

Editorial: Operational excellence in the supply chain of perishables at the time of the outbreak

1. Introduction

The COVID-19 pandemic is causing widespread disruption in the industrial sector and inducing difficult economic and environmental conditions for businesses around the world. It is a tragedy for human civilization and is increasingly affecting the global economy. The increase in cases of COVID-19 has closed international, national, regional, and even urban borders. Supply chain (SC) activities have, since disrupted stages like distribution and retail. Disturbance was seen in the food SC (FSC) sector including perishables like fresh vegetables and fruits (Hobbs, 2020). This outbreak has also impacted pharmaceutical industries, where shortages of pharma products can cause an overwhelmingly negative impact on global fatality. In 2020, the turmoil of the global COVID 19 pandemic severely tested lean, agile, resilient and sustainable SCs.

Like the world economy, the food, agricultural and pharmaceutical industries are also suffering (see for example, Chowdhury *et al.*, 2020). The outbreak has had a deep impact on agricultural SCs in terms of risks associated with humanitarian issues where all four aspects of food security have been adversely affected, i.e. stability, availability and accessibility (Laborde *et al.*, 2020). Over the past year, the outbreak has had a profound impact and continues to affect how agricultural production, distribution and consumption are controlled around the world (Barichello, 2020). Due to this unexpected and unusual situation, food and beverage industries face notable challenges in terms of supply disturbances and decreased consumption (Hobbs, 2020).

Our food system is one of the main drivers of climate change because it generates large amounts of solid waste and releases greenhouse gases into the environment. The food loss discarded by food suppliers and retailers occurs at various stages in the FSC (Maina *et al.*, 2017). It is important to recognize that food products are similar to other consumable products. That means there is not much recycling of unused (or discarded) products. This mode of consumption heavily affects the environment. In SC language, circular economy (CE) is also seen as a closed SC that seeks regenerative uses, implying that the system was formed in the “lifetime” of industrial-grade products and services at an industry level. By explicitly implementing design models, product systems and material designs, toxic substances are eliminated and waste is reused and eliminated (Mehmood *et al.*, 2021). With respect to SC, the purpose of CE is to make resources more efficient and optimize environmental outcomes.

As the COVID 19 outbreak disrupts many industries, countries around the world have imposed restrictions on the shipment or export of medicines (Kuo *et al.*, 2020). While many drug SC disruptions have concentrated on flaws in foreign manufacturing units, equally, the consequences on the allocation of pharmaceuticals within the country's SCs are also a concern (Xu *et al.*, 2020; Goodarzian *et al.*, 2021). Pharmaceutical SC faces a great challenge due to COVID 19 restrictions and its impact on two of the largest manufacturers of pharmaceutical ingredients: China and India (Tirivangani *et al.*, 2021). Because of these restrictions, the non-delivery of pharma products to purchasing countries caused a shortfall and disturbance in pharmaceuticals SC.

In addition, COVID-19 has a higher absentee rate due to a shortage of skilled workers leading to a labor shortage (Gray, 2020). In some countries, there is a wait for quarantine at



docks and depots. As a result, logistics activities have ceased, cycle times have increased and the risk of product obsolescence has increased. Due to the deterioration rate of fresh food and the uncertainty of demand, many unsold products are discarded and retail products are in short supply. SC discrepancies increase the environmental impact of disposing of expired products (Griffin *et al.*, 2009). The effect of the outbreak on FSC was seen as a disaster of severed links between supply and demand, where manufacturers have no exit and consumers do not have access to food due to lockdowns and restrictions imposed (Heck *et al.*, 2020). Upstream SCs have transferred or disposed of products due to the perishability of the products, but consumers have had difficulty accessing groceries (Chin, 2020). The consumer is now looking for alternative sources because of the shortages of products.

