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Changes in Cargo Movement due to the Effects of COVID-19

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Abstract

This study analyses and discusses how the unique cargo movements in Japan and changes in the social environment during the COVID-19 pandemic have affected social life. Since the outbreak of COVID-19, cargo movements in Japan have undergone significant changes. This study analyses cargo movements in Japan by showing correlation coefficients to indicate the extent to which each industry was affected by the spread of the new coronavirus to infected persons. The heightened awareness of the pandemic caused by the state of emergency led to the closure of many stores and a decline in outbound shipments. Although the volume of incoming shipments increased, the volume of outgoing shipments did not. As a result, warehouse vacancy rates declined. Therefore, the study revealed that distribution centers in Japan are becoming more self-sufficient, and cloud-based logistics information systems are becoming more widely used.

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1. Introduction

Prior to the COVID-19 pandemic, significant attention was focused on expanding global supply chains and corporate collaboration to improve efficiency. However, since early 2020, social life in Japan has changed considerably due to COVID-19. Even with the requirement for social distancing, logistics did not remain stagnant. The supply of medicines, food, daily necessities, and the like remained essential despite changes in social demand, and the need to reduce the risk of COVID-19 affected logistics, as Chen et al. (2022) pointed out. Still, global supply chains and corporate collaboration have been significantly affected. Incidentally, Ardolino et al. (2022) previously organized many studies related to COVID-19 and logistics.

In the early days of the COVID-19 pandemic, lockdowns and a state of emergency paralyzed the lives of citizens around the world, including Japan. A large-scale hoarding of goods due to anxiety about COVID-19 and its impact on the world's uncertain future was observed. This hoarding was not limited to the consumer level, as intermediaries and brokers also intervened on a large scale, resulting in serious shortages of

many products. Therefore, a logistics perspective on cargo movement in the pandemic's early stages is necessary.

In response to the lockdowns and the declaration of a state of emergency, companies increased their procurement and purchase volumes in preparation for potential emergencies. As a result, product inventories piled up in warehouses, and products were not shipped quickly. Consumption was sluggish, partly because retail stores were closed or had shortened business hours, which limited sales opportunities. On the other hand, the demand for some products increased, resulting in consumer shortages and hoarding at the beginning of the pandemic. Temporary shortages of items such as masks, toilet paper, and disinfectants were observed.

As restaurants and other establishments were asked to close or shorten their working hours, "staying at home" and "drinking at home" became a trend. This led to major changes in the shipping systems of food manufacturers. Shipments to restaurants, which had previously been significant, decreased sharply while shipments to convenience stores, supermarkets, and other establishments targeting general households saw a sharp increase. Some supermarkets reported a significant increase in shipments of nest-related products.



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However, it does not mean that the overall shipment volume has significantly increased, but rather only the change in cargo movement due to the shift in demand from restaurants to general households. Additionally, the food delivery service industry has expanded its market size by 50% post-COVID-19 compared to its pre-crisis market size. Therefore, this paper focuses on cargo movement during the pandemic and the resulting changes and trends faced by distribution sites in Japan.

The logistics industry appeared to be greatly perplexed by the major changes in logistics volumes due to COVID-19. The impact of the Corona Disaster on this industry is evident from a macroscopic perspective. The industry has strengthened its measures against natural disasters, such as major earthquakes and tsunamis; however, it has largely been ineffective against pandemics. Nevertheless, the risk of new pandemics is here to stay. There is a possibility of outbreaks, including the transmission of avian influenza to humans, global epidemics like Ebola, and outbreaks of new and unknown infectious diseases. Emergency preparedness and the background to a pandemic should be understood. A study on logistics during such pandemics is significant to prepare for future pandemic countermeasures.

2. Characteristics of Cargo Movement During COVID-19

The outbreak of COVID-19 between January and July 2020 led to significant restrictions on social activities in Japan. Therefore, this study aims to analyze the relationship between the rise in the number of COVID-19 infected individuals and the amount of cargo flow during this period. The following presents an outline of cargo movement in different industries due to the influence of COVID-19.

