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## Research Article

**Keywords:** House of Risk, Business Continuity Management, Business Impact Analysis, Business Continuity

**Posted Date:** November 25th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-111840/v1>

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# The analysis of disruption management due to COVID-19 using business continuity management and house of risk on maritime operations

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## Abstract

The high frequency of shipping in Indonesia is directly proportional to the increase of port activities. Along with the activities, the risk of disruption that might occur also increase. The impact of a disruption can be detrimental to many parties such as crew, company, ship, cargo carried, and environment. During the COVID-19 pandemic, ports are encouraged to develop a plan that could minimize the disruption of the role that port play in keeping trade flowing and vital supplies moving. The possible impact from COVID-19 related disruption urges companies to apply the Business Continuity Management (BCM) system to deal with any potential disruption that might occur. This paper tries to identify and rank each potential disruption from COVID-19 based on severity & occurrence, House of Risk method was used with the aid of questionnaires and interviews. Furthermore, business impact analysis is conducted in order to analyse the impact of COVID-19 pandemic and how BCM helps to minimize the potential loss. Business continuity value also measured through analysing container throughput growth data.

**Keywords** House of Risk · Business Continuity Management · Business Impact Analysis · Business Continuity Value

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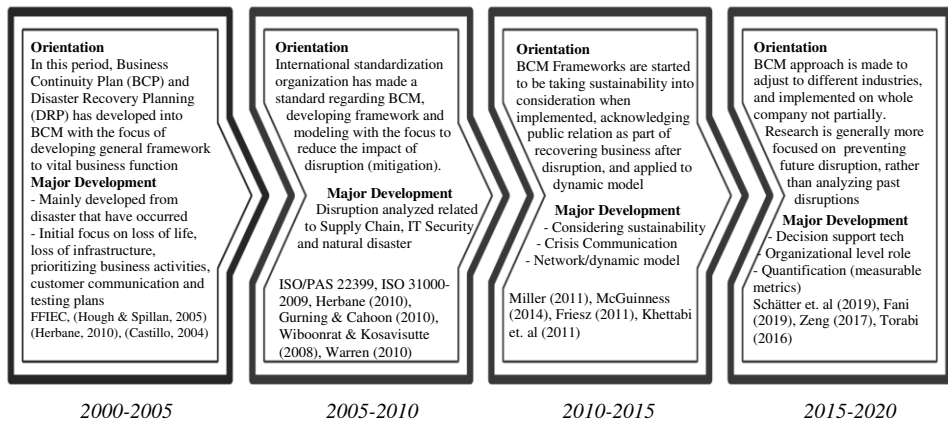
# 1 Introduction

In running a business, an approach is needed for business to keep going and minimize losses if disruptions occur. Most companies are applying the approach of conventional risk management where the risks are analysed based on the likelihood of occurrence and the impacts produced but do not take into account the recovery process if the risk does occur. The high shipping frequency in Indonesia and the density of ships going in and out of ports for loading and unloading, making ship and the facilities highly prone to disruptions and accidents, including on the crew of the ship. One of the most recent and highly discussed disruption that could affect many stakeholders is the COVID-19 pandemic outbreak. The potential loss could be lessened significantly with Business Continuity Management (BCM) and Business Continuity Planning (BCP). Business Continuity Management System is an idea or ideas that integrate the recovery process with use a risk management framework. (Herbane, et al., 2010) (Hiles, 2007) (Watters & Watters, 2004).

The high number of accidents encourages companies or organizations to apply the Business Continuity Management (BCM) system to prepare for any possible accident. At the beginning of its development from 1970 to 1990, Business Continuity Management was introduced as a law that is issued during a disaster such as flood and at the same time as insurance disbursement due to disaster in United States (Gallagher, 2002) (Ozier, 1999) (Sr & Kunreuther, 1998). Then in 1990 to 2001, BCM began to be developed into a standard in the United States and the United Kingdom which is applied in the health, economic and financial industry (Defence, 2000) (Page, 2004). Business Continuity Management is starting to become popular as it happens the tragedy of the attack on the WTC building in September 2001. Some research on BCM then emerged as a response to the tragedy. The research has the scope of decision making (Lodge, 2009), crisis management of public and private assets (Boin & Smith, 2006), and planning for disaster recovery needs and business continuity (Spillan & Hough, 2003). In the maritime industry, the formulation and implementation of BCM and BCP is currently experiencing development. This was explored by several researchers in various countries that consider maritime assets are critical assets, due to possibilities of disruption by natural disasters. Discontinuity in maritime assets such as ports and shipping, will cause logistics distribution around the country hampered and will have a national-scale impact. Therefore some countries like the United States, California, and Japan do BCM planning in maritime assets in accordance with the demographics of each region - respectively (Ono, 2016) (Securities, 2006).

