The Impact of the Coronavirus Pandemic on Supply Chain: A Case of Egyptian Market

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Abstract

COVID-19 is considered as a supply shock and a demand shock. It is claimed that current global supply chain practices have limited capabilities and do not allow for systemic exploration of alternate risk strategies. Therefore, the main purpose of this paper is to evaluate the impact of COVID-19 on supply chain performance, and to investigate the most suitable global supply chain risk strategies have been taken by Egyptian companies within a global supply chain setting. The research approach is based on a global survey of supply chain risk by 92 impacted companies in nine industries.

It is evident as a finding that coronavirus pandemic (COVID-19) is causing major supply chain disruptions. Consequently, global risks are raised as strong and immediate impact on the supply chain performance since some key players are temporarily unavailable such as manufacturers, distributers, and suppliers. This leads to materials, semi-finished and finished goods shortage, longer lead times than originally anticipated, reduced revenue and service levels, where planned customers' demands can no longer be met. The originality of this paper that it provides an empirical exploration of the global supply chain risk strategies experienced in the context of COVID-19. As a practical implication, the results of the survey questions conducted in this paper display practically the right global supply chain risk strategies to improve decision-making. This includes securing the sourcing with nearshore and local sourcing, the adoption of multiple sources, maintain buffer inventory, and reducing the number of small DC. This helps to reduce the impact of such global risk events.

***Keywords**: Covid-19, Disruption, Risk Management, Supply Chain Strategy.*

Introduction

In December 2019, a novel coronavirus was identified in Wuhan City, China, that is termed COVID-19 (SARS-CoV-2) by the World Health Organization (WHO) (Daga et al., 2019; Sohrabi et al., 2020). Despite irregular global quarantine efforts, the rate of COVID-19 continues to rise. At the end of January 2020, the WHO declared that COVID-19 is a public health emergency of international concern posing a high risk globally (Patel et al., 2020; Sahin et al., 2020). In comparison with other two coronaviruses infections, the Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS), COVID-19 has the highest number of countries with reported cases (Arabi et al., 2020). Urbanization and the development of rapid transport systems in China probably accelerated the spread of COVID-19 across China.

With COVID-19 spread globally, global supply chains are characterised by a long-term disruption, uncertainties and risks (Manuj and Mentzer, 2008). The supply chain (SC) risks are classified into operational

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risks and disruption risks (Xu et al., 2020). The operational risks are concerned with day-to-day disturbances in these lead-time and demand fluctuations, while the disruption risks belong to low-frequency-high-impact events such as natural disasters. Also, risks can be assessed as strong and immediate impact on the supply chain performance since some key players are temporarily unavailable such as manufacturers, distributers, and suppliers. This leads to materials shortage, long lead times, reducing revenue and service level, and fail to meet customers' expectations. Ivanov (2020) highlighted that the associated risks with epidemic outbreaks, such as COVID-19 and Ebola, are characterised by three components, including (1) long-term disruption and its unpredictable scaling, (2) disruption circulation in the SC, and (3) disruptions in supply, demand, and logistics infrastructure (Daga et al., 2019). Other factors made organisations more vulnerable to remote disruptive events including (Escaith, 2009; Sheffi, 2018): rising global trade, a growing middle class in developing countries, outsourcing, increasing product complexity rising global competition, lean manufacturing, natural resource constraints, and consolidation of suppliers in some industries. the main purpose of this paper is to evaluate the impact of COVID-19 on supply chain performance, and to investigate the most suitable global supply chain risk strategies have been taken by Egyptian companies within a global supply chain setting. The research approach is based on a global survey of supply chain risk by 92 impacted companies in nine industries.

The rest of the paper is organised as follows. In section 2, the research questions and methodology are addressed. In section 3, the paper reviews the related global supply chain strategies applied in crisis time. In section 4, findings of the survey respondents are explained and the risks and applied strategies are mapped with the type of risk. The conclusion and practical implications take place in section 5.

