

Perspectives on Supply Chain Management in a Pandemic and the Post-COVID-19 Era

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IEEE DOI 10.1109/EMR.2020.3016350

Abstract—This article draws out some perspectives on the management of product supply chains in the event of a pandemic through cases specific to certain industries: automotive equipment, personal computers (PCs), and home furnishings. In particular, the discussion is based on “distributed management and centralized management of a single location” and the dynamic capability of organizational theory derived from supply chain risk assessment studies. Results show that the automotive industry is shifting to a centralized management model that takes advantage of its inherent closed-integral strengths by increasing proximity to the country of production, while the PC industry is shifting to a model that takes advantage of its global supply chain while maintaining transactions with local suppliers. For the home furnishings industry, results show that “tighter vertical integration” is required.

Key words: Global supply chain, post-COVID-19, product supply chain

INTRODUCTION

THE unprecedented situation associated with the global explosion of the COVID-19 virus is wreaking havoc not only on human health but also on social life. In particular, the World Bank has estimated the real growth rate of the global economy for 2020 at -5% [1], noting that the impact on developing countries will be particularly severe. Central banks such as the Federal Reserve Bank began buying commercial paper in March, as many companies around the world have become increasingly concerned about a lack of funds to pay for fixed costs in the wake of sharp declines in sales. It also began buying corporate bonds in April, setting up a total of \$75 billion in the issuance and secondary markets, including lower-rated bonds [2].

On the other hand, many companies around the world have not been able to take effective measures to cope with the stagnant distribution of their products and services and sharp decline in sales. However, many

companies are accelerating the formulation of management strategies with supply chain restructuring in mind for the post-COVID-19 era. In our last survey, we found that supply chain corporations had a significant impact on business continuity planning (BCP) during disasters [3]. In any case, the spread of COVID-19 has indeed had a severe impact on the supply chains of companies, and there should be further review of the complex supply chains that were unprotected against contingencies. As a result, the front line of competition in supply chain operations should shift to more comprehensive proactive modeling.

Previous research on resilience in the event of supply chain disruptions has examined the perspective of how to recover to the “original state” in response to a degree of impact of the disruption [4]–[6]. However, post-COVID-19, there is a widespread view of the world in which the supply chain can be remade as the new normal rather than returning

to the “original state (before COVID-19)” [7]–[9]; how it can be remade, though, has not been discussed. At the very least, companies in the post-COVID-19 era need to understand their supply chains from a different perspective to prepare for the next pandemic. Therefore, this article extracts some perspectives for the management of product supply chains in the event of a pandemic, especially in the automotive, PC, and home furnishings industries.

VARIOUS CASES IN THE SUPPLY CHAIN DURING THE DISRUPTION OF COVID-19

Many of the articles on post-COVID-19 supply chains point to an accelerated movement from globalization to localization [10], [11]. Global procurement has been questioned in the past in terms of the supply chain risk [12]. However, simply deglobalizing is not the optimal management of the post-COVID-19 supply chain, and measures will vary by industry. Here, we look at differences in the responses of different industries that have achieved supply chain recovery during the disruption of the COVID-19 outbreak.

Case of the Auto Industry In the months before COVID-19, there was a growing interest among global automakers to produce critical components in the home country [11], [13]. Trade tensions peaked with the escalation of the tariff war between the United States and China, and a broader nationalistic spirit was elevated in other countries. The intensification of protectionism through targeted financial trade barriers posed a real and present threat to multinational auto operators that needed to be dealt with. The COVID-19 pandemic demonstrated how vulnerable the automotive supply chain is and validated the expansion of global supply strategies. In

particular, the sudden closure of production sites in China and its domino effect caused widespread disruptions among the world’s automakers, with impacts in Europe, the United States, India, and South America. Having offshored their manufacturing activities to low-cost countries, many automakers and suppliers are now scrambling to create a centralized management system at a single location in the supply chain [11].

Until just before COVID-19 appeared, most of the world’s major automotive manufacturers were sourcing 30%–60% of their components, including modules and subassemblies, from China [11], [13]. Given the sheer number of components required and the different lead times for each, the return to a centralized supply chain management system at a single location is a very complex and important challenge. And with the spread of infection, OEMs, component manufacturers, and automotive subsystem manufacturers are trying to establish alternative, flexible, and adaptable supply chains while mitigating the vulnerability of a single source. To this end, it is considering sourcing, assembly, and delivery from within the borders of the region’s strategically centralized management system and has begun to re-examine the establishment of regional logistics hubs [11].

Case of the PC Industry In contrast to the automotive industry, even in the PC industry, which has gained a competitive advantage by building a global supply chain, there has been speculation that post-COVID-19, it may be necessary to reduce dependence on specific countries such as China [14]. South Korea’s Samsung Electronics, which produces the largest number of smartphones in the world, has been dispersing its production bases to Vietnam, India, and other countries

for the past few years to diminish its dependence on China. Initially, it was strongly believed that the virus was limited to China, and the impact on Samsung was thought to be minor, but the infection has spread globally, which eventually led to concerns about disruptions in Samsung’s global supply chain as well [14].