Indonesia as an archipelago that has significant contribution in the maritime industry certainly has maritime assets that support the country's logistics distribution. Discontinuity of assets such as ports and maritime logistics will be able to disrupt state stability. With the Government of Indonesia establishing that the COVID-19 pandemic is a national disaster, all Indonesian company should support the efforts by the central and regional governments to reduce the rate of increase in the number of COVID-19 cases in Indonesia. One of the main efforts is to carry out the recommendations of social restrictions and to do isolation at home. For all cross-sectoral and industrial organizations, this means that there has been a percentage of disruption that brings organizational operations no longer in a business-as-usual condition, where every activity in the workplace both in offices & factories are no

longer carried out as effectively. In response to this situation, each organization should implement business continuity management by having a business continuity plan.



**Fig. 1** BCM research trend 2000-2020

Above is the development of BCM research from 2000-2020. The year 2000-2005 was an introduction to BCM which was a combination of BCP and DRP and the issuance of many frameworks, one example of BCP is FFIEC (Federal Financial Institutions Examination Council, 2003). This year, BCM focuses on developing a framework for vital business functions. The main focus in the range of years prioritizes loss of life, loss of infrastructure (Castillo, 2004) and raising awareness of need for business continuity and disaster recovery (Spillan & Hough, 2003) and the focus is due to the effects of the WTC tragedy (Herbane, 2010). 2005-2010 is the year of standardization of BCM (ISO 31000, 2009) and focuses on mitigation in a wider disruption area, such as the supply chain (Gurning & Cahoon, 2010), climate change (Warren, 2010) and Information Technology (Wiboonrat & Kosavisutte, 2008). The orientation in 2010-2015 is the emergence of a framework to consider sustainability when implemented (Khettabi, et al., 2011), consider public relations when business recovery (Mcguinness, 2014) and the application of dynamic models (Friesz, et al., 2011). The 2015-2020 range is the BCM approach that is made to suit different industries and can prevent disruption in the future. BCM is implemented on a whole company (Fani & Subriadi, 2019) and the development has used quantification (Torabi, 2016).

As mentioned earlier, business continuity management started as response to disruptions that has occurred. Considering the most recent disruption, which is COVID-19, it is needed to find out further regarding the role of business continuity management in order to minimize the loss caused from the disruption. Figure 2 shows a company productivity graph during the months that are affected by COVID-19. The level of productivity is determined by container flow or throughput, measured in boxes. From the graph it can be concluded that during 4 months there was a fluctuation in container throughput. There was a decrease in container throughput in January from 253,234 boxes to 241,265 boxes in February. The increase in continuous throughput also occurred in February from 241,265 boxes to March to 268,932 boxes in March. Then a decrease of 24,393 boxes occurred in

March to April. On 29 February 2020 the Republic of Indonesia’s Minister of health established an emergency caused by COVID-19. The decision affected the throughput of containers which declined in March after the emergency was declared. On March 16 the Ministry of Health issued a circular with the aim of preventing the spread of COVID-19 by self-isolation at home. Moreover, there was an International and domestic decrease of traffic, mainly from China, this is due to an indication of new developments of COVID-19 detection in these period.

With these 2 events, there was a decrease of 24,393 boxes in March to April, more than the previous decline. COVID-19 made an impact on container throughput on maritime operations, but to be measured in one month the decrease is not significant. Of interest is that the company had a business continuity management prepared and implemented when the disruption occurs.