Research Questions and Methodology

The COVID-19 has global impact due to many types of disruptions, and hits many suppliers in the different industries at the same time, making it more difficult to find alternative sources of supply. From a risk modeling perspective, supply chains include some consideration of the trends that might drive risks higher or create new and unexpected risks. Therefore, COVID-19 is considered as black swans (High-Impact Low-Likelihood) with deeper kind of uncertainty in term of impact and likelihood (Sapovadia, 2020). COVID-19 is a supply shock and it is a demand shock. Both aspects will impact international trade in goods and services (Selmi and Bouoiyour, 2020; Baldwin and Tomiura, 2020).

Companies still lack the means to define the strategic picture of supply chain risk across the company and to communicate it effectively to the board (Arntzen, 2010). In addition, it is claimed that current global supply chain practices have limited capabilities and do not allow for systemic exploration of alternate risk strategies (Basole et al., 2016). The literature shows that there is a lack of conceptual frameworks and empirical results which can provide a clear comprehension of the concept of risk and risk management in the supply chains (Balambo and Haouari, 2014).

In COVID-19 epidemic outbreaks context, this paper has addressed the following questions:

- How can global supply chain remain in a disruption?
- What is the effect of epidemic outbreak on the global supply chain?
- What are the most appropriate supply chain strategies in COVID-19 context?

Research Methodology

The duration of the supply-shock depends upon the virus's lethality and is thus highly uncertain (Baldwin and Tomiura, 2020).

Surveys are applied as a methodology to analyse the risk events which are associated with the supply chains (Lockamy and McCormack, 2010; Cohen and Lee, 2020). Thus, the research approach in this

paper is based on a global survey of supply chain risks by different companies in a range of industries as shown in Figure 1. Understanding how COVID-19 impact the global supply chain requires to identify the global risks imposed by the pandemic and to investigate what risk strategies are applied in industry (Remko, 2020).

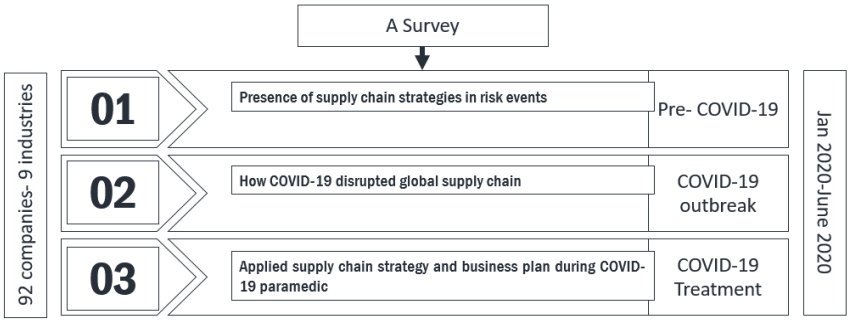

Figure 1 - Research Approach

The survey is directed to those managers and persons in charges regarding; supply chain, procurement and purchasing, warehousing, inventory, transportation, logistics, and distribution functions. In addition, the survey has directed to 92 impacted companies in Egypt, representing nine industries, namely; construction, pharmaceutical, healthcare, food, FMCGs, automobile, electronic, carpet, and cosmetics industries. The survey has designed as follows:

1- The goal; the main goal of the survey is to understand the effect of COVID-19 on supply chain and to identify the applicable supply chain strategies applied in response to COVID-19 disruption.

2- The questions; the questions are divided into three main sections with total 24 questions as follows:
   - Part one: focuses on supply chain strategies in risk events. This part aims to answer the first question mentioned in the research problem.
   - Part two: focuses on how COVID-19 disrupted supply chain performance. This part aims to answer the second questions mentioned in the research problem.
   - Part three: focuses on applied supply chain strategy and business plan during COVID-19 paramedic. This part aims to answer the third question mentioned in the research problem.

