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Effect of Pandemic Covid-19 to the Operation Management Activities in Industry

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ABSTRACT

COVID-19 pandemic has affected the activities related to operations management in the manufacturing industry under the scope of production interruption of raw materials and spare parts, labour, logistics, finance as well as supply and demand fluctuation. Manufacturing industry has faced limitation in the import of raw materials and spare parts which cause delay in manufacturing projects and activities. Due to the pandemic, standard operating procedures are implemented to ensure the labour can work in a safer environment without having the risk of getting infected. Logistics are also adapted with a new practice to ensure contactless delivery of products and items are disinfected before delivering. The pandemic has caused companies to face many financial issues where they are forced to shut down or take loans to sustain their business. Moreover, the supply and customer demand for the products fluctuate as the lifestyle of people changes to adapt themselves to the pandemic. The effects have showed the importance of implementing countermeasures to prepare the manufacturing industry for the post-pandemic world.

Keywords:
Covid-19; Operation management; Manufacturing industry; Supply and demand; Financial impacts

1. Introduction

Operations management is the administration of business practices that enhances efficiency and ensures that companies can produce maximum profit. Operations management is important to control the company processes including design, operation, maintenance, and improvement of the systems. Besides, it also ensures that the products delivered to the customers meet the quality standards. Operations management can be divided into several main functions in the manufacturing industry. One of the common functions is production planning and control. Production planning and control is the process of planning the production and ensuring the production system can achieve optimum performance by using different control techniques. It is divided into several main stages

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including planning, routing, scheduling, dispatching and follow-up. The planning stage involves planning of the production processes in terms of the resources required. The routing stage involves the selection of the most advantageous production path. In the scheduling stage, the time required to complete production processes are determined. The dispatching stage is the stage where the actual implementation of the plan starts. The follow-up stage focuses on updating the daily progress of the production work, followed by regular inspections and maintenance. Production planning and control is vital to increase the production efficiency by minimizing the costs. It also ensures that less waste and scraps are produced during production. However, the coronavirus disease (COVID-19) that emerged in 2019 had affected the activities related to operation management as well as production planning and control.

COVID-19 is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus. The disease first emerged in Wuhan, China in December 2019 and was declared a pandemic by the World Health Organization (WHO) on 11 March 2020 [1]. Initial studies have reported an estimation of 3% for the global case fatality rate (CFR) of COVID-19 [2].

Most people infected with the virus will experience some common symptoms such as fever, cough, shortness of breath, among others [3]. There are also some cases in which the infected individuals become seriously ill and require intensive medical care. The virus can be easily spread from person to person just by coughing, sneezing or even breathing [4]. Thus, it is difficult to prevent the transmission of the virus. In the absence of effective medication or vaccines as the cure for the infection, people are advised to wear facemasks, practice social distancing as well as following the standard operating procedures (SOPs) implemented by governments and organizations to reduce the transmission of the virus. These SOPs not only have changed the lifestyle of people, but also affected the industrial activities related to the operations management. The effect of the COVID-19 pandemic towards the activities related to the operations management can be divided into several scopes, which are production interruption of raw material and spare parts, labours, logistics, financial impacts as well as supply and demand fluctuation. Proper design management resulted in project success such as done by Hanid *et al.,* [5] in the construction industry. In which a systematic method of managing design process through integration of multiple stakeholders in a construction project. In addition, preventive maintenance implemented in oil and gas company contribute to organizational performance [6].

2. Production Interruption of Raw Material and Spare Parts

Due to the outbreak and spread of the COVID-19 pandemic, the operation management and production planning and control of manufacturing industries such as automobiles, aircraft and consumer electronics industries have been greatly affected. This situation has led to the economic downturn of the affected countries as manufacturing sectors often play a crucial role in the country's economic transformation. Since the main role of a manufacturing industry is to create and produce goods from raw material with the aid of machines, tools and equipment, labour, and chemical or biological processing, control actions taken to prevent the emergence of new clusters, such as lockdown, flight stop and outside activities restrictions, has significantly disrupted the production lines of industries. This is because with the control actions taken, production lines (also known as assembly lines or factory lines), which is an organized path with sequential operations of the assembling process of an end product established in a factory, will face a situation where the input for the production process is inadequate due to the delay or lack of raw material and spare parts supply. This will then result in the production interruption, forcing the manufacturing industries that are deeply involved in the global supply chain to be shut down [7]. Thus, in this subtopic, the influence

of the COVID-19 pandemic on manufacturing industries, especially on the interruption of raw materials and spare parts supply in the production line, will be discussed.