To investigate the relationship between the number of COVID-19 infected individuals and the actual results of commercial warehouses (i.e., the amount of goods received), we analyzed data announced by the Ministry of Land, Infrastructure, Transport and Tourism (2020). The results indicate a high correlation coefficient of 0.9. However, in the case of warehousing records (the amount of goods delivered), the correlation coefficient is only 0.11, which suggests no significant correlation between COVID-19 infected individuals and warehousing records. Similarly, for storage records, the correlation coefficient is 0.15, indicating no correlation.

Therefore, the study concludes that while warehousing is sensitive to the number of COVID-19 infected individuals, storage and warehousing records (the amount of goods delivered) remain almost unchanged compared to pre-COVID levels. In other words, an increase in the number of COVID-19 infections triggers awareness of a crisis, and the rise in orders suggests an increase in the amount of warehousing in ordinary business warehouses. Thus, no correlation was found between the amount of storage and other variables. Although the relationship remains unconfirmed, the increase in storage volume since COVID-19 is thought to be due to the increase in warehousing volume. Additionally, according to CRE (2020), the vacancy rate of large warehouses in the Tokyo metropolitan

area is extremely low, currently at 0.43%. Notably, the shipment amount has not increased due to the increase in receipt amount being caused by “the increase in safety stock due to the heightened sense of crisis.” Meanwhile, the shipment amount to the retail industry, restaurant industry, and similar areas is suppressed.

To summarize, the relationship between warehousing and the number of people infected with COVID-19 is sensitive, as shown in Fig. 1. However, storage and warehousing levels are consistent. As the number of people infected with COVID-19 increases, so does awareness of the crisis and the number of orders, resulting in an increase in warehousing in ordinary business warehouses. While no correlation was found regarding the storage amount, the increase in storage since COVID-19 is believed to be due to the increase in warehousing. In addition, the vacancy rate of large warehouses in the Tokyo metropolitan area remains extremely low.

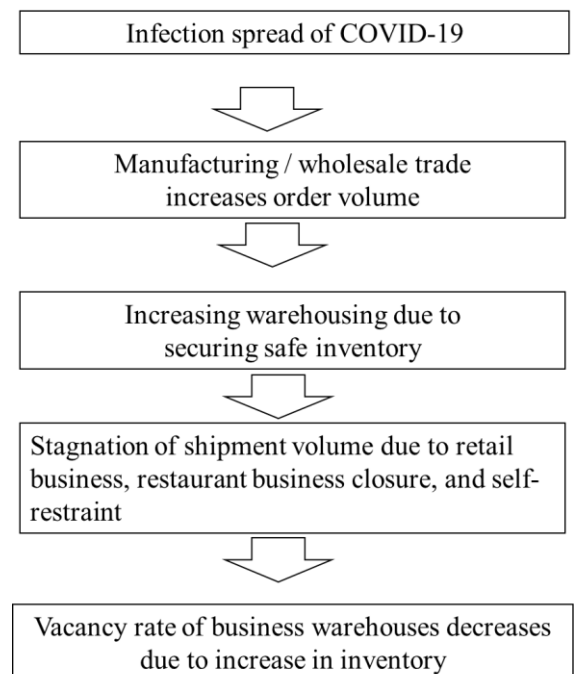


Fig. 1. Impact of COVID-19 on cargo movements

The quantity of shipments has not increased due to the rise in safety stocks brought about by heightened crisis awareness. Shipments to retailers, restaurants, and overall shipment volume have been decreased, particularly for daily necessities and food items. In addition, a significant shortage was observed in items that were purchased.

3. Characteristics of Cargo Movements by Industry

A correlation was found between the number of people infected with COVID-19 and the amount of warehousing. However, this study also investigated whether this correlation exists when viewed by industry. As shown in Figs. 2 and 3, a positive correlation was found for agricultural products, daily

necessities, base metals and steel products, and chemical industrial products. However, almost no correlation was found for food industrial products and machinery. The lack of correlation with agricultural products was due to oversupply caused by restaurant closures and the interruption of school meals, according to the Japanese Consumers' Co-operative Union (2020). The correlation data were quantitatively measured and published by the Japanese Ministry of Land, Infrastructure, Transport and Tourism in its "Warehouse Statistics Quarterly Report" and other logistics-related publications on the COVID-19 pandemic (2020-2022), and analyzed using statistical analysis software.

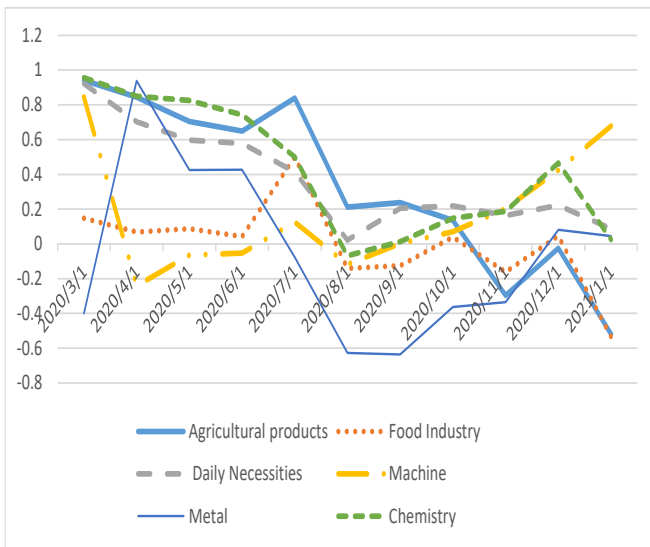


Fig. 2. Changes in the correlation coefficient between the number of infected individuals and the Cargo Movement Index for goods receipt

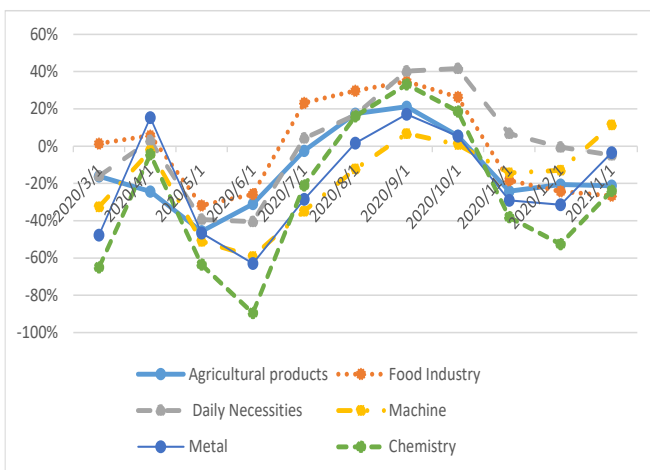


Fig. 3. Changes in the correlation coefficient between the number of infected individuals and the Cargo Movement Index for storage

Sales in other areas, specifically sales at major regional co-ops nationwide, have significantly exceeded the previous year's levels for five consecutive months since February, both in stores and home delivery. Many delays and shortages are apparent, with some co-ops waiting for new applications for

several months. Moreover, the purpose of daily necessities and chemical industry products is to secure demand and safety stock for masks, disinfectants, and medical products in general.

On the contrary, the warehousing amount of steel products has not increased due to the suspension of production at automobile factories in China, the influence of production cuts, and the difficulty in procuring parts made in China. Although there is no significant correlation between the balances, the storage balances are increasing. And it is possible that the inventory was increased due to concerns that the supply of goods would be stagnant because of production bases' closure due to the spread of COVID-19.

The above discussion provided an overview of the relationship between cargo movements and the number of people infected with COVID-19.

Data published by the Ministry of Health, Labor and Welfare and local governments in Japan were used for the number of infected persons. This study used data published by the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in its "Warehouse Statistics Quarterly" and other logistics-related publications on the Corona Disaster (2020-2022), such as the "Warehouse and Logistics Real Estate Market Report" by CRE, Commercial Real Estate, a leading private company, and the "Corporate Logistics Short-term Trend Survey" by the NX (Nippon Express) Research Institute.

In the two years and six months since February 2020, at the beginning of the coronary disaster outbreak, the number of infections has increased. The social perception of the infection has also changed dramatically. Trends during the entire period of the coronary disaster were closely monitored. However, the focus of this study was on the first year of the coronary disaster outbreak in 2020. The bias is that infection control measures have advanced over the years.

4. Expansion of Home Delivery Services

Under the influence of COVID-19, both the food service industry and the retail industry have increasingly prioritized home delivery services.