Furthermore, the spread of the infection will have a significant impact on global companies like Apple, which procures components from all over the world and ships its products worldwide. In particular, most of the production of Apple’s flagship iPhone has been undertaken by Taiwan’s Hon Hai Precision Industry, whose factories are mostly located in mainland China. However, Hon Hai has only been assembling the final products, and the components that make up the products are sourced from various countries and regions. In particular, the majority of them are from Taiwan, Japan, the United States, and China. More than 40 countries are said to be involved in the manufacture of the iPhone, including smaller ones. Many of the semiconductors that form the core of the product are made in the United States, but the engineers involved in the development of the product are not necessarily located in the United States and are scattered throughout Israel and other parts of the world [15].

Apple is keenly aware of its supply chain risks and has viewed supply chain globalization as more of a risk hedge. It has tried to transfer the production of some products to specific regions such as Vietnam and India, but it is said that it is difficult to make significant changes to the centralized production system in China with Hon Hai as its hub. Therefore, the spread of the COVID-19 infection hit Apple’s supply chain and sales, and in mid-March, Apple resumed store operations in China and production at its factories,

but by that time, the novel coronavirus disease had spread to other parts of the world, and the company was forced to close stores in various parts of the world, only keeping a few stores open in such locations as mainland China, Hong Kong, Taiwan, and South Korea [15].

In response, Apple's Tim Cook said that while it is difficult to know how to roll out, he thinks that the long-term outlook is bright, and he especially praised the company for starting up the iPad Pro and iPhone SE production lines despite the closure of its Chinese manufacturing plant in the first quarter [15]. In a television interview with Bloomberg, Apple's supply chain was said to have fully recovered in March [16]. The company has recovered quickly from the devastation of COVID-19 because it is manufacturing and sourcing components not only in China, but also in the United States, where it maintains a supply chain capable of sourcing more than \$60 billion from over 9000 suppliers.

Case of the Home Furnishings Industry

Nitori, a home furnishing store that sells reasonably priced products in Japan and has been increasing sales and profits for more than 30 years, reported a 5% year-on-year increase in net income to 71.3 billion yen in its consolidated results for FY2020. In addition to strong sales of standard products such as bed mattresses, mail-order sales also rose, and the company's earnings forecast for the fiscal year ending February 2021 calls for a 6% year-on-year increase in the net income to 75.7 billion yen, even under the assumption that the impact of the spread of the novel coronavirus disease will continue through the first half of the year (March to August 2020). Its operating income rose 7% to 107.4 billion yen, with mail-order sales up more than 15%, due in part to the impact of "stay at home orders." This increase was the result of a

decline in the cost of procuring goods imported from overseas, as the settlement rate for commodity procurement was 107 yen to the dollar, nearly 3 yen higher than in the previous fiscal year. Until now, Nitori has taken most of the logistics related to the import and delivery of its products in-house, and about 90% of its products are produced by local companies it owns in Southeast Asia and China. In other words, Nitori has been noted as a company that has achieved an extremely fast recovery from the spread of COVID-19 through vertical integration of its global supply chain [17].

Although it is not possible to derive a general theory from the abovementioned cases, it seems that to construct a supply chain that is highly resilient to the damage of outbreaks, the local supply chain should be maintained to some extent while expanding globally, and vertical integration could be used to overcome difficulties encountered during the period of the spread of infection.

THEORETICAL OVERVIEW

In a study on the risk assessment of supply chains in the face of disaster, it was pointed out that a change in the composition of a supply chain from decentralized management to centralized management of a single location will result in a tradeoff between minimizing logistics costs and maximizing resilience [18]. In other words, centralized management of a single location is advantageous for maximizing resilience, and the implication is that in a contingency situation, it is advantageous to maintain local suppliers at a particular location rather than procuring from globally dispersed suppliers.

On the other hand, the composition of the supply chain network differs depending on whether the transactions with suppliers are due to

a "thick market" of generic assets that can be procured externally relatively easily or a "thin market" of specialized assets that are not widely distributed in the market [19]. In a thick market, based on transaction costs, it is sufficient to strategically choose between market procurement and in-house production; in a thin market, it is sufficient to strategically decide whether to use existing in-house capabilities or to use the capabilities of other firms through the market [20]. Indeed, under stable market conditions, the market thickens according to the degree of product commoditization, but during periods of expansion, a product in a thick market may temporarily transform into an extremely scarce specialty asset due to supply chain disruptions and other factors. In these extremely thin traded market conditions, there is a need to reconfigure in-house capabilities or to acquire dynamic capabilities that create new distribution markets consisting of a group of firms with the required capabilities [21].

