Supply chain resilience after COVID-19: strategies for risk management

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The dramatic events which are affecting the whole economy since the beginning of 2020 have forced companies to understand, or at least evaluate, the "price" they will have to pay for the exploitation of globalized supply chains. Since the spreading of COVID-19, the productive pace of the world economy has started to slow down in a manner that nobody could have expected. Recently published estimates show that most of major economies will lose at least 2.4 percent of their gross domestic product (GDP) value over 2020[i].

Globalization has allowed companies from all over the world to take advantage of tremendous cost reductions and product quality improvements by spreading their supply chain in the most strategic production environments. This trend has also supported the rise of Supply Chain Management (SCM) and of its related risk management branch. Unfortunately, the arrival of COVID-19 has revealed that the majority of companies are not ready to deal with those kind of risks [ii]. The worldwide spreading of COVID-19 is threatening the stability of several supply chains, for example the food production chain[iii]. From a logistic perspective, the virus is having a major impact on three main areas:

Supply

The lockdown of whole industrial districts, if not of entire countries, has rapidly created a barrier for suppliers trying to satisfy customer demand. In certain cases, factory layouts have been converted to respond to demand of unexpected products required to secure availability of products and services used in the fight against the virus.

Production

The mandatory quarantine imposed by governments has reduced or frozen the availability of workforce. This has had a major effect on production lead times and on service effectiveness.

Distribution

The transportation sector is facing both the shortage of workforce and the increase of restrictions imposed by major economies legislation. This has resulted mainly in additional traffic congestion of international transportation routes.
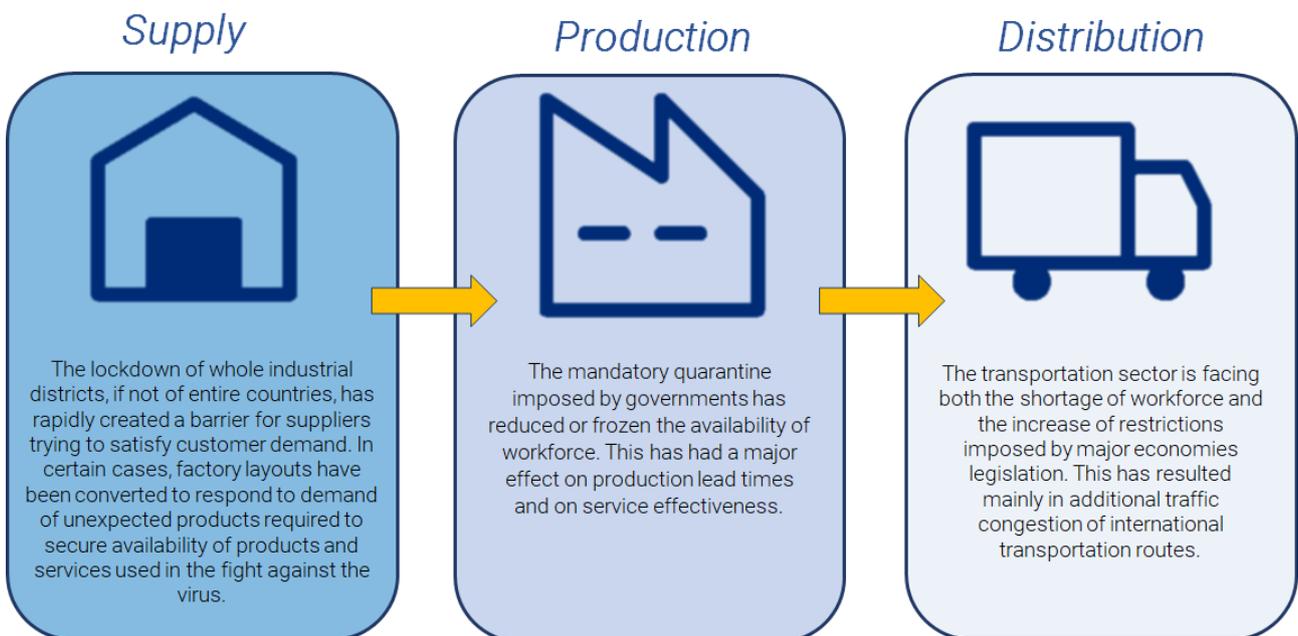
Figure 1 - COVID-19 impacts on major Supply Chain building blocks

In addition, the trend of establishing just-in-time supply chains in order to increase competitiveness on the market has turned to be a major tension factor for many companies, already affected by several direct impacts of the virus.