According to Chen *et al*., [8], the production for most of the manufacturing industries in the countries affected by the COVID-19 pandemic is forced to pause their operations due to the insufficient raw materials supply. This situation occurs due to the embargo policies implementation in which the initial intention is to stop the transmission of the disease. However, this control action has severely affected the raw materials supply and demand in the global supply chain. In this case, manufacturing enterprises are very critical. This is because, without proper contingency plans in place to overcome the supply disruption issue, the production capacity of an enterprise will be significantly reduced, leading to the out-of-stock for customer orders. Thus, to avoid backorder costs or customers' abandonment of orders, a disruption recovery strategy was developed to assist the manufacturers in coping with unexpected massive disruptions such as the pandemic outbreak under economic uncertainties like market demand and supply situation. In this strategy, two different ways were suggested to mitigate the losses and effects due to supply disruption. First, the manufacturers can make an emergency procurement of the raw materials in short supply from alternative suppliers so that they will have sufficient resources to run the production line continuously. Yet, this action will incur additional procurement costs which will lead to a loss in sales profit. The second contingency plan is to revise the original product composition where the initial raw material required is replaced with another material that can be obtained from other unaffected suppliers. In this approach, the manufacturers must consider the cost of product change such as the cost of procurement for new materials and the cost of lost sales due to the difference in product cost of the original and revised product design. From here, we can imply that the outbreak of the COVID-19 pandemic had brought a lot of trouble to the manufacturing industries. The reason for this is that although there is a recovery strategy for the disruption that occurred, there will still be some unavoidable difficulties, especially in terms of the costs incurred. Therefore, future research is still required to establish an optimal recovery strategy model that incorporates factors such as the influence of demand fluctuation and the transshipment cost that may occur during the pandemic outbreak.

Another study by Lindagato *et al*., [9] shows that the outbreak of the COVID-19 pandemic has even exacerbated the unstable tantalum ore supply chain as the government of Africa temporarily closed the mines, factories, and borders to control the spread of the disease. This had not only led to the shrinkage of mining activities but also restricted the imports and exports of raw materials, causing tantalum resources to be increasingly scarce. However, the outstanding properties of tantalum in storing and releasing electrical charges and having a high melting point have increased its demand not only for electronic and communication gadgets production but also for 5G network systems and electrical vehicle production during this pandemic. This has been a tremendous challenge as the manufacturing of products with tantalum as raw material is not only restricted by the shrinking mining activities but also constrained by the mining resumes pace that cannot keep up with the growing demand for tantalum. As a result, the risk of a tantalum supply shortage has increased substantially, causing its price to fluctuate. From here, we can notice that the production of goods involving tantalum as raw material will be interrupted due to the lack of tantalum resources if the issue mentioned above cannot be resolved. Hence, we need to adopt new norms of reliability and stability rather than relying on the old uncertain and unstable supply system to overcome the scarcity of tantalum during this digital era.

Relevant past research about the development of supply chain resilience knowledge in less-developed countries such as Guinea-Bissau, an underdeveloped West African country, during the pandemic age is done by Lopes *et al*., [10]. The impact of the COVID-19 pandemic is more severe in less-developed countries as most of the manufacturing companies in these countries are import-

dependent where the products and raw materials they used are mainly imported from the third countries. This can be proven when all the manufacturing industries in Guinea-Bissau were seriously affected by the surprise pandemic and were exacerbated by the closure of the borders, which limits the import of raw materials, causing delays in materials' arrival. This situation has led to a negative impact on supply chains that relates closely to the stock availability for customers' orders. Another reason for the manufacturing companies in less-developed countries to suffer from the critical consequences of the disruptions caused by the pandemic is that they were never prepared for a crisis, causing them to have inadequate capacity to anticipate and deal with the disruptions that occurred. Thus, if this situation is not properly handled, the risk incurred due to the sudden instability of supply chains will be increased drastically, resulting in a long-term impact on the company. Through this article, we can imply that instead of focusing all the raw materials imports on one single supply chain, we must implement supply chain diversification to avoid any unexpected supply disruptions. Also, an effective stock management policy should be established, and an alternate supply route must be prepared as a backup when the acquisition of raw materials is highly import-dependent.