   The questions are derived from both sources. The first source is based on different related literature (Escaith, 2009; Arntzen, 2010; Sheffi, 2018; Hudecheck et al., 2020; Cohen and Lee, 2020). The second source is based on online roundtables and webinars with 16 supply chain managers representing different companies in Egypt. The second source helped to discuss with managers the challenges, strategies and practices considered for managing the global supply chain risk in the context of COVID-19.

3- The answer choices; using answer choices that lean a certain way can result in respondents providing inauthentic feedback.

4- Revision; the designed survey questions were reviewed by selected 16 supply chain managers from different industry before conducting formally it.

5- The drafted findings are discussed with participating supply chain managers providing a useful feedback loop and analysis of findings.

Supply Chain in Crisis Time

COVID-19 and Global Supply Chain Performance

In order to prevent further COVID-19 transmission, most of the countries have suspended the entry of overseas travelers and closing completely the boarders such as in cases of EU, GCC and China (Daga et al., 2019). The public transportation including long-distance bus routes, metros, express railways, and aviation were uncompromisingly sealed off (Lai et al., 2020). Also, the WHO has recommended to set restrictions on trade and travel as an effective method of curbing viral spread. Since China was considered as

the world's largest manufacturer with total 17% of world gross domestic product, the world economies are currently challenged to survive in the market (Selmi and Bouoiyour, 2020; Ahani and Nilashi, 2020). In the Chinese infected Hubei Provinces, the factories are ordered to stay closed or to run at low capacity, which are responsible for over 90% of Chinese exports. In air transport, the traffic disruption is expected to play a role in reducing of the global GDP growth due to the reduction in the number of passengers after the Coronavirus outbreak. Iacus et al. (2020) forecasted an overall reduction for all flights originating from China in the period January - March 2020 estimating a reduction by 4 million passengers, corresponding to -2.5% of the expected volume of traffic. This is putting global economic recovery at risk. Sohrabi et al. (2020) clarified that the spread of COVID-19 will cause down for full-year global growth. Tian et al. (2020) investigated the effect of the type and timing of transmission control measures on the spread of COVID-19 from Wuhan city using generalised linear regression models. Suspending public transport was one of the most effective control measures facing the epidemic virus.

The key difference between COVID-19 and SARS is the complexity of supply chains that China is now involved in. They claimed that there is little available guidance for the disruption of such global supply chains on global scale. On the other hand, at least five million companies around the world rely on one or more suppliers in the Wuhan region, COVID-19's origin (Ivanov, 2020). Hence, some big companies may think about transferring parts of their supply chains outside China (Ahani and Nilashi, 2020). Ivanov (2020) underlined that COVID-19 impacted the Chinese exports and extremely reduced the supply availability in global supply chains. Based on a certain lighting equipment case study, he examined and predicted the impact of COVID-19 on the global supply chain using a simulation-based methodology; anyLogistix simulation and optimisation toolkit. In reaction to disruptions, a set of elements were identified including; risk mitigation inventory; lead time; and ripple effect existence, with a conclusion that the most negative impact on the supply chain performance is observed in the cases with very long facility and demand disruption regardless of the disruption period. Daga et al. (2019) emphasised on the primary objectives of WHO surveillance to determine risk factors and the geographic risk area. This will in turn help governments set risk management strategies.

Risks in the Global Supply Chain

The novel coronavirus outbreak has led to a substantial disruption of global economic activity through a reduction in international production, travel, and trade. This disruption has led to express concerns about an upcoming global recession. In a COVID-19 outbreak, Fetzer et al. (2020) investigated the impact of the coronavirus spread until February 29 on search activity for the Google search topics 'Recession' and 'Stock Market Crash'. They highlighted that the coronavirus strongly shapes participants' perception of the crisis and the effect of the coronavirus on the aggregate economy constitutes about 45% of the surveyed participants. As a precautionary action, the provision of medicines supplies chains, personal protective equipment, and hospital supplies should be made in a short time for the protection of the global health (Ranney et al., 2020; Sahin et al., 2020). As the coronavirus crisis differs from previous crashes, Megginson and Fotak (2020) claimed that governments need equity rescues.