As it clearly appears to all of us, the impacts of COVID-19 on global supply chains are of enormous dimensions and are affecting the totality of the building blocks of the major industries. Although the consequences of these impacts are still unknown (we are only going to feel the full breadth in the next coming years[iv]) the direct impacts on local supply chains can be more easily estimated on the basis of companies available data. This activity, which entails risk estimation, is not easy to carry out and cannot provide deterministic results as it is, by its nature, subject to the laws of statistic. However, there are methodologies and approaches that can help risk managers and supply chain managers to speed up the process of risk analysis and subsequent mitigation, allowing them, in the very end, to take both precautionary and corrective measures. Let's see how this can be achieved.

1. Build up your Supply Chain risk management strategy

Strategy definition is the first activity that needs to be addressed when you face any complex situation. Without a structured and reliable strategy, efforts cannot be efficiently directed towards the final aim.

This conclusion also applies in the case of risk management and supply chain risk control. In this specific situation, strategy should be built-up considering simultaneously different aspects of both supply chain and risk management areas. The final strategic plan should then combine actions from both knowledge areas into a cohesive plan in order to be effective. Once the strategic direction is set, the following phase of strategy development can start. In the aforesaid specific case of supply chain risk management, the development plan should address 3 main areas:

- **Knowledge**: in order to realize a consistent and robust risk mitigation strategy, companies should gain a deep knowledge about their own supply chain. Furthermore, basics principles of risk management should be shared and well mastered by staff working on this topic.

- **Organization**: risk management activities require a well-structured organization, with clear roles and responsibilities. Each risk should always have an owner inside the company capable of recognizing the symptoms of risk and alert the company consequently. This drives activities of job enlargement and process reengineering which have to be carefully managed in order to become effective.

- **Technology**: risk identification and mitigation are activities which require hard facts and data. From this point of view, data availability and accuracy can make the difference in evaluating correctly or not the impacts of identified risks. Because technology infrastructure impacts directly the efficiency of risk mitigation process, it has to be designed, developed and modified according to the risk management strategy. The solution is to reproduce a digital copy of the existent supply chain, the so-called **Digital Twin**, in order to rapidly conduct scenario analyses based on the identified risks.

In conclusion, setting up the supply chain **risk mitigation strategy** is an activity that **requires a variety of skills and knowledge in different areas** and cannot be underestimated in its importance. In the following paragraphs we are going to see how this strategy could be converted into specific actions within a structured supply chain risk management approach.

2. From theory to practice: deploy your Supply chain risk management strategy

In this section we are providing a short overview on three axes of intervention that need to be addressed when a company decides to deploy its risk mitigation strategy.

2.1 Starting point: know your own supply chain

Sometimes companies have limited visibility on their supply chain[v], especially if they adopt widely dispersed or globalized models with factories and suppliers located throughout world's industrial districts; and with sourcing contracts that consider substantial usage of third parties. The **supply chain assessment** activity should be carried out while keeping in mind its primary objective: the discovery of "hidden" aspects of the supply process that may turn into threats if not managed properly.

This exercise could entail the necessity, for example, to gain knowledge on the width and depth of the entire chain.

Without necessarily being exhaustive, some important aspects to be considered while analyzing a specific supply chain are the following:

- What is the real length of the supply chain? How many suppliers are involved? Who are the suppliers of our suppliers? And the customers of our customers? Gathering information about the complexity and number of the entities which build-up the supply chain, with relative lead times and critical information, will help the business in evaluating the collateral effects that a change in some upstream or downstream elements of the supply chain may have on the overall business.

- Which are the sourcing policies of major components and raw materials? Are there any particular

procurement contracts which could constitute a constraint to supply chain flexibility? Evaluating the nature of sourcing relationships may point out the existence of critical supply relations (e.g. single sourcing; unavailability of back-up suppliers) that may become a risk if triggered by external events.

