and a significant reduction in the use of public transport. Decreasing mobility has also reduced emissions. The decrease in air pollution is also noticed by more authors who analyze the importance of the impact of the pandemic on logistics processes. The authors of this article also emphasize that the number of traffic accidents has decreased due to the reduced traffic flows and it has accounted for more than 50%. What is logical is the emphasis on another positive aspect – the levelled demand, in other words, the disappearance of the problem of flow fluctuations during the 24 h. According to the authors, it can be concluded that quarantine measures have led to minimization of traffic flows, lower transport emissions and pollution, reduced the number of traffic accidents and disappeared traffic jams [7].

Summarizing whole analysis of methodological and scientific material in this article, it is possible to make certain generalizations and assumptions for the upcoming research. First of all, it should be emphasized that the instructions and recommendations analyzed in this article are objective text, as most of these recommendations have
been developed using scientific research results. There are scientific texts that directly analyze the impact of the pandemic on logistics processes, but many of them analyze the problems of the city and the region, there is a need to evaluate global logistics processes.

In assessing the impact on logistics processes and taking into account the content of the research, it makes sense to further analyze the following problem areas:

1. **Dynamics of the impact of a pandemic on logistics processes** – in scientific and methodological works it is noticed that the authors evaluate the impact of a pandemic on a time scale, especially when predicting possible future scenarios;
2. **Area of activity of transport and logistics companies affected by the pandemic** – it is probable that the company’s work with customers, internal infrastructure, relations with competitors have been affected differently;
3. **Local and global logistics processes** – which part of the logistics supply chain has been affected most first/last mile or global processes and long-distance shipments;
4. **Logistics supply chain disruptions** – how and which processes in the logistics supply chain were most affected;
5. **Passenger transport technologies** – there is still a need to find out how passenger transport technologies can be changed and what the prospects for change are.

### 4 Determination of Survey Methodology

Taking into account the theoretical analysis and the formulated tasks of possible research, an expert survey was conducted. The study was conducted from September to October 2020. The study was conducted in 6 countries – Lithuania, Finland, Luxembourg, Italy, Poland and Germany. The research was qualitative, it involved selected experts who met the criteria of experience and professionalism – that is, researchers working in the field of transport and logistics, participating in projects, publishing scientific studies on transport and logistics issues. Representatives of the transport and logistics business were needed as a control group in the study, but they also needed an additional qualification requirement – participation in associated transport and logistics organizations.

The experts were asked 10 groups of questions or statements that needed to be rated on a 10-point scale, where 0 means no expert giving an assessment or no answer, 5 means a neutral opinion, a score from 1 to 4 means a negative rating scale, and a score from 6 to 9 means a positive rating scale, 10 points means absolute agreement with the statement made. The questions covered topics related to the dynamics of the pandemic development and impact on logistics on a time scale, analysis of the impact of the pandemic on specific logistics activities, assessment of affected logistics processes in macro and microenvironment, analysis of customer service activities and possible changes in passenger transport technologies.

**The study aims** to form an overall initial expert picture of the situation assessment of how the pandemic affected logistics processes.
5 Results of the Study of the Impact of the Pandemic on Logistics Processes

Experts were asked to assess the dynamics of the impact of the pandemic on logistics processes between March and September 2020 (Fig. 1). Statements reflecting three possible scenarios were provided for the assessment. The first scenario is the impact of the pandemic was strongest at the beginning, later the situation normalized and will remain so in the future, the second – the impact of the pandemic is constantly strong and negative, the third – the situation was bad at the beginning of the period, later normalized but will worsen again in the future.

For the first scenario, the experts gave the highest ratings. Thus confirming, that the logistics system has already had the greatest impact at the beginning of the period and the situation has normalized and is likely to remain some in the future. Such an assessment can be interpreted by the fact that the logistics system and logistics processes have “learned from experience” and decisions have been made at the appropriate levels that allow the system to function well. This reaffirms the possible notion that logistics is sufficiently labile and adaptive.

The analyzed period is from March 2020 to September 2020. It is stated that:

- The negative impact of the pandemic on logistics processes was uneven: the impact was mostly felt in March-April, after which the processes more or less returned to normal conditions with some exceptions. →
- The impact of a pandemic is permanent with no significant fluctuations. →
- The impact of the pandemic is wavy: the first negative impact was in March-April, then the situation returned to normal, and since the beginning of September the situation has been deteriorating again. →

![Fig. 1. Assessing the dynamics of the impact of a pandemic on logistics processes.](image-url)

Experts assessed how the pandemic affected certain areas of the transport and logistics company’s operations (Fig. 2). The interpretation of the experts’ assessment can be linked to the observation that practically all activities of the transport and logistics company were affected in the same way, except for the relationship with competitors. Experts rated this area of activity less than a neutral score. This result can
be explained by the fact that in a crisis when the need for logistics services increases, or logistics processes are affected by other difficult-to-manage forces – the competition is relegated to the background. The highest expert evaluation score was to working with clients. Knowing that the need for logistics services has increased or has changed, as well as considering that there has been a great need for the supply of medical and personal protective equipment, the actualization of working with customers is fully understood. As it is understood, the impact of the company’s internal infrastructure and health and safety of employees was assessed with a high expert score.