Pour *et al.,* [11] carried out a study regarding the role of industry 4.0 technologies in overcoming the pandemic challenges for manufacturing sectors. Industry 4.0 is a concept where the manufacturing ways of industries are revolted to improve the sustainability and efficiency in product production. This technology possesses outstanding merit in that it can build a very responsive resilient system that can handle, predict and prevent the relapse of another pandemic outbreak in the future. With the aid of this industry 4.0 technology, uncertainties and challenges that may occur due to the outbreak of the COVID-19 pandemic, such as unforeseeable market demand, supply chain disruptions, labour shortage and factory closures due to lockdown can be addressed. The importance of industry 4.0 in maintaining the sustainability and efficiency of production lines in manufacturing industries, which can be critical during the time of pandemics in ensuring a stable supply chain has been highlighted in this study. Also, great insight has been provided for us in understanding the seriousness of production interruption due to raw materials and spare parts supply disruptions.

3. Labour

It is common knowledge that labour quality is important for productivity and economic growth [12]. There is an established Labour Quality Index called SHH-LQI for the Taiwanese manufacturing sector which includes seven primary metrics for labour quality. These seven metrics are:

i. education
ii. manpower training
iii. labour productivity
iv. labour force structure
v. work safety and worker health
vi. industrial relations and work ethic
vii. labour-management models and quality of work life [13].

COVID-19 has impacted several of these seven metrics for labour quality which we will be discussing in this review.

For industries that are non-essential, the shutdown measures taken by the government have forced businesses to lay off their employees to reduce cost and prevent their business from bankruptcy during their period of closure [14]. This affects metric 4 of the SSH-LQI Labour Quality Index. Laying off employees during the shutdown period would help the business survive during the

pandemic but it would lead to slower production during reopening as the labour force structure is understaffed. It is also difficult to re-hire the laid off employees as they may seek other jobs during their period of unemployment and maintain their decision to work there after the effects of the pandemic subside which further hampers the ability of a company to speed-up the production rate as before the beginning of the pandemic.

COVID-19 has pushed businesses to adopt a work from home routine which is aimed at reducing the number of staff in the building which hence leads to fewer infections [15]. Working from home reduces the productivity of staff as they are less reachable from home. They may be preoccupied as they are at home and must attend to young children or the elderly. COVID-19 being an unexpected phenomenon in the world means that most businesses have not prepared for such a scenario. For example, many employees that had to work from were not set up laptop computers [16].

For businesses deemed essential, their operations were also affected as these industries are required to practice physical distancing in the workplace. To adhere with this physical distancing guideline, industries have strategically created long period alternating shifts for their employees within a month by dividing their departments and systemizing their staff to work in weekly or bi-weekly phases. This strategy of working in alternate phases not only allows industries to adhere to physically distance their employees to prevent infections but also splits them into teams and prevents a whole department from collectively being in close contact with a COVID-19 positive individual or being collectively infected. This cuts the productivity of a business in half but ensures the business can keep running as there exists a backup team if any one team has COVID-19 positive member of staff. Although, a decrease of frequency of quality of social interactions was found to lead employees to a burnout regime where their motivations diverge to negative infinity, with the consequence of vanishing productivity [17].

Additionally, the manufacturing industry requires employees to be present as blue-collar staff are key components to the running of a plant or factory. COVID-19 has led to countries having to close state borders to protect states or districts from infecting each other. Difficulties in ensuring employee presence during the pandemic include border crossing restrictions and physical distancing policies invoked by the government which reduce the number of employees that can be enter to the factory at the same time. For industries that are essential and are allowed to operate during the pandemic, the closures of borders have posed a challenge for their operation. This brings significant effect to manufacturing companies with employees working outside the border of which the company operates. The industry is allowed to operate but their employees may not be able to attend to work especially when their employees reside in a COVID-19 high risk red zone [18]. For companies that operate close to a state border and have many employees residing on the other side, this could truly hamper productivity, adding challenges to the management of production.