- How big is the portion of the supply chain that we may monitor through data? Are there any programs involving data exchange with suppliers? The knowledge of particular information on the supply chain, such as visibility on suppliers' stock and production capacity, is fundamental in order to evaluate correctly the impact of the risks that will be identified.

2.2 Identify supply chain risks

Risk identification implies the **set-up of risk management task forces** able to deal with risks affecting specific company areas (as the financial one, the supply chain area, the human resources area, etc.). Those task forces should be made up by members coming from both inside and outside the organization, in order to maximize the possibility of having an all-encompassing vision of the possible risks.

Concerning specifically supply chain related risks, among the different categories of risk that could be distinguished, we could carry out a first distinction based on the origin of risks: there could be **endogenous risks and exogenous ones**[vi]. While the first category relates to aspects that generate the normal variability within a specific supply chain (e.g. the Bullwhip effect), the second one includes exceptional risks, which are mostly characterized by a sporadic manifestation and by a propagation of their effects along different systems (industries).

If the endogenous risks are in some way "easy" to manage and identify, because they are commonly known

Figure 2 - Supply chain related risks

and recognized by experienced people, the exogenous ones cannot be identified and assessed that easily, even by skilled people. In all situation the organization should always try to at least identify these risks in order to be prepared before their occurrence. Examples of major supply chain related risks are reported in figure 2.

2.3 Finally: Evaluate risk impacts and take rapid decisions

So far, we have been talking about knowing the environment we want to control and recognizing the risks that could threaten it. If these activities could provide qualitative information, on the contrary, **risks' impact estimation requires solid computations**. This is often why companies do not spend their time on risk assessment activities: these are time consuming and require the commitment of multiple people inside the organization.

Moreover, the estimation of risks' impacts requires a **holistic view of the different interdependencies between the variables** that describe the supply chain. This leads to the impossibility of carrying out risk impact analysis with a "traditional" spreadsheet approach.

The above issue appears to be linked also to the **multitude of data** that need to be considered in order to carry out an exhaustive analysis of risk impacts. Fortunately, we live in the so called "Digital era", where the data availability can be fulfilled with an increasing number of technologies and software solutions. This now allows even small companies to collect comprehensively their own data on key business processes (sales, inbound,

production, outbound, etc.).

In this context, **simulation emerges as a strong tool to support the process of risk impact estimation** capable of considering simultaneously the entirety of data available and the totality of interdependencies between variables.

The main advantages provided by the use of a simulation software to support supply chain risk estimation are twofold: first of all, the interdependencies between different entities (e.g. supply chain tiers) and variables (e.g. profit, service level, inventory, etc.) are already defined in the general framework and can be adjusted to fit at best the real situation. This generates important **time savings** throughout the current scenario modeling process and in avoiding missing some important constraints or interdependencies. Second, the parametric logic with which simulation software are developed allows to rapidly change and **adapt models** in order to test, with high efficiency, several scenarios.

Moreover, these kinds of tools usually include a whole section dedicated to KPIs or dashboards which rapidly describe outcomes of simulated scenarios through plotted data.

With such an approach, the time spent to conduct risk impact analysis can be reduced significantly while the span of evaluation of possible scenarios increases. Provided that simulation is carried out with the right knowledge of the methodology, the right tools and the right data, then the overall quality and effectiveness of the risk management process is drastically improved. Once the impacts have been estimated, the list of identified risks could be prioritized, thus setting the fundaments for the planning of associated risk mitigation activities.

In order to gain an effective control of risks, the process of risk estimation should be performed with a certain frequency allowing the risk register to be always up-to-date. This requires revisiting frequently assumptions and calculations of different risk scenarios. This is driven by the fact that data that feed the simulation change over time but also because risks may change in nature and probability.