There are different categories of risks in the supply chain as shown in Figure 2. This categorisation can be viewed as supply, demand, operational, and security risks (Manuj and Mentzer, 2008). Other categories of risks are; currency, transit time variability, forecasts, quality, safety, business disruption, survival, inventory (and tools) ownership, culture, dependency and opportunism, and oil price fluctuation.

Balambo and Haouari (2014) highlighted five types of risks faced by a supply chain including; Demand, supply, the environment, process, and control. Shahbaz et al. (2019) argued that overall supply chain risks can be categories into seven constructs that are supply side risks such as quality problems, process side risks such as high labour turnover, demand side risks such as high customer expectation, logistic side risks

such as delay in delivery time, collaboration side risks such as distorted information, financial side risks such as economic shift, and environment side risks such as diseases or epidemics (Hafiz et al., 2020).

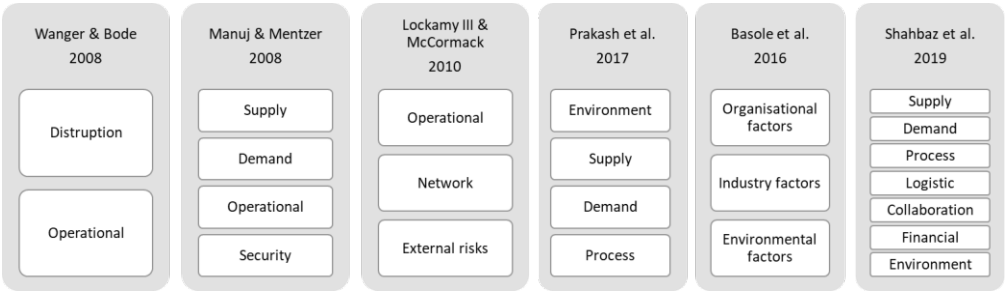

Figure 2- Risk Catrgorisation in Global Supply Chain

It is evident that the number of risk catrgorisation in supply chain has increased over the years as displayed in Figure 2. Also, some categories of supply chain risk remain significant; such as supply side risk, demand side risk, and operational side risk. As a definition, Manuj and Mentzer (2008) highlighted that global supply chain risk management is the identification and evaluation of risks and consequent losses in the global supply chain, and implementation of appropriate strategies. The main purpose is to reduce losses, probability, speed of event, speed of losses, the time for detection of the events, frequency, and exposure. Boot et al. (2020) highlighted that the COVID-19 spread has led to shortages throughout the production and distribution cycles. This is because it affects supply chains all over the world, particularly relating to goods and components imported from China, and the service industry including travel and tourism. In turn, the virus epidemic poses a major liquidity problem for firms, where cash flows drastically reduced. Globally, companies struggle to pay their suppliers, their employees, and ultimately their bankers. Hence, a provision of liquid funds is highly recommended as mitigation strategy to those firms that face a break in production and/or their supply chain (Boot et al., 2020).

Modelling Risks in Supply Chains

There is wide acknowledgement in the literature of the risks and uncertainties in global supply chains. Risk in a global supply chain context can be defined as the distribution of performance outcomes of interest expressed in terms of losses, probability, speed of event, speed of losses, the time for detection of the events, and frequency (Manuj and Mentzer, 2008; Prakash et al., 2017). Basole et al. (2016) developed a computational model of risk diffusion in global supply networks, highlighting that a supply chain with high visibility is less risky. Supply chains, with their complex global connections and diverse stakeholders, can have many risks. Disruption in supply chains can be classified into five categories including (Sheffi, 2018): natural disasters, accidents and safety violations, intentional disruption, creative destruction, and global crisis. Each disruption has different degree of impact and occurs with different likelihood.