4. Logistics

Logistics firms, which are involved in the movement, storage, and flow of goods, have been directly affected by the COVID-19 pandemic. As an integral part of value chains, both within and across international borders, logistics firms facilitate trade and commerce and help businesses get their products to customers. Supply chain disruptions to the sector caused by the pandemic could, therefore, impact competitiveness, economic growth, and job creation. Using China as an example, COVID-19 had 5 impacts on China's logistics which will be discussed here. The first impact of COVID-19 on China's logistics is a sharp drop in logistics demand. Due to the slowdown of the worldwide economy, China's logistics demands have greatly shrunk. The China Federation of Logistics and Purchasing reported that the total value of social logistics in China from January to February in 2020

was down by 11.8% in comparison to the same time frame last year. In just these two months alone, road freight went down by 24.8%, waterway freight down 14.8%, air freight down13.8%, but inversely proportional railway freight volume increased by 1.4%. The next impact of COVID-19 on logistics is the shortage of transportation capacity. The pandemic happened during the unfortunate time of the Chinese Spring Festival where most logistic employees have returned to their town of origin far from work. Affected by the swift action of government restrictions for traveling, this left a shortage of manpower in most logistics' firms. Not only have businesses had to shut down due to the pandemic but those essential industries that are still able to run are left with logistics firms too short of manpower to operate.

Other than that, COVID-19 caused a disruption in the logistics network. Comprehensive control measures sanctioned by the China's government to curb the spread of COVID-19 was effective to stop the spread, but this led to a complete halt in the transport network. The China Federation of Logistics and Purchasing (CFLP) surveyed the managers of 100 Chinese road transport enterprises in February 2020 and 74% of them mentioned an inability to complete transportation services on time due traffic restrictions in the region.

Additionally, the pandemic sparked a change of service mode in logistics because of the pandemic. E-commerce became a trend as customers are biased towards avoiding in person contacts to the best of their ability. Due to this, new logistics services have sprouted i.e. contactless delivery. The 'Contactless Delivery Report' released by Meituan reported that contactless delivery makes up for more than 80% of the total orders from 26th January 2020 to 8th February 8 2020. Looking at delivery time, contactless delivery does not require customers to collect the goods hence making the contactless delivery have a shorter waiting time compared to traditional delivery. In terms of costs on the other hand, contactless delivery requires more contactless facilities, the initial fixed investment cost of the operation is higher than that of traditional delivery, but contactless delivery is more efficient and leads to a lower unit variable cost over time.

The last effect of the COVID-19 pandemic on logistics is an increased operating cost and increase in loss making enterprises. According to the Deputy Secretary General of the National Development and Reform Commission (NDRC), China's social logistics costs increased drastically because of COVID-19. The delayed return of drivers to service after the restriction of people's mobility has been lifted resulted in an increase in labour costs. Other than that, there are control costs of these deliveries such as disinfection of parcels and construction costs of contactless delivery infrastructure. Lastly, the sporadic and unpredictable nature of COVID-19 has led to difficulties in transport route plans and transport plans in general not knowing which facilities will be shut down due a rise in cases. Looking for alternative routes may consume a larger budget than initially planned.

5. Financial Impacts

One of the most notable key performance indicators of any industry is its financial status. Finance refers to the study of handling and management of money as well as the processes of acquiring needed funds to help industry thrive and prosper. It is without a shadow of doubt that the COVID-19 pandemic has affected businesses of all sectors, especially financially. Arthi & Parman [19] described the shutdown of businesses during the COVID-19 crisis as more pronounced due to its economic dislocation compared to previous economic downturns such as the Great Depression and the 1918 Influenza Pandemic. This economic instability has had adverse effects mostly on Small & Medium Enterprises (SMEs). One of the many reasons as to why SMEs face higher risk of bankruptcy is due to their low recovery rate [7] With smaller returns on investment, SMEs suffer prolonged effects of shutting down their businesses upon instruction by the government. Min & Jiawen [7], also reported

that the increasing rate of bankruptcy among SMEs is caused by a very limited capital reserve. Approximately two thirds of SMEs possess enough capital reserves to survive for less than 2 months of operation according to a survey by China Association of Small and Medium Enterprises. Gourinchas *et al.,* [20] conducted a study on the estimated impact of the COVID-19 pandemic on SME business failures and deduced that most sectors of business will have an increase in bankruptcy rates after COVID-19 as opposed to before. For example, in the manufacturing industry, an increase from 8.48% to 16.73% was observed if SMEs attempt to fight to stay open in times of dire financial situations. This shows that most industrial sectors in the SME category have a higher risk of filing for bankruptcy if the direction of the business is to try and adapt to the changes caused by COVID-19. Therefore, Gourinchas *et al.,* [20] introduced an option called mothballing. Mothballing is the extension of a business where it chooses to temporarily shut down if the flow of cash is not profitable and lower under production. A mothballing firm incurs only its fixed cost and will reopen once labour restrictions ease or the demand favours the production of the business. The same example of the manufacturing sector was taken and the increase in bankruptcy rates of SMEs was only 5.7% compared to the initial 8.25% without mothballing. It can be concluded that mothballing is an effective strategy to curb the financial effects of COVID-19 which has hindered the production of goods, but with lesser costs incurred, the losses can be minimized.