In these grave times, digital technologies such as Industry 4.0 (I4.0) have been used as rescue pods. Associated technologies such as big data for digital transformation, robotics, integrated systems, IoT with the next-generation network (5G), cyber security, simulation and computing for the cloud. For example, Taiwan used a health database and integrated it with the customs databases to begin creating big data for analysis and based on travel history and symptoms from clinical trials, real-time alerts were created regarding medical visits to help identify cases (Wang *et al.*, 2020). Expansion of IoT in hospitals and clinics makes it easier to build highly connected digital ecosystems, and large-scale real-time data that can be used in deep learning to know trends (Ting *et al.*, 2020). The use of these I4.0 technologies can have a notable impact on the sustainability and efficiency of the global FSC (McClements *et al.*, 2021). The use of data mining and analytics, IT and blockchain etc. ensures fair and ethical business practices. However, these aspects are rarely thoroughly studied, becoming an industrial paradigm.

The COVID-19 pandemic shows both the flexibility and vulnerability of the current FSC (The Economist, 2020a, b). The short-term panic resulted from imposed restrictions like social distancing and lockdowns by governments in many countries and caused significant challenges. Particularly for food arrangements based on just in time (JIT), the sudden increase in demand led to severe shortage of stock (Mussell *et al.*, 2020; Kumar, 2020). The pandemic has shown the potential vulnerabilities of the FSC. Also the goal of the pharmaceutical industry is to set up a support needed for the healthcare system by delivering critical medicines in JIT systems (Bourlakis *et al.*, 2011). However, in the event of a pandemic like COVID-19, the resilience of the pharmaceutical and FSC is of paramount concern. Therefore, managing these operations is a top priority and addressing these issues requires proper design and management of SC stages such as planning, delivery, manufacturing and distribution. The outbreak further highlighted these operational challenges in perishable SCs (PSCs) and the need for a better understanding and presentation of the latest research approaches.

2. The special issue (SI)

The motive of this SI is to acclimatize new research about how operational excellence is helping PSCs in overcoming the challenges posed by COVID-19. The SI serves as a base for further research in this area and aims to prepare for such a pandemic in the future. The innovative, high-quality articles present novel research related to outbreaks such as COVID-19, and some are supported by the integration of I4.0 technologies with the operations of PSCs.

3. Contribution of the SI

Many excellent articles were considered for the SI, but following a detailed review process only specific research articles were accepted as noted below, which are divided into the following clusters:

- (1) Conceptual linkage between I4.0 and PSC.
- (2) Empirical investigations

Contributions of each cluster are mentioned in [Table 1](#). Starting with the first cluster, Nayal *et al.* propose a study investigating the effects of factors identified based on the technology, organization and environment framework and organizational information processing theory on adopting AI in SMEs in India. Their framework works on the principles of innovation adoption and provides the industry with comprehensive, concise and useful intuition into technology adoption (see also Lai *et al.*, 2018).

In the second cluster, Khan *et al.* propose a study to provide proof for the relationship between FSC and outbreaks in Ecuador. The study argues that CE practices (CEP) are an important feature that enterprises need to improve performance and external integration with SC.

Additionally, Sharma *et al.* propose a framework based on resource-based view (RBV) which was examined using a structural equation model (SEM) of data aggregated from a sample of 263 retail workers working in the United Kingdom during the ongoing pandemic. Equally, Muhammad *et al.* study the implementation of lean, six applications in small and medium-sized enterprises (manufacturing companies) in Pakistan's industrial areas aiming to discover lean, six sigma and sustainability relationships with enterprises whilst.

Kayicki *et al.* conducted a survey with diverse members in the blockchain ecosystem to know the perspectives of multiple members on the operational brilliance of fresh FSCs. This study provides a deep knowledge of the operational challenges, risks and inefficiencies of the FSC caused by pandemic.

Raassens *et al.* study the disaster management practices businesses adopt to combat the crisis. In particular, this study aims to answer how does the COVID-19 pandemic affect the day-to-day operations of the hospitality industry and which crisis management strategy is used by catering companies in the busy early stages of the COVID-19 pandemic? In another study, Puram *et al.* try to shed light on the challenges of providing last mile services from the driver's perspective in the global turmoil caused by the COVID-19 whilst.

Cluster number	Manuscript title	Authors
1	Exploring the role of artificial intelligence in managing agricultural supply chain risk to counter the impacts of the COVID-19 pandemic	Nayal <i>et al.</i>
1	Using blockchain technology to drive operational excellence in perishable food supply chains during the pandemic	Kayicki <i>et al.</i>
2	Achieving operational excellence through the lens of lean and Six Sigma during the COVID-19 pandemic	Muhammad <i>et al.</i>
2	Surviving the hectic early phase of the COVID-19 pandemic: a qualitative study to foodservice firms' SC strategies	Raassens <i>et al.</i>
2	Investigating the effects of the outbreak of COVID-19 on perishable food supply chains: an empirical study using PLS-SEM	Khan <i>et al.</i>
2	Material convergence issue in the pharmaceutical supply chain during a disease outbreak	Patil <i>et al.</i>
2	Last-mile challenges in on-demand food delivery during COVID-19: understanding the riders' perspective using a grounded theory approach	Puram <i>et al.</i>
2	Impact of disruptions in agri-food supply chain due to COVID-19 pandemic: contextualised resilience framework to achieve operational excellence	Mishra <i>et al.</i>
2	Impact of COVID-19 pandemic on perishable food supply chain: a contingent Resource-Based View (RBV) perspective	Sharma <i>et al.</i>

Table 1.
Contributions in each cluster

Mishra *et al.* examine the FSC disturbance caused by the outbreak and attempt to assess the skills needed to improve SC resilience to achieve operational brilliance during the pandemic.

Finally, Patil *et al.* investigate the situation actor process (SAP) and learning action performance (LAP) with the help of various SC stakeholders and the strategic suggestions from the SAP-LAP practices was validated using animation. A case study followed on pharmaceuticals and it was conducted during the outbreak.

4. Managerial implications

SC traceability and SC visibility are challenging, especially during pandemic turmoil. There are two practical implications of Sharma *et al.* First, adopt and apply sustainable practices to improve SC performance. Second, SC traceability improves SC visibility and ensures proper coordination between the firms. Logistics personnel, carriers, retailers, wholesalers and suppliers can use this task as a guide to making strategic decisions to operate their SC in a pandemic situation.

Patil *et al.* proposed a framework for implementing CE practices. Key proposals and strategies were generated around the resale and refurbishment of the CE Principles. According to Mishra *et al.* practitioners will be able to develop resilience and achieve operational brilliance during a pandemic, enabling practitioners to reconfigure existing resources and introduce new practices. Kayikci *et al.* findings will help PFSC firms to understand the potential operational challenges, risks and inefficiencies caused by outbreaks such as COVID-19. In addition, food industry companies have gained a lot of insight into developing and implementing their blockchain-based solutions, mainly when they occur. Nayal *et al.* showed how AI-enabled I4.0 systems help analyze and create value using AI technologies such as big data analytics, machine learning, and deep learning from data collected from cloud computing via IoT devices. This study also shows that information sharing has a positive impact on AI. Therefore, SC risk can be reduced smoothly by improving the technology and quality of information sharing.

5. Concluding remarks

This SI brought together various scholars who examined the impact of the COVID-19 outbreak on PSCs. These papers have illustrated numerous avenues for future research as noted below:

- (1) What improvements on-demand food delivery (ODFD) organizations can make during disruptions?
- (2) Using COVID-19 outbreak as an opportunity to re-configure the SC while keeping future flexibility in mind.
- (3) Reverse logistics research can be conducted in terms of government, environment, labor, costs and technical resources especially during outbreaks.
- (4) Compare different blockchain-driven ecosystems in terms of blockchain functionality and observe interactions between SC partners within the ecosystem and between different ecosystems. Investigate CE (CE) based business models such as the sharing economy and cyber-physical social networks at sustainable SC (SSC) and the impact of outbreaks on these ecosystems and business models.
- (5) Compare blockchain-based ecosystems that differ in terms of blockchain capabilities and observe the interlinkages between SC partners in the ecosystem and between distinct ecosystems including the role of disruptive forces such as outbreaks.

- (6) How do organizations use SC resilience development skills to face diverse uncertainties and vulnerabilities related to outbreaks?
- (7) How do companies achieve and maintain organizational excellence during COVID-19?

Finally, the SI editors would like to provide special thanks to Professor Britta Gammelgaard who as the editor of the *International Journal of Logistics Management*, supported and motivated us continuously during this process. We are also grateful to numerous reviewers who provided important input during the review process.

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