PERSPECTIVES ON SUPPLY CHAIN MANAGEMENT IN A PANDEMIC AND THE POST-COVID-19 ERA—FROM THE VIEWPOINT OF "DECENTRALIZATION AND CONCENTRATION" AND "DYNAMIC CAPABILITY"

The automotive industry is characterized as "closed-integral," as shown in Fujimoto's product architecture matrix [22] in Figure 1, so parts makers are highly dependent on automakers. Conversely, automakers are also governed by a special path dependence based on their long history of doing business with component manufacturers and are highly dependent on specific component manufacturers even when other options are available [23]. In this sense, the auto industry's parts

market was a “thin market,” and global decentralized management with a strong dependence on specific foreign countries was widespread. However, in a pandemic, the market will be even thinner, so rather than utilizing a decentralized management with a structure that is unevenly distributed among specific countries, it should be shifted to a centralized management model that takes advantage of the inherent strength of a closed-integral setup, with greater proximity to the producing countries as much as possible. Second, the PC industry is typically positioned as open-modular in many cases. If Apple is a typical example of a company in the PC industry, it can be described as open-modular, using as many industry-standard components as possible while simplifying its products. Additionally, the collaboration between a hub production site such as Hon Hai and Apple corresponds to vertical

integration that leverages the capabilities of other firms through the market [20], [21]. During the pandemic, many of the commoditized parts became scarce and the market temporarily was thin, but with the help of more than 9000 suppliers secured in their home country, Apple was able to recover production. In other words, it could be said that the company had used its dynamic capability to realize procurement by reorganizing and relocating the existing capabilities and physical assets that it had independently preserved in the case of an emergency while promoting vertical integration through the capability of Hon Hai obtained through market procurement during normal times. In other words, in a pandemic, PC manufacturers that utilize global supply chains similar to Apple’s will be effective in maximizing their resilience by maintaining a certain number of local suppliers while

sourcing their production capabilities from the market.

Finally, Nitori in the home furnishing industry is the equivalent of the closed modularity in Fujimoto’s matrix. By vertically integrating the majority of the world’s relevant suppliers, standardizing designs to the limit, and practicing production by their overseas suppliers, they were able to quickly get their business back on track even during a pandemic. Nitori’s management of its suppliers is similar to that of the automotive industry and other industries, where it not only outsources design work to its suppliers but also provides guidance on manufacturing and management methods, and in the case of critical functional parts, requires quality assurance contracts with material and parts manufacturers below secondary suppliers [24]. Such an action could increase transaction costs and undermine the benefits of a vertical integration that takes advantage of integrated design and production capabilities. However, in the case of vertical integration in a global thick market such as Nitori’s, the introduction of strict quality control to strengthen centralized control of foreign suppliers may be rather effective against a pandemic.

CONCLUSION

Using the response to the COVID-19 pandemic in the automotive, PC, and home furnishings industries as a case study, this article summarizes the perspectives required for the management of supply chains hit by a further pandemic in the post-COVID-19 era.

The automotive industry has traditionally formed a relatively local supply chain network centered on the region where the company is based. However, it is undeniable that the fact that today’s automobile production bases have been transformed into “metanational” companies that secure

	Integral	Modular
Closed	closed-integral	closed-modular
Open	open-integral	open-modular

Modular architecture is the case where the design parameters of each process element can be determined independently from other process elements.

Integral architecture is the case where the design parameters of the process elements are interdependent.

Open architecture is a type of modular architecture in which “mix and match” of component designs is technically and commercially feasible not only within a firm but also across firms.

Closed architecture is the case where mix and match of independently designed components is possible only within a firm, as the interface designs are common only within a firm, if not within a product.

Figure 1. Product architecture matrix [22].

global superiority by developing global operations and effectively utilizing the management knowledge accumulated in countries around the world [25], which has eventually become a hindrance to the pandemic response. In the future, therefore, it will be effective to shift to a centralized management model that takes advantage of the inherent strength of a “closed-integral” model, which increases the proximity between suppliers and production sites as much as possible.

While Apple’s case alone cannot explain the entire PC industry, the conclusions of this article are unlikely to be significantly affected by whether the company utilizes hub production capabilities such as Hon Hai or enhances its production capabilities. Certainly, in Apple’s case, it is the production hubs like Hon Hai that are responsible for the production stagnation in the pandemic, but even if Apple had sourced and manufactured its

products, it would have faced difficulties, and in any case, the early recovery of production would not have been possible without the help of local suppliers. Therefore, in an industry such as the PC industry, which utilizes global supply chains, it is important to develop dynamic capabilities, or the self-transforming abilities to respond to higher-order changes to hedge risks in contingencies such as pandemics. The management style that worked in this study should be required in all industries.

This article presents the case of Nitori in the home furnishings industry as a representative of closed modularity. The “closed-modular” type may be relatively resistant to pandemics, but the effect will vary depending on the degree of “closed.” This is because there are various forms of “closed,” ranging from “loose partnerships that do not depend on contracts” to “mergers and acquisitions.” Although Nitori’s

globalization of the supply chain was seen as a disadvantage in the pandemic, the company has survived the situation by achieving strong vertical integration through the introduction of strict quality control. On the other hand, if the supply chain is localized, further examination is required to determine whether even a more relaxed collaboration can survive a pandemic.

In this article, the discussion was limited to the automotive, PC, and home furnishings industries, but more industries need to be considered. In any case, in the post-COVID-19 era, it is believed that a resilient supply chain in the event of the next pandemic will not be rebuilt as the new normal, but will be found based on the extension of the traditional and steady efforts. Finally, it is hoped that the knowledge gained from this articles will be of help to many practitioners.

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