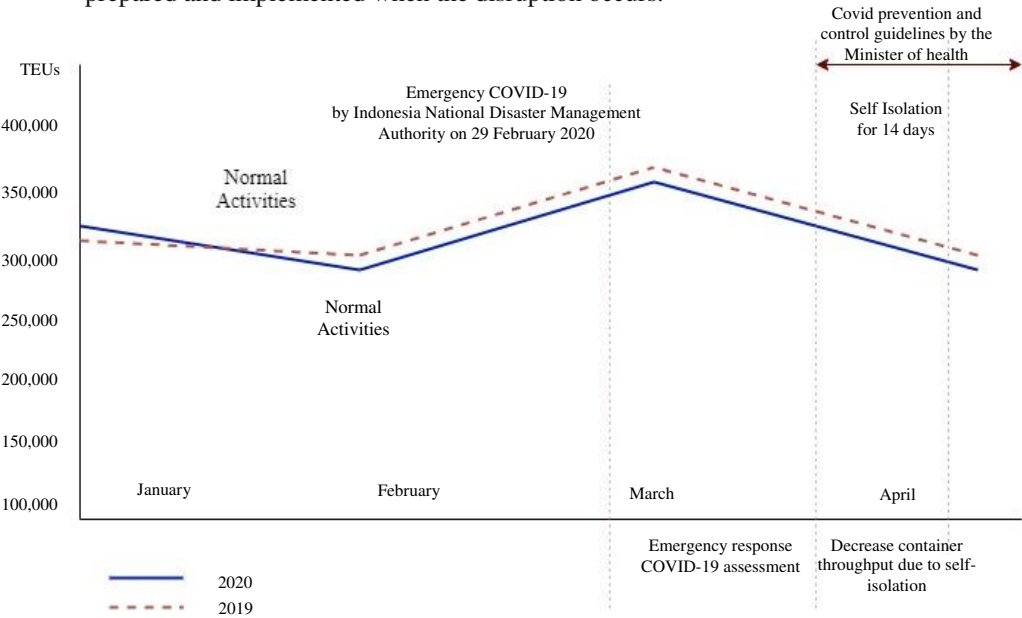


Fig. 2 Productivity changes during COVID-19 pandemic

This paper addresses how systematically implementing BCM can significantly lessen the potential loss that might be suffered from the possible disruptions by COVID-19 pandemic. This paper thus contributes to the literature of business continuity management on maritime operation by providing the knowledge of measuring business continuity value based on actual throughput during the months that are affected by the COVID-19. Throughput volume was used because the cargo transfer product indicates operational performance and productivity (Yang, 2016; Schøyen & Odeck, 2017; López-Bermúdez, et al., 2019). The approach that is used to identify and rank disruption risk agents and risk events is the House of Risk (HOR) method. HOR is a development of the failure mode and effect analysis (FMEA) and quality function deployment (QFD) model (Lutfi & Irawan, 2012). There are two main advantages of using house of risk. Firstly, it allows to analyse each disruption along with the source that could be the cause of several other risks & the potential preventive action (Pujawan & Geraldin, 2009). Secondly, it can measure the Aggregate Risk Potential (ARP), making it clear to understand which

disruption risk agent contribute most to the overall loss.

The remainder of this paper is organised as follows. Section 2 is a literature review of relevant theory about business continuity management and maritime disruption; Section 3 presents the identified disruption risk agents and risk events used to measure aggregate risk potential; Section 4 presents the empirical result of the business continuity value measurement and business continuity management implementation analysis; Section 5 concludes the paper.

## **2 Literature Review**

This chapter presents some relevant theory about risk and disruption management, business continuity management, business continuity plan, business impact analysis, and house of risk. Other sub chapter is review of previous research that is in relevant with this topic.

### **2.1 Risk and Disruption Management**

The definition of risk according to the International Standard Organization (ISO/IEC, 2016) is a combination of all types of opportunities and consequences for an event. To manage any risk, it is essential first to analyse or identify the various internal and external risks existing in the firm (Mishra, et al., 2018). According to (Hiles, 2007) the objective of risk management is to identify, assess and control risks in order to prevent them from impairing business objectives. In order to narrow the scope of events that are very broad in risk management, it is necessary to set a boundary with the aim to focus on events that are able to completely halt business objectives. (Snedaker & Rima, 2007) and (Torabi, 2016) argue that for companies that cannot tolerate any downtime, some risks should be categorized as disruptions because their ability to fail business system completely. In maritime industry, ISM Code is formed in order to achieve sea safety, human safety, and the avoidance of environmental damage. It needs to be implemented with the full support of every stakeholders in the organizations that will lead to a successful implementation of ISM Code (Karakasnaki, