

## **LOGISTICS&SUPPLY CHAIN MANAGEMENT: UP-TO-DATE RESEARCH DIRECTIONS**

*Chornopyska N.V., Popovych A.I.  
Lviv Polytechnic National University*

Today's world has become volatile, uncertain, complex, and ambiguous (VUCA). In such a world, supply chains (SC) not only are embedded in VUCA environments but also increasingly exhibit VUCA features (Ying Gao, Zhuo Feng, Shuibo Zhang, 2021). A widely recognized characteristic of VUCA was analyzed a long ago and described as:

- **Volatility:** An event encountered by a supply chain is unexpected or unstable; however, information on such an event is available and its impact is generally predictable.
- **Uncertainty:** The cause and effect of an event encountered by a supply chain are known; however, other information about the event is unavailable.
- **Complexity:** Both the environment and the supply chain itself have many interconnected parts and variables; hence, connecting the cause and effect of an event is very difficult.
- **Ambiguity:** An event encountered by a supply chain is unexpected; moreover, the causal relationships are also completely unclear. (Bennett and Lemoine, 2014)

The VUCA environment in combination with VUCA specific features in supply chain itself reinforce the possibilities of its disruption creating direct impact on SC resilience. Those four components, described above, give a clear definition how correspond to possible risks and their categories in SC. In the world of volatility, highlighted information about both the probability and the impact of a given risk may be available. In that case, resources should be dedicated to reduce and prevent risks with small probabilities. However, we also know that as much redundancy we need as higher costs we will spend. As an example, to mitigate our risk we can use contract design that traditionally adopted in supply chain management, to implement certain aims in coordination.

In an uncertain world, we do not know what to expect from risk, but some knowledge of its impact we can predict. This category includes all risks that occurs because of human decisions whether

good or bad. Behavior of members in SC is main study in that phase. All decisions that was or can be made should be carefully studied to avoid undesirable events that may disrupt the whole supply chain. Furthermore, to avoid so-called “inappropriate behavior” in SC some management strategies needed to be explored.

In a complex world, how risk can disrupt the supply chain is unknown but the probability of its occurring is available. The complex structures of SC come off: location, heterogeneous institutional environmental regulation and logistic system. Therefore, a small risk faced by one supply chain member may eventually lead to the failure of the whole supply chain, the so – called ripple effect. In consequence, to prevent risk companies should simplify their SC by moving small amount of production to home country and determine what impact reshoring has on its competitive advantage. If it is difficult to simplify the structure of a supply chain, the cause and effect relationship should be uncovered to understand how an event affects the whole supply chain (Ying Gao, Zhuo Feng, Shuibo Zhang, 2021).

In an ambiguous world, neither the probability nor the impact of a risk is known. Therefore, the supply chain faces “unknown unknowns”. At present, an increasing number of events are being encountered by supply chain members for the first time, and dealing with these “unknown unknowns” would become “a new normal” for them (Cohen and Kouvelis, 2021). That’s when Ripple effect explicit the most in past unpredictable or ongoing events, such as pandemic COVID-19, hurricanes, cyber-attacks etc., which was generally unexpected by each supply chain member.

Disruptive risks in supply chains often cause ripple effect. That effect takes place if a disruption in SC cannot be restrained affecting networks structure, lowering performance and flexibility of logistic system. Many authors describing ripple effect as “risk/disruption propagation” distinguishing it by much wider impact on nodes#in SC network. This implies that disruption risk make influence not just on a single SC node, but spreads and prevails in supply, production, and distribution nodes of network.