Based on availability of data, various risk management models can be used such as in cases of regarding wind, floods, fires, accidents, and crime. In the absence of accurate data such as in case of COVID-19, a 5 x 5 matrix is recommended where relative nonlinear numerical score of 1, 3, 7, 15, and 31 assigned to levels of impact (the horizontal axis) and a relative numerical score of 1, 2, 4, 7, and 11 to the five levels of likelihood. This can be achieved by multiplying the impact and likelihood numerical scores to compute a total risk score. The weight can present a mathematical expectation of the damage from a disruption, and the assumption is that the higher the expectation, the more resources should be directed toward mitigation and resilience (Sheffi, 2018). Also, the design of the scales means that high-impact/low-probability disruption is risky than high-probability/low-impact. In COVID-19 case, a supply chain geographic risk map may also be a more applicable approach, when there is disruption in the logistical connections between geographi-

cally dispersed nodes of companies, their suppliers, and their customers. Others used a multi-element risk assessment, scorecard, and Risk Wheel approaches in similar cases.

Sheffi (2018) clarified that models of supply-chain risks should follow three steps as follows:

- The likelihood and impact of root causes of damage to the company's own facilities from fires, floods, earthquakes, and so forth.
- The models extend to include the sites of suppliers.
- Understanding some categories of risks and supply-chain structures.

In a global supply chain context, Manuj and Mentzer (2008) developed a model of risk management strategies in global supply chains, based on three factors including; temporal focus, supply chain flexibility, and supply chain environment. The strategies are as follows: postponement, speculation, hedging, control/share/transfer, security, and avoidance. Prakash et al. (2017) highlighted that the risk management process takes place as follows; risk identification by mapping all possible causes or sources of risk to the supply chain, risk Management through risk analysis, risk evaluation, and formulating risk mitigation strategies. In natural disasters, such as epidemics like SARS in South-East Asia in 2003, Wagner and Bode (2008) classified the supply chain risks into: (1) demand-side risks, (2) supply side risks, (3) legal risks, (4) infrastructure risks, and (5) catastrophic risks. They applied a methodology of a cross-sectional survey administered in Germany to a sample of top-level executives in logistics and supply chain management. Following the same approach, surveys are applied as a methodology to analyse the risk events which are associated with the supply network, internal operations, or external factors (Lockamy and McCormack, 2010; Cohen and Lee, 2020).

Global Supply Chain Disruptions and Responsiveness

In the global supply chain context, companies face logistical complexity and a set of challenges such as disruption, customs, regulatory restrictions, for example, in their supply chain flows. Direct supply disruptions will (i) hinder production and increase the direct supply shocks, (ii) will increase the cost of business for manufacturing companies, and (iii) firms find it harder and/or more expensive to acquire the necessary imported industrial inputs from the hard-hit geographic locations. Where demand disruptions will (i) lead to economic recessions, (ii) purchase delays by consumers, and (iii) investment delays by firms (Fernandes, 2020; Baldwin and Tomiura, 2020). It is suggested that risk management must be based on a logical sequence of determining the risks, and to assess probability risk of occurrence, or the impact or both (Balambo and Haouari, 2014).

As a research approach applied in this paper, a survey aims to understand how firms are adopting new global supply chain strategies and restructuring their supply chains in response to fundamental changes in their environment due to COVID-19.

The respondents to the survey highlighted the impact of COVID-19 outbreak on the global supply chains, and the applied strategies. The results of the survey analysis reveals three main outcomes as discussed in the following sections.

Global Supply Chain Risk Management

Regarding the first research question of how can global supply chain remain in a disruption, the results display the following:

1- In a global context, 87% of companies have formal supply chain strategy, compared to 13% of companies.

2- Globally, 52% of responded monitor world events when there are only global risks, compared to 48% of companies conduct periodically global supply chain risk assessment.

3- About 72% of respondents actively work on supply chain risk management and having business continuity plan.

4- About 43% of companies involve selected suppliers and customers in supply chain risk management, with 30% do it sometimes, and 18% do it when there is a risk, and 9% never involve them.

5- About 44% of companies have a risk manager or a group that goes beyond just buying insurance to work on supply chain risk issues, where 32% of companies' launch risk management team when there is a global risk influence the global supply chain. And, about 24% of companies do not have risk manager or dedicated team.

6- In a disruption period, about 81% of companies simulate or visualise different supply chain risks and disruptions in order to reach the right strategies.

7- Regularly, about 62% of companies review their supplier risk mitigation performance. However, the respondents show various review periods from weekly, monthly, quarterly to yearly review.

COVID-19 Disrupted the Supply Chain Performance

Regarding the second research question of how COVID-19 disrupted supply chain performance, the results display the following:

1- As a supply risk, about 73% of companies suffer from shortage in supplying materials/equipment/tools.

2- As a demand risk, 66% of companies have shortage in inventory and stock out occurrence.

3- In term of international transportation, about 77% of companies receive delay notice in transportation with high associated shipping costs. This is due to extending the lead times and cancelation of many flights and shipping lines' schedules.

4- In fact, about 79% of companies have demand shocks and declining in order fulfilment.

5- About 69% of the companies have shortage of labour and working hours' limitation.

6- Only 85% of companies have investment/ownership restrictions due to COVID-19.

7- About 73% of companies only have information and communication disruptions.

8- About 71% of companies declare that there is raising in products' prices.

9- About 74% of companies prefer to have an adequate buffer stock of crucial parts and other inputs on hand.

10- About 89% of companies aim to understand of how prepared key suppliers and other stakeholders are for an unexpected event.

Global Supply Chain Strategies in COVID-19

Regarding the third research question about the applied supply chain strategy and business plan during COVID-19 paramedic, the results display the following:

1- In response to shortage in inventory and delay in transportation, about 64% of companies added capacity to response to supply disruption.

2- And, about 60% of the companies increased inventory level to avoid shortage.

3- While, only 38% of the companies plan to terminate the disrupted suppliers, where about 40% of the companies refuse to cut their contracted suppliers.

4- About 50% of the companies look for alternative sources with less specification, while 34% of company's reject to find alternative sources.

5- For cutting costs in disruption period, about 50% of companies for applying a concept of a single major of distribution centers (DC) instead of multiple small DCs.

6- About 89% of companies apply multiple sourcing strategy to avoid supply chain disruption.

7- About 79% of companies apply centratlised purchasing strategy.

Conclusion

In fact, the COVID-19 outbreak has led to many disruptions. Companies suffer the materials shortage, long lead times, reducing revenue and service level, and fail to meet customers' orders. As a methodology, a survey has developed to explore how COVID-19 impact a range of industries, and to investigate those strategies taken to reduce the global supply chain risks experienced of COVID-19. In conclusion, a set of strategies are recommended from the industrial perspective, such as; terminating the disrupted suppliers, changing the purchasing strategy, finding alterative suppliers with local sourcing focus, and maintaining a buffer stock to avoid any potential stock out. These strategies will definitely change the supply chain architecture, at least on the short and medium times. Accordingly, this will lead to redesign the global supply chains. Another main conclusion is about how some companies fail to simulate or visualise different supply chain risks and disruptions in order to reach the right strategies. this requires to enhance their staff skills and competencies using technologies. The usage of technology becomes indispensable tool in COVID-19 context. As future research, it is recommended to conduct researches on how companies should develop and manage their supply chain risk teams in crisis management. This will help to cope proactively with global risks.

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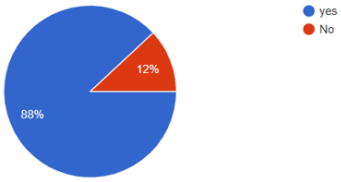
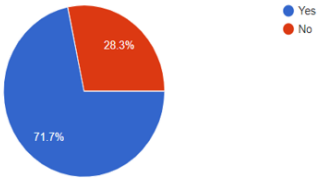
Appendices

1- Global Supply Chain Risk Strategies in COVID-19

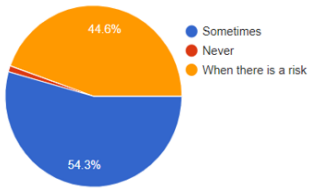
In a global context, a company has a formal supply chain strategy 92 responses