4.1. Food Delivery

The food and beverage industry is facing a challenging situation due to social demands for holidays, shorter business hours, and self-restraint. To reverse the decline in demand, food delivery has become a popular solution. The food delivery process involves consumers visiting the food delivery company's website, selecting the menu products, and placing an order. The food delivery company or the contracted delivery person then delivers the product to the consumer. The website also offers delivery from restaurants using large logistics companies' delivery network. The total supply of 65 major regional co-ops nationwide has been significantly higher than the previous year for eight consecutive months since February 2021. Additionally, due to the impact of COVID-19,

there has been a sharp increase in the number of web subscribers.

The beer industry, which had anticipated an increase in demand during the Tokyo Olympics, has collapsed due to the COVID-19 outbreak. Consequently, there has been a noticeable change in the demand pattern, with personal demand increasing from the previous year. As a result, overall growth has been negative. Beer manufacturers have responded to this trend by focusing on product development for home use, raw materials, and foaming, and healthy products.

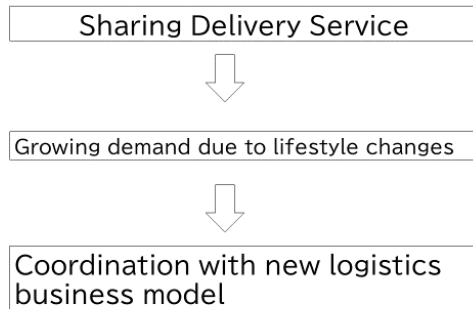


Fig. 4. Sharing delivery as a new business model

4.2. Online Shopping Company

The brick-and-mortar retailers have experienced shortened business hours or closures. Therefore, online shopping companies have observed a rise in product purchases. Online shopping companies have been compensating for the reduced demand from in-person shopping stores on a larger scale than ever before. In the online shopping market, digital transformation (DX) is needed to ensure logistics-related security.

With the outbreak of COVID-19 pandemic, virtual stores have increasingly taken over the demand from physical stores. This has caused a surge in the demand for fulfillment centers that perform long-tail inventory management. Moreover, the Internet environment has enabled the construction of a precise supply chain, including the acceleration of logistics DX.

Internet mail-order companies are starting to adopt advanced fulfillment through in-warehouse logistics operations. Fulfillment includes after-sales services such as order receipt, product shipment, inventory management, payment management, return management, and complaint processing. It refers to the strategic flow of a series of operations both inside and outside the warehouse. Emphasis is placed on improving customer satisfaction and increasing value-added services over traditional distribution centers. To achieve this, advanced warehouse management systems (WMS) have been introduced, and efforts have been made to reduce operating costs and inventory levels. This is done through thorough labor management and work management after promoting logistics DX.

Furthermore, unmanned logistics operations are becoming more prevalent due to the link with DX. The use of unmanned forklifts, automated guided vehicle (AGV), and other technologies have promoted unmanned operations. Therefore, these

have become the control tower for the advancement of Supply Chain Management.

Moreover, the focus in distribution centers for online shopping is more on improving customer satisfaction and increasing value-added services than in conventional distribution centers. Start-up companies often outsource distribution and have no choice but to enlist the help of 3PL companies with expertise in fulfillment operations for the operation of distribution centers, and courier companies for the last mile. Micro-fulfillment centers are also appearing in the suburbs of consumption areas to offer quicker delivery from bases near consumption areas rather than direct shipments from large-scale distribution centers. Micro-fulfillment centers are small-sized logistics bases.

However, at small bases dealing with frequent, small-lot, fixed-scale shipments, a considerable amount of work for conventional distribution centers is highly likely. Therefore, a storage system that enables high-density storage by stacking small containers without gaps, while considering shipping frequency by linking with AI can be found. Moreover, high storage efficiency and quick operation are expected in a space-saving manner. Multi-shuttle automated warehouses are also expected to play an active role. They have a space-saving design that allows multiple shuttle cars to enter and exit, minimizing dead space.

In recent years, technological innovations in the use of roller conveyors, which are indispensable for logistics, and systems have been developed to install barcode reading gates on conveyors and to obtain shipping information from conveyors. The number of types that can flexibly respond to speed shifting and the like is increasing.