3. Modeling risk scenarios with simulation

In order to provide a better explanation on risk evaluation approach using simulation, we're going to refer to the below **flowchart** which explains how the **modelling process** is carried out during a **risk estimation project.** As detailed below, the process of simulation modelling for supply chain risk starts with two parallel sub-processes: one for risk definition and one for supply chain modelling, which later converge into the phases of risk estimation.
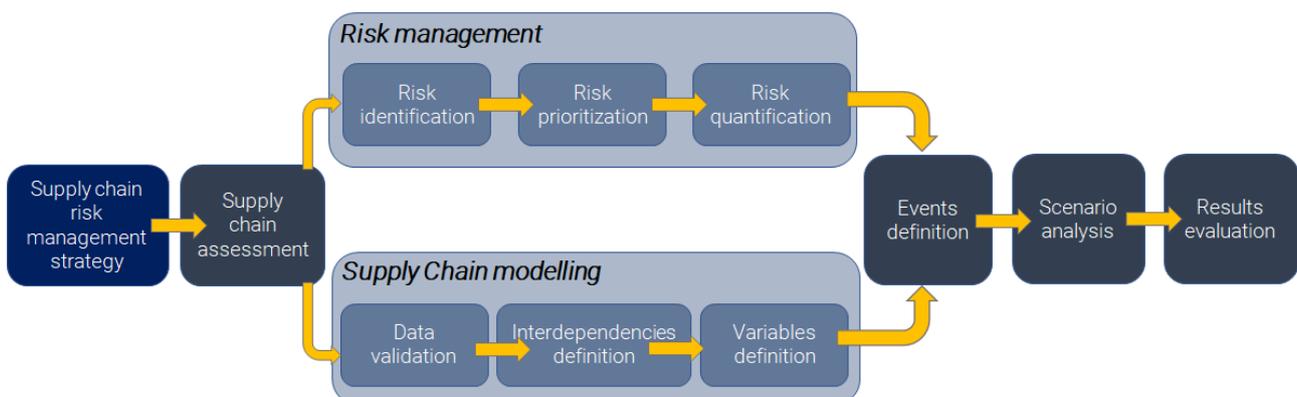

Figure 3 - Logical framework for Supply chain risk estimation

The first two phases of the process have already been discussed in the previous sections, so we will focus now on the Risk management process, which comprises 3 main activities.

The first one deals with **risk identification**, i.e. the analysis and recognition of possible sources of risks. This activity should be carried out by a team composed by people and experts from different background and role in order to ensure a wide perspective on risk factors analysis. Benchmarks and market researches are also very useful in this phase as an additional source for discovering possible threats.

Once **risks** have been identified, they **should be prioritized** based on the expected probability of their occurrence and based on a qualitative estimation of their possible impacts. This activity allows to focus on the top risks that need to be analyzed and managed with focus and priority, while secondary risks can be managed in a separate instance.

The last activity of this process deals with the **quantification of the impacts** of top risks in terms of company performances. Quantification does not automatically mean a numerical estimation of risk impact, as it will occur once the supply chain model will be defined, but has to do with the identification of company's performance areas (es. cost, quality, service, ...) that could be affected by the risk. This exercise will allow to better model the various risk in the supply chain scenarios described in the next stages of the process.

The **parallel process of supply chain modelling** is also composed of three main stages.

The first stage is **data validation** which consists in verifying which data are needed in order to run the model, which missing data should and could be derived from other data sources and which level of detail is required in the simulation model.

The subsequent stage is one of the most delicate and entails the **definition of the interdependencies** which regulate the actual supply chain scenario. These interdependencies are of different kinds and basically include: inventory level policies and target inventory levels; transportation policies and routes; sourcing and procurement policies (for suppliers and production sites); production policies. The whole set of interdependencies constitutes the skeleton of the Supply Chain model on which the various scenarios should be tested.

Then follows the third stage of **variables definition** where, for each interdependency, the variables and the parameters regulated thereof (as for example: production and transportation lead times; safety stock levels; vehicles, production and storage capacities; demand forecast; facilities locations; …) are identified. This phase requires a detailed analysis of the granularity of each parameter and variable; such analysis has to be coherent with the overall structure of the model. At the end of this stage, **the as-is model of company's supply chain is considered complete** and needs to be populated by risk events in order to generate scenarios for risk estimation.