Considering external circumstances disruption can be caused:

- Due to demand risk: Under a volatile market environment, demand risk may be triggered by various external factors varying from new competitors, natural disasters or emerging disruptive technologies in the market (Shen and Li, 2017; Ojha et al., 2018). For example, in 2019, warmer weather continuing into autumn adversely affected fashion retail demand in the UK, leading to an 80 – million – pound loss every week (Met office UK & British retail consortium, 2019). In the context of COVID-19, Agricultural SCs faced a sudden fall in demand (post-panic-buying events) for their produce due to pandemic – related lockdowns (UK Parliament, 2020).
- Due to logistics risk: Sufficient transport capacity is vital at each SC entity, which ensures product movement and on – time delivery. In the wake of the COVID-19 pandemic, a critical shortage of containers drove up shipping costs (up to 300%) and delayed deliveries for goods purchased from China and other Asian regions (Tan, 2021). An example of logistics disruption is the UK – EU border chaos during the spread of a new variant of COVID-19 combined with the confusion associated with “Brexit” (The Economist, 2020).
- Due to supply risk: As the starting upstream node of the SC system, variations in supplier operations tend to influence the SC holistically by affecting various factors attached to the subsequent echelons of the network. The stability of the supplier’s supply level can directly or indirectly impact the key SC indicators such as inventory level, transport capacity, production and sales level (Ghadge A., Ivanov D. and Chaudhuri A., 2021). For example, during early COVID-19, multiple agri – food producers/suppliers could not harvest the food (e.g., fruits) primarily due to labour shortages, leading to huge food loss and waste (The Guardian, 2020).
- Due to simultaneous risk: In this situation three risks (supply quantity, transport capacity and market demand) occurring simultaneously. This risk is particularly important, as it helps to understand and compare the ripple effect caused by individual and multiple disruption scenarios. For example, automotive and electronics industries have experienced an unprecedented shortage of semiconductors in the first quarter of 2021, leading to production halts and delivery delays through the ripple effect

(Shead, 2021). The reasons for these shortages were an unexpected increase in demand at automotive firms that recovered after pandemic shock in 2020. However, the semiconductor suppliers have re – allocated their capacities to other SCs to benefit from their increasing demand for semiconductors and substitute the missing demand from the automotive industry (Ghadge A., Ivanov D. and Chaudhuri A., 2021).

The events that caused biggest ripple effect in history:

1. The Ever Given cargo ship that blocked Suez Canal for six days in 24 March 2021 roughly cost 12 per cent of global trade and was holding up trade valued at over \$9 billion per day. The total trade loss has been estimated at roughly \$54 billion (Ann Russon Business reporter, BBC News., 2021).
2. In Winter 2020, the COVID – 19 virus outbreak resulted in production disruptions at many locations in China and missing deliveries from/to China impacted the global supply chains and even the stock values of many multi-national companies (Ghaffary and Molla, 2020, Ivanov and Dolgui 2020a).
3. In 2018 five most significant events were all natural disasters: Hurricanes Florence (U.S.) and Typhoon Mangkut (Philippines, Taiwan, China and the Taiwan Earthquake. In combination, these natural disasters impacted more than 24,000 supplier sites with an average time to recovery of between 19 and 25 weeks. The damages was estimated at \$ 700 billion. (Patrick Burnson, 2019)

Even though a variety of valuable insights have been developed in this area in recent years, new research avenues and ripple effect taxonomies need to be identified for the near future. Despite the remarkable progress in the ripple effect research, little is known about disruption propagation under long – term disruptions when demand, supply, and logistics are disrupted sequentially and simultaneously at different SC echelons (Dolgui A., Ivanov D., 2021).

In the VUCA world, not all risks can be initiated prevented and proactively mitigated. If a risk that is unprepared for materializes and leads to disruption, a resilient supply chain should have the capacity to make a quick recovery. For example, how big data can help the disrupted supply chain members to quickly find the

available suppliers in the market. Risks propagate along the supply chain that make resilience-building more expensive and less flexible. Moreover, multidisciplinary research and multiple methodologies are required to effectively build supply chain resilience because supply chain management is not the only subject that becomes vulnerable in the era of VUCA. The above examples of events that became the reason of Ripple effect in volatile, uncertain, complex, and ambiguous circumstances shows how the impact of the external environment is changing rapidly and requires the innovative researches with predictive values, which would help supply chains respond to changes much faster and with slightest losses in the future. Focus on supply chain resilience not only serves as a complement to trending logistics and supply chain management theories, but also is expected to serve as a catalyst in building new theories in present VUCA era.

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