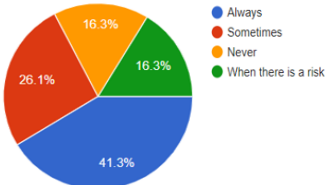
We actively work on supply chain risk management and we have a business continuity plan 92 responses



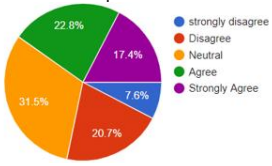
Globally, we monitor world events for events that affect us 92 responses



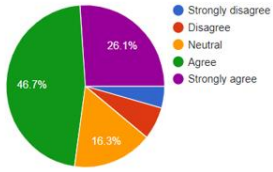
We involve selected suppliers and customers in our SCRM and business continuity plans. 92 responses



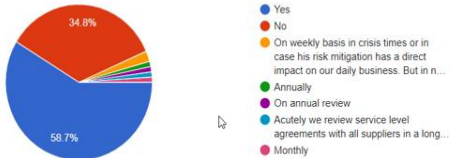
We have a risk manager or a group and our risk manager goes beyond just buying insurance to work on supply chain risk issues 92 responses



We simulate/ visualize different supply chain risks and disruptions 92 responses

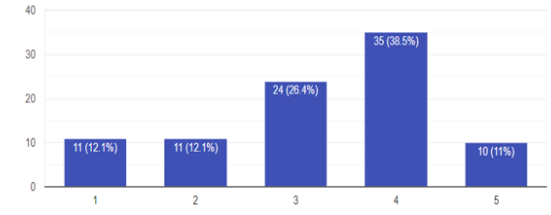


We review supplier risk mitigation performance at quarterly review 92 responses

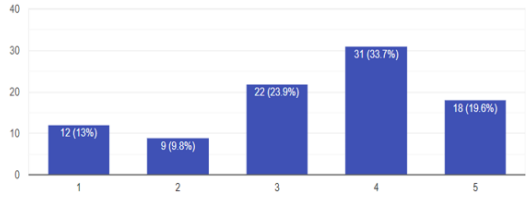


2- How COVID-19 disrupted your supply chain performance

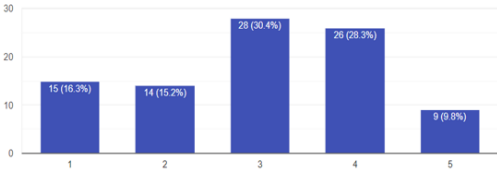
Shortage in supplying materials/equipment/tools. 91 responses



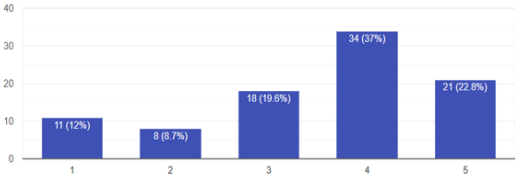
Delay in transportation with high associated shipping costs. 92 responses



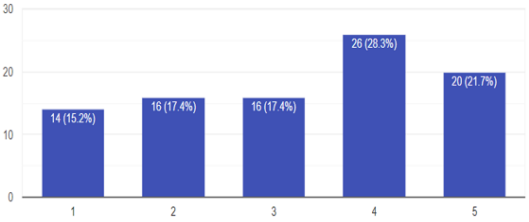
Shortage in inventory and stock out occurrence. 92 responses



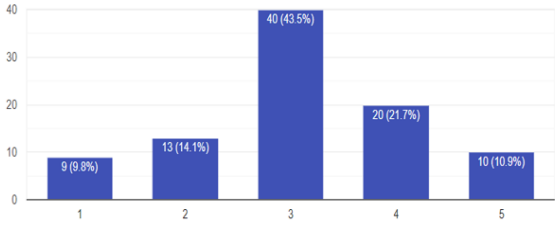
Having demand shocks. 92 responses



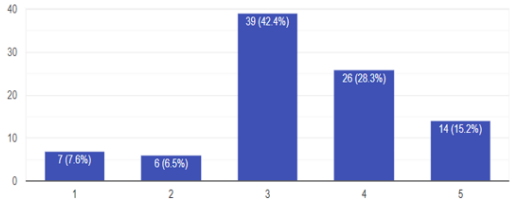
Shortage of labour and working hours limitation. 92 responses