4.3 Small Cargo

The volume of parcel delivery services continues to increase even during the pandemic, amidst an expanding demand for nesting leading to a surge in the online shopping market. Consequently, the number of small cargos has increased considerably. Analysis of the data reveals that there is a positive correlation of 0.6 between the number of positive cases and the handling record of small cargo by the largest courier company, as illustrated in Fig. 4.

While the volume of large cargo handled in corporate logistics is decreasing, it has become evident that the demand for courier services, which are consumer logistics targets, is on a rise, along with the volume of small cargo handled. Fig. 5 shows the handling record number of packages of small cargo during COVID-19 by Yamato Holdings.

The online shopping market has experienced rapid expansion due to the COVID-19 outbreak, surpassing previous records. The declaration of a state of emergency, closure of physical businesses such as retailers and restaurants, and the need for shorter working hours have all accelerated the shift towards virtual stores. This expansion of online shopping has a significant effect on transporting small-lot freight. Correia et al. (2022) suggested that fulfillment services are also expanding globally, including countries outside of Japan.

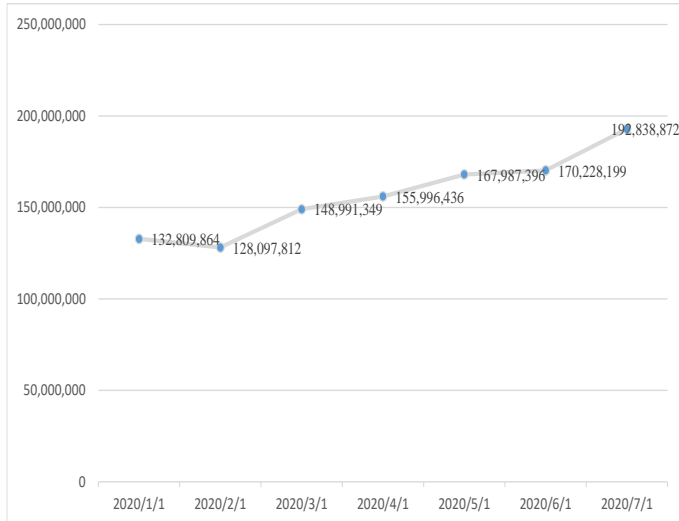


Fig. 5. Handling record number of packages of small cargo during COVID-19, Yamato Holdings(2020)

The fundamental scheme of Japanese home delivery service is as follows: when sending a parcel from home, bring the parcel to the nearest convenience store or parcel delivery service office, fill in the slip, and complete the delivery procedures. Parcels for courier services are picked up at convenience stores, courier service offices, etc., and then brought to a large courier service center (base) that oversees the area. At this base, the parcels are sorted by destination and sent to the home delivery center in the destination area. The parcels are then sorted again by destination at the courier center in the destination area and delivered either directly or through a sales office.

A closer look at individual operations reveals that sorting plays an important role in ensuring smooth and speedy parcel delivery. Usually, sorting work for parcel delivery involves multiple sorting operations such as primary sorting and secondary sorting. Sorting is performed at the base, and final sorting is completed at each base. In cases involving manual labor, a list or barcode containing purchase information is read with a handy terminal. However, when a large amount of material must be processed, an automatic sorting machine is used. Items collected are transported on a conveyor and the sorting destination information is read from barcodes on the conveyor. Digitization and DX have made great progress in this regard.

Before COVID-19, a major issue with parcel delivery was the lack of delivery destinations during the day in urban areas. In the current situation, many double-income households and individuals living alone struggle to receive a parcel in one delivery. Furthermore, in response to the growth of the online shopping market, securing delivery drivers to deliver parcels has become a major challenge. However, the situation surrounding courier services has completely changed since the pandemic. With the increase in telecommuting, the problem of “absence” in urban areas has been temporarily resolved.

Moreover, there has been a noticeable movement to avoid “closed spaces,” “crowded places,” and “close-contact settings.” Home delivery companies and consumers have been reluctant to leave their homes. However, the acceptance of

parcel delivery during the pandemic is only temporary, and it cannot be denied that in the post-COVID-19 era, the perception of parcel delivery will become negative again, while the redelivery rate will increase. Even though this situation may be acceptable temporarily due to increased telecommuting during the pandemic, it does not mean that the status quo will remain when the pandemic is over.