The following stage of **events definition** consists in **inputting the identified risks into the model** and attributing them a **probability of occurrence and a stochastic distribution**. Then each risk event should be associated to different interdependencies throughout the model in order to evaluate correctly the impacts on performance areas.
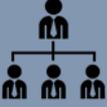
At next stage, it is possible to conduct **scenarios analysis** by deciding which risk events need to be activated simultaneously, with the associated overall probability, in order to gain a panel of different scenarios. This is the step where simulation provides its key benefits, both in terms of number of scenarios that could be generated and tested and in terms of computation speed.

Finally, results derived from simulations can be benchmarked towards the identified performance areas. In the context of supply chain the performance areas are mainly cost and service level. These results, together with their economic value, represent the quantification of the different risk events.

4. Major obstacles in supply chain risk management

Establishing and deploying an effective supply chain risk management strategy will for sure presents **barriers which have to be overridden**. Therefore, we herebelow wish to summarize the most common barriers together with the actions required to override them.

Barriers	Characteristics	Actions required
Knowledge	Superficial understanding of company supply chain structure and related risks.	•Supply chain assessment •Risk assessment •Information sharing among team members
Culture	Risk estimation is seen as a useless activity which utilizes resources and provides results not reliable over time.	•Demonstrate with facts, using simulation, what the real benefits of risk prevention could be •Conduct risk management training activities
Organization	Risk management requires people to take major responsibilities and dedicate part of their working time to risk estimation/mitigation.	•Evaluate the possibility of including full time roles for risk management •Externalize some activities related to risk management (e.g., risk identification) •Review contracts and job descriptions
Technology	Inadequate IT infrastructure; poor quality of data; high cost of simulation software.	•Conduct IT assessment and evaluate trade-offs (IT investment vs risk impact) •Improve data quality through technology enhancements or process reengineering
Modelling	Inadequate skills for supply chain modelling; limited knowledge of modelling software and techniques.	•Externalize modelling of SC Digital Twin •Team training on modeling

5. Get ahead of risk: turn your risk management program into an "ordinary" activity

In the last section of this article we will anticipate how to establish a **structured and repetitive risk estimation process**, able to detect and anticipate risk impacts before they can turn into real issues.

Taking as an example what is happening nowadays with the COVID-19 pandemic, what is clear is that the majority of companies have reacted to this risk once it was already present [vii]. From a risk management perspective, this is an approach that tends to follow and contain the risk, instead of anticipating and preventing it. Of course it is helpful for companies to estimate the impacts that this risk is having or will have on their supply chains but it would have been definitely better if these estimates had been identified ahead of their occurrence. This would have allowed the companies to react properly and be prepared to face it immediately (e.g. by increasing inventories or by activating back-up suppliers).

In order to establish a **proactive risk management approach**, there are two conditions that must be established:

> ➢ **A proper risk culture should be established**, leading to the creation of specific task forces able to deal with specific risks and having all the necessary means to face it (authority, time and resources)
> ➢ The **actual scenario should already be mapped** into a simulation system and powered with updated company datasets (creating the so-called Supply Chain Digital Twin [viii])

With such proactive approach, it will then be possible for a company to quickly estimate the impacts of risks even if they are far to occur or seem just a remote threat.

Just think about what your company could have done if only it would have had the vision about risks impacts when COVID-19 started to spread in China at the end of 2019. In this kind of situations, time is of crucial importance and it is not sufficient to drive your company to start, in a rush, a structured risk evaluation process inclusive of the modeling of its "as-is" situation. Unfortunately, in these cases, there is just time to collect information on the ongoing risk, create different scenarios and test their impact on company's performance, provided that you've already created a robust baseline for simulating the impact of the risk.

With a **proactive and structured risk management approach** it would have been possible to **prevent, or at least reduce, the impact of several supply chain risks** related to the spread of COVID-19, and consequently reduce the sense of confusion, uncertainty and discomfort that companies are feeling today[ix].

After all, the difficulties that we are now dealing with are in part dependent on the uncertainty about the evolution of the situation. Such confusion could be reduced, at company level, with a correct supply chain risk management approach able to provide the right answers at the right time.

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