With the COVID-19 pandemic affecting industries financially, the management of finance needs to be monitored closely to avoid unjustified spending which may cause financial strain to the industry. This has prompted industries to manage their capital expenditures effectively. Capital expenditures refer to the funds used by the industry to accommodate for the purchase, upgrade and replacement of assets. With the strict budgeting during COVID-19 needed to generate the revenue necessary to cover the cost of the capital expenditure, industries have resulted in requesting for loans from banking sectors or the government to replenish cash reserves. The U.S Census Bureau, 2020 released its annual capital expenditure survey which shows that in the manufacturing sector for example, 69.3% of businesses requested for financial assistance from the Paycheck Protection Program where 65.7% received the loans whereas 21.2% of businesses in the manufacturing industry requested for Economic Injury Disaster Loans whereby 19.1% of loans were approved. Besides, 24.4% of small manufacturing sector businesses in the United States of America applied for financial assistance for Small Businesses Administration (SBA) Loan Forgiveness where it was received by 19.5% of businesses. The financial assistance has helped keep businesses afloat during the pandemic as well as ensuring the wellbeing of employees with the cost of altering the financial direction of the company due to the repayment plan of this assistance. These funds were mostly used to maintain employees on their payroll (69.2%), managing utility bills around manufacturing plants (20.3%) as well as paying for rent and mortgages (24.2%). Besides the 5.3% of financial assistance used for other expenses, businesses in the manufacturing industry allocate a very small amount of the financial assistance received (2.2%) towards capital expenditures. The direction of the business drastically changes as the budgeted capital expenditures are affected by the COVID-19 pandemic. As reported by the U.S Census Bureau, 2020, it was found that 10.3% of the budgeted capital expenditures in the manufacturing industry were cancelled whereas 13.6% of companies postponed their budgeted capital expenditures. 9.4% of companies decreased their budgeted capital expenditures whereas only 0.7% of companies increased their capital expenditures to cope with the pandemic. One of the reasons as to why some companies had to increase their capital expenditures is due to the investment of funds related to social distancing or safety considering the COVID-19 pandemic (8.7%). With a decrease in legitimate capital expenditure budgets, the businesses can free up significant amounts of cash to help mitigate the financial effects of COVID-19. With the reduction in capital expenditure comes challenges such as determining the right amount to decrease by limited facts to

make the right decision whether to defer or cut budgets, lack of organizational buy-ins as well as lack of comprehensive approaches to free up cash flow [21]. These prioritizations and resetting of portfolios can affect the trajectory of the company as projects need to be delayed or even stopped due to the robust trade-offs required.

6. Fluctuation of Supply and Demand

An economic theory called the law of supply and demand explains how supply and demand are related to one another and how this relationship impacts how much goods and services cost. A basic tenet of economics is that when there is more supply than demand for an item or service, prices decline. Demand is a representation of a consumer's desire to purchase goods and services; it acts as a measurement of a consumer's willingness to purchase a specific good or service at a given price. Prices typically increase when demand outpaces supply. The pandemic, COVID-19 had a serious effect on the supply and demand for the manufacturing industry. It is common knowledge that during the pandemic certain sectors in the industry benefited and others lost their demand on the supply for some items. Researchers argued whether the COVID-19 shock could be treated as a demand shock caused by rising unemployment and falling incomes plus the purchasing power among the people, or a supply shock resulting from breakdown in supply chains, the shutting down of industries, and so on [22]. Others, such as Triggs and Karas [23] argue that the situation is not just a demand and supply shock but also a financial shock. Eventually, ultimately, the majority of the researchers agreed that COVID-19 was a genuine shock to the economy with aspects of supply and demand. Studies from Napoleone and Prataviera [24] shows during the period of the pandemic, especially March 2020, Italian manufacturers were struggling hard compared to other European countries. The industrial production was reduced by 28.4% compared to previous year. However, a study from Hilmola *et al.,* [25] reveals that the figures for overall trade volumes are rather consistent or are even increasing for countries like China. Therefore, this subtopic would like to focus on the fluctuation of supply from the manufacturers and demand from customers due to the effects of the COVID-19 pandemic mainly in the manufacturing sector of current industries.