5. Joint Distribution Center

Due to the COVID-19 outbreak, the demand for home delivery services has risen, making it essential to supplement the existing distribution network. However, there are few companies that can create a new advanced logistics infrastructure. Hence, logistics infrastructure sharing is being utilized, and sharing delivery in the food and beverage industry is one such form.

Moreover, companies are now using sharing services not only for transportation and delivery but also for distribution centers, predominantly for storage, cargo handling, and distribution processing. Buffer warehouses are being employed for this purpose, as highlighted by Suzuki et al. (2016). Major 3PL companies in Japan have even introduced a pay-as-you-go service, wherein multiple operators share distribution equipment. Sharing services have made it relatively easier for small- and medium-sized businesses and start-ups to venture into the online shopping business, as no significant investment is required.

As a measure for infection control, non-contact work is encouraged, especially for distribution center workers. An increasing number of companies have made it necessary to enhance polymerase chain reaction (PCR) testing and to mandate the wearing of masks on-site.

In distribution centers, automation has been promoted to reduce contact between workers by mechanizing manual work as much as possible. For example, there has been an increase in cases where inspection work has switched from manual visual inspection—which carries a high risk of infection—to barcode inspection using handheld terminals and non-contact automatic inspection using radio frequency identification (RFID).

However, it is undeniable that the economic recession caused by the impact of the new coronavirus on the economy has resulted in many companies facing declining sales and profits, leaving little room for new capital investment. Therefore, the introduction of relatively cost-effective systems, such as semi-automated rather than fully automated systems that can be non-contact and reduce costs, has gradually progressed.

5.1. Sharing of Large Distribution Centers

In this new normal era of coexisting with COVID-19, a large distribution center can be utilized to secure social distancing. By introducing the latest material handling equipment, it is also possible to realize labor savings and effectively prevent infection. The distribution center has added “measures to prevent infection of employees” and product “disinfection/safety” as new values. Moreover, if it is a large-scale

company, the introduction of fully automated equipment in the warehouse is expected to progress in the future.

As for Medium-Sized Distribution Center, by proposing a system that uses AGVs, labor-saving and automation become possible, thus reducing fixed costs and preventing infection.

5.2. Services of Logistics Equipment

In the logistics industry, the burden on distribution sites is increasing due to the expanding demand for nesting, which has led to the trend towards platformization of warehousing or inventory management.

5.2.1. Platformization of Vendor Managed Inventory (VMI) Warehouses in the Manufacturing Industry

The construction of a digital supply chain for distribution and commercial distribution is progressing to facilitate sales distribution from manufacturing to wholesale and retail. In the upstream part of the manufacturing industry's supply chain, assemblers and group suppliers implement just-in-time (JIT) and milk runs. However, with the progress in global procurement and standardization and modularization of parts, etc., the procurement network is not necessarily set up within the framework of affiliated companies. Consequently, an increasing number of suppliers are building networks to supply parts and materials to multiple assemblers.

That is, an increasing number of forms of inventory management can be observed, starting from the VMI warehouse shown in Fig.6. In this model, suppliers keep delivery deadlines in mind, rather than JIT led by assemblers. The diagram on the left shows that with the VMI warehouse as the core, optimization is being promoted on both the physical platform for hardware and the digital platform for software. Suppliers and assemblers share inventory information, delivery dates, and more, starting from the VMI warehouse. The supplier determines the inventory status and delivery date at the VMI warehouse, formulates a production plan, and establishes a timely replenishment system.

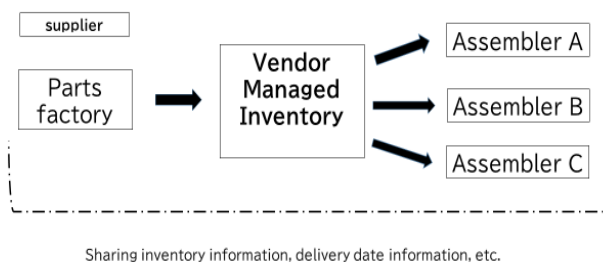


Fig. 6. Scheme of Vendor Managed Inventory

5.2.2. Platformization of Cloud-Based Inventory Management System for Online Shopping

Cloud-based inventory management systems are becoming increasingly popular due to the rising number of online shopping businesses. A platform has been developed that can cen-

trally manage inventory data in real-time from multiple locations and realize IoT inspections through smartphones. Recent systems also offer services that allow invoices and delivery notes to be created using order data.