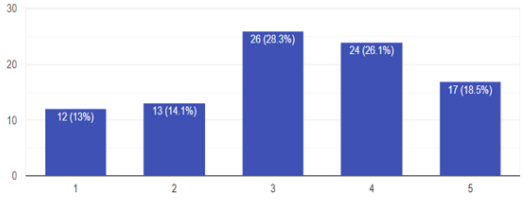
Information and communication disruptions. 92 responses



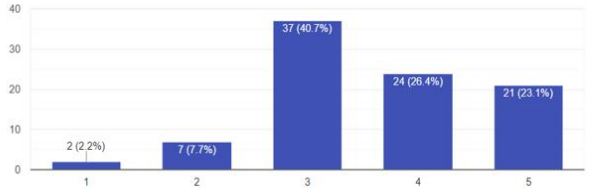
Investment/ownership restrictions. 92 responses



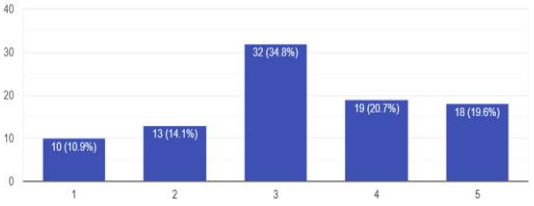
Raising in products' prices. 92 responses



Have an adequate buffer stock of crucial parts and other inputs on hand. 92 responses



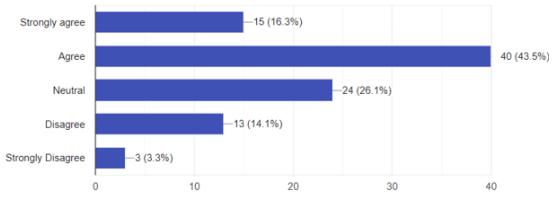
Understanding of how prepared key suppliers and other stakeholders are for an unexpected event. 91 responses



3- Applied global supply chain strategy in COVID-19

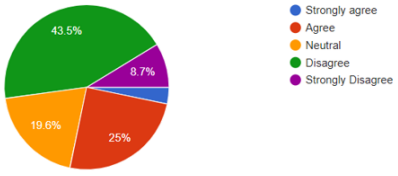
We added capacity to response to supply disruption

92 responses



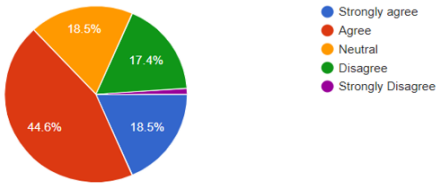
We have terminated disrupted suppliers

92 responses



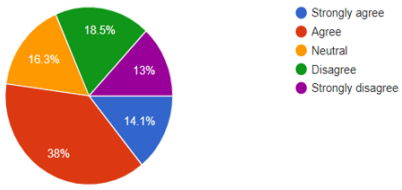
We increased inventory level to avoid shortage

92 responses

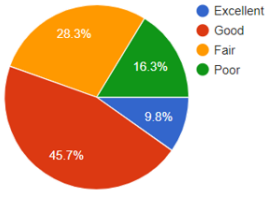


Find alternative sources with less specification

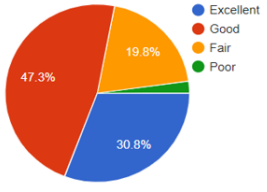
92 responses



You apply a concept of a single major of distribution centers (DC) instead of multiple small DCs. 92 responses



You apply centratlised purchasing strategy 91 responses



You apply multiple sourcing to avoid supply chain disruption 92 responses