According to Ramani *et al*., [26] fluctuation of supply in the semiconductor manufacturing industry was caused by the pandemic responses done by governments of the world. This includes the actions such as the infectious disease onset, lockdowns, and consumer demand variation. Many governments implemented various degrees of lockdown due to the widespread concern of an infectious disease with clinical signs ranging from a moderate fever to serious problems like organ failure. This was done to slow the infection's rapid spread. Government also imposed restrictions on movement to reduce interactions between individuals which reduced demand in the automotive industry. Another cause according to Ramani *et al.,* [26] includes supply disruptions. This includes the product and plant and disruptions, logistical delays, and virus outbreaks in the South Korean and Taiwanese plants which causes the lack of labour. The fluctuation of supply was not strictly limited to the effects of the pandemic as it was seen with the cold waves in Texas in early 2021 which disrupted the production at Infineon Tech, Samsung and NXP semiconductor plants. The production delays were further made worse by a fire at a Renesas Electronics Corp. factory in Japan, which practically destroyed two-thirds of the building used to make automobile chips. Congestion at the ports and shipping delays contributed to the logistical delay. The loading and unloading of cargo were delayed as a result of infections at one of the busiest ports in Yantian, southern China. Chip producers had to deal with rising shipping costs as containers became backed up at several ports, with the price of using containers basically doubling.

Other studies such as the one from McKinsey Global Institute [21], shows that certain manufacturing industries such as aviation suffered one of the highest losses during the pandemic due to very low demand for air travel from the customers. The leisure air travel industry effectively lost 100 percent of its traffic which caused less demand for new orders of passenger planes to come in for the aircraft manufacturers. Yet another paper published by McKinsey Global Institute [21] reveals that orders for commercial aircraft were down by 55% in 2020 from the previous year's level while the number of deferred aircraft deliveries increased fivefold. Due to the overstock of aircraft, rates for new aircraft leases were significantly lower; for example, leasing rates for widebody aircraft (such as the Boeing 787-9) decreased by over 35% in 2020 from where they were in 2019, only making a 10% recovery in 2018. On the other hand, a study by Socal *et al.,* [27] found out that the pharmaceutical manufacturing industry struggled to meet the demand for medical supplies during the peak of the pandemic. This was due to unexpected sharp increases in customer demand which exceeded manufacturers' production capacity. The study also shows that even though the USA today depends on a global supply of drugs, medication manufacturing used to be predominantly done domestically. China, India, and Europe serve as the primary suppliers for the global pharmaceutical supply chain. Due to lockdowns, staff shortages, travel, and export bans, as well as other national and international actions, the manufacture and shipment of medications around the world have been hampered during the COVID19 epidemic, making these flows particularly vulnerable.

Demand is always related towards the needs of a customer/consumer during a certain period. One of the main sources of demand is panic buying. Panic buying could be commonly recognized by behaviour that were shown by the customer where the purchases made could be unusually large or an unusually varied range of products in anticipation of, during or after a disaster/perceived disaster. Studies conducted by Yuen *et al.,* [28] shows that in response to the pandemic, there are four key factors that cause panic buying: fear of the unknown, perception, coping behaviour and social psychology. They concluded that consumers are driven to engage in self-protective behaviours, such as panic buying, to reduce perceived risk when they believe the possibility and consequences of being infected to be high. Study done by Loxton *et al.,* [29] shows that certain industries such as essential manufacturers like food, water, medical supplies and even home gym supplies see an increase in production due to the panic buying demand during the COVID-19 pandemic.

7. Conclusion

In conclusion, COVID-19 pandemic has brought positive and negative impacts to the industrial activities related to operations management in terms of production interruption of raw material and spare parts, labours, logistics, finance and supply and demand fluctuation. COVID-19 pandemic has caused the increase in sales on the facemasks and protective personal equipment manufacturing industries due to the increase in awareness on the importance of facemasks on reducing the risks of getting infected by the virus. However, the continuous spread of COVID-19 also caused many manufacturing companies to suffer profit loss and some of them are forced to go bankruptcy due to the lack of raw materials and labours. Therefore, effective countermeasures should be taken to reduce the negative impacts brought by the pandemic. The countermeasures focus on two stages, which are to ensure a smooth supply chain operation at present as well as preparing for the post-pandemic world and next possible upcoming pandemic wave. With the increasing trend of digitalization, the countermeasures can help the manufacturing companies to reduce the burden caused by the pandemic and at the same time allowing the companies to excel better and gain more profits from their production processes.

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