From an information security and material handling equipment compatibility perspective, systems that are managed by introducing our own server have been the mainstream so far. However, in the trend towards DX, we have introduced a cloud-based inventory management system. It is attractive because the system is quick to build and can be introduced at a low cost. Another advantage of cloud-type management systems is that inventory information can be shared in real-time. For example, a major cloud-based inventory system offers a program that introduces retailers who use their system to partner with 3PL companies that use their inventory management system as a platform to horizontally expand into related businesses.

On the other hand, businesses can benefit from a fulfillment service that covers inventory management, packing, shipping, and coordinating with courier services, thereby supporting the efficiency of logistics for online shopping businesses. Furthermore, moving beyond the cloud-based inventory management system seems to be the future of WMS as a platform. If the inventory management system incorporates functions such as managing the progress of warehouse work in the flow of DX, the possibility of integration with WMS will eventually be realized. However, from the standpoint of on-site improvement, even though it is a cloud-based system, it is necessary to implement a step-by-step introduction rather than a hasty system. The main premise of the introduction is to improve the site by standardizing the layout and operation of the warehouse.

6. Conclusion

This study analyzed the impact of the increase in COVID-19 infection cases on the logistics industry, with a focus on cargo movements. Additionally, this study highlighted the industry's trends in the new normal era. By examining the relationship between the number of infected individuals and cargo movements, a strong correlation was observed with the amount of goods received. However, almost no correlation could be found with the amount of storage and goods delivered.

This result can be interpreted as follows: for agricultural products, daily necessities, chemicals, etc., which showed a particularly high correlation coefficient, the upstream of the supply chain reacts sensitively to an increase in the number of infected individuals, leading to the shipment of goods. Although no guideline can be seen, companies will begin to secure safe inventory as a means of risk-hedging against potential shortages of goods. In turn, this will cause storage amounts to increase, leading to a low vacancy rate of related warehouses and ultimately inducing a shortage of warehouses. In addition, the volume of small cargo such as parcel delivery services is increasing due to the expansion of the food delivery and online shopping market.

A positive correlation has been confirmed between the number of people infected with COVID-19 and the volume of

small cargo handled. With the outbreak of COVID-19, the market for courier services is likely to expand further, but it is expected that the form of delivery sharing will develop in the future to compensate for the shortage of truck drivers and the lack of maintenance in distribution networks. There are signs that sharing will be promoted not only for transportation and delivery but also for distribution center operations. From the perspective of encouraging thorough social distancing and crowd avoidance, multiple distribution centers aiming for full automation or unmanned operation have been observed. It is conceivable that the movement to share with companies will increase.

Furthermore, the design and construction of smart supply chains in the new normal era, which has progressed since the pandemic, assumes that information will be thoroughly visualized through integration with digital technology. In other words, it is not just the flow of analog things and its accompanying information network, but also a digital information infrastructure backed by big data on a different layer. It can also be said that the emergence of a “typical supply chain” is about converting from a conventional analog supply chain to a digital supply chain, or how to promote “supply chain DX,” which can be regarded as a significant issue for the revitalization of the Japanese economy.

Digital information plays a crucial role in modern-day smart supply chains. Effectively leveraging the big data generated at supply chain sites is of utmost importance. Furthermore, DX is gaining attention as a decisive factor. With the onset of the new normal era, with a focus on coexisting and thriving amidst COVID-19, logistics movements are taking on new dimensions.

Due to social demands such as shortened business hours, holidays, and self-restraint, the food and beverage industry is facing challenging times. Consequently, food delivery is becoming increasingly popular, with the aim of stemming the decline in demand. Food delivery systems involve consumers visiting the food delivery company’s website, selecting menu items, and placing orders. The consumer then receives their order from either the food delivery company or the contracted delivery personnel. Additionally, websites enable delivery of food from restaurants through delivery networks comprising large logistics companies. Since February 2021, the overall supply of 65 major regional co-ops across the country has been significantly higher than the previous year for eight straight months. The number of web subscribers has also drastically increased due to the COVID-19 pandemic.