The area of activity related to state or local authorities was assessed as positive, which means a significant score. The evaluation score is not high, that does not indicate a very significant impact in this area, but is nevertheless mentioned. This assessment can be interpreted by the fact that some businesses have had the opportunity to apply to the authorities for support for a suspended business. Mostly it was hotel restaurants or other businesses in the hospitality industry. The expert assessment, which is close to 6.5 points, shows that such support for the logistics business was not significant. However, it should be mentioned, which is the observation of the author of this article, during the second wave of the pandemic, the assessment of this criterion may be more significant, as the increasing number of illnesses affects the job conditions of employees in logistics companies.

![Image of bar chart](image)

**Fig. 2.** Estimation of the activities of transport and logistics companies were most affected by the pandemic.

Experts were asked to assess which part of the longitudinal section of the logistics supply chain – in the first/last mile, otherwise – at the beginning/end of the logistics supply chain or in the section of global transports (long distances) the impact of the pandemic is most felt. The answers were somewhat surprising, as experts focused more on the issue in global shipments than on the first/last mile stretches (Fig. 3). The difference in assessment scores is not very significant, but the trend is somewhat
dissonant with the theoretical claims that most problems in pandemic conditions arose in logistics processes when it was necessary to collect and especially distribute small consignments to recipients. In this case, however, a distinction needs to be made between “business to business” and “business to end customer” logistics systems. Concerning “business to end customer” (often the term B2C) logistics services, which include courier services and small parcel business, it should be noted that their workload has increased and activity has intensified during the pandemic. However, it can be assumed that although this caused additional burdens on the logistics business, it did not cause significant disruptions or collapse of the system – shipments may have been delayed, but reached consumers. The choice of experts to give slightly higher priority to the claim that the pandemic had a greater impact on global shipments is correct, as changes in logistics supply chains related to production disruptions were much more significant and had negative consequences for the Last Mile system as well.

| The pandemic has had the greatest impact on the logistics processes that are taking place in: |
|---------------------------------------------------------------|
| • the “First” and “Last” miles of global shipments. → |
| • global logistics supply chains, global transportation; → |
| 0 | 2 | 4 | 6 | 8 | 10 |
| 7.9 | 8.7 |

**Fig. 3.** Assessing the impact of a pandemic on the longitudinal section of the logistics supply chain.

In this context, it should be noted that the experts rated the statement “Logistics processes were most affected by quarantine and suspended production” with 9 points (average), which confirms the assumption that quarantine and production suspension measures had a significant impact on logistics processes in global logistics supply chains.

The assessment of changes in passenger transport technology was based on the premise that significant technical – technological changes are possible, which would include possible changes in the design of the passenger compartment, new technological solutions or infrastructure requirements (Fig. 4).

This assumption was based on information disseminated in the public domain about possible cabin partitions, a new way of disembarking passengers, and other design solutions. As an alternative claim, another scenario was presented which declared that the changes, if possible, would not involve a new design of vehicles, but higher requirements for passengers, including the possession of “vaccine passports”. Experts
rated the alternative scenario higher. This can be explained by the fact that passenger transport, especially in aviation, decreased significantly during the pandemic and airlines suffered significant economic losses. The additional economic burden and investment in the development and acquisition of redesigned vehicles would be excessive.

In summary, it can be said that it was a very valuable experience in reviewing the situation of logistics processes in the opinion of experts. Thank you to all the experts who agreed to participate in the survey and submitted their assessments. It is also worth noting that the study is open, it is planned to expand the circle of experts and conduct a second round of research by presenting the results of the first round.

6 Conclusions

Based on the results of the research, it can be stated that changes in logistics processes during the pandemic situation have occurred and some of them have a long-term impact, some have disappeared as the situation normalizes. Given the unexpected and rapid spread of COVID-19 worldwide, logistics regulators have been forced to make quick decisions that may not be fully justified or debated. It can be assumed that the recommendations provided were based on general experience in the prevention of infectious diseases, so the specificity of COVID-19 will be assessed in the future and it is likely that these recommendations will be transformed in the future. In essence, the recommendations on how to carry out logistics processes in a pandemic situation sought to maintain the movement of goods and people, although the countries closed their borders as the disease spread and these processes were disrupted. However, despite universal quarantine, logistics processes have taken place, especially for freight. A major change in logistics processes has been a new approach to occupational safety and passenger safety to use sanitizers, face masks, filter air, disinfect surfaces and maintain social distance.
The study confirmed the lability of logistics processes and the ability to adapt quickly to changing circumstances. This leads to the conclusion that sufficient technological and managerial experience has been accumulated in the historical retrospective of logistics processes. Therefore, it is likely that in future crises, which will be similar to the current pandemic, decisions can be taken quickly and effectively.

The pandemic situation had the greatest impact on the customer service process, logistics inevitably had to respond to production disruptions, and the greatest impact was felt in global logistics supply chains. However, it must be acknowledged that fundamental technological changes are not to be expected, as the logistics system faces a dilemma – companies suffer losses in the event of a pandemic, and fundamental technological changes require additional investment. It can be assumed that state support and financial investments in technological change become important in this situation.

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