The beer industry, which anticipated a surge in demand during the Tokyo Olympics, has experienced a significant decline due to COVID-19. This decrease in demand has prompted a significant shift towards personal buying, resulting in negative growth. To counter this trend, beer manufacturers are focusing on developing new products for home consumption, honing materials and foam production while ensuring that their products can cater to consumers with health preferences.

Acknowledgements

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Reference

- Ardolino, A., Bacchetti, A., Dolgui, A., Franchini, G., Ivanov, D., Nair, A., 2022. The Impacts of digital technologies on coping with the COVID-19 pandemic in the manufacturing industry: a systematic literature review. *International Journal of Production Research*, DOI: 10.1080/00207543.2022.2127960
- Chen T., Y.D., Wong, X., Wang, D., Li, 2022. Investigating consumers’ intention of using contactless logistics technology in COVID-19 pandemic: a Copula-Bayesian Network approach. *A Leading Journal of Supply Chain Management*, DOI: 10.1080/13675567.2022.2116410
- Correia, D., Vagos, C., Marques, J.L., Teixeira, L., 2022. Fulfilment of last-mile urban logistics for sustainable and inclusive smart cities: a case study conducted in Portugal. *International Journal of Logistics Research and Applications*, DOI: 10.1080/13675567.2022.2130211
- CRE, 2020. Warehouse / Logistics Real Estate Ma-Ket Report (β version) Ver.202006, <https://www.logi-square.com/column/detail/200812>
- Japanese Consumers’ Co-operative Union, 2020. 2020/7/21 https://jccu.coop/info/newsrelease/2020/release_200721_01.html
- Lord, C., Bates, O., Friday, A., McLeod, F., Cherrett, T., Martinez-Sykora, A., 2022. The sustainability of the gig economy food delivery system (Deliveroo, UberEATS and Just-Eat): Histories and futures of rebound, lock-in an path dependency. *International Journal of Sustainable Transportation*, DOI: 10.1080/15568318.2022.2066583
- Ministry of Land, Infrastructure, Transport and Tourism, Policy Management, 2020. Business Ordinary Warehouse Achievements (21 major)
- Montoya, J.R., Muñoz-Villamizar, A., Mejia-Argueta, C., 2021. Mapping research in logistics and supply chain management during COVID-19 pandemic. *International Journal of Logistics Research and Applications*, DOI: 10.1080/13675567.2021.1958768
- Ozkan, O., Atli, O., 2021. Transporting COVID-19 testing specimens by routing unmanned aerial vehicles with range and payload constraints: the case of Istanbul. *Transportation Letters, The International Journal of Transportation Research*, 13(5-6), 482-DOI: 10.1080/19427867.2021.1896063
- Park, K.T., Son, Y.H., Noh, S.D., 2021. The architectural framework of a cyber physical logistics system for digital-twin-based supply chain control. *International Journal of Production Research*, 59(19), 5721-5742 DOI: 10.1080/00207543.2020.1788738
- Suzuki, K., Y., Kawai, K., Wakabayashi, 2016. Design and analysis of the location of an online resale business distribution centre in Japan. *Production & Manufacturing Research* 4(1):152-174 DOI: 10.1080/21693277.2016.1234951
- Yamato Holdings, handling small cargo Achievements (January-July 2020) <https://www.yamatohd.co.jp/investors/financials/monthlydata/archive.html>

由于 COVID-19 影响导致的货物运输变化

關鍵詞

后勤
送外卖
联合配送中心
供应商管理库存
小货

摘要

本研究分析和讨论了疫情期间日本独特的货物运输以及社会环境变化对社会生活的影响。自 COVID-19 爆发以来，日本的货物运输发生了重大变化。本研究通过展示相关系数来分析日本的货物运输，以表明每个行业受到新冠病毒传播影响的程度。由于紧急状态引起的疫情警觉性增强，许多商店关闭并且出口货物减少。虽然进口货物的数量增加了，但出口货物的数量没有增加。因此，仓库空置率下降。因此，本研究揭示了日本的分销中心变得更加自给自足，并且云物流信息系统越来越广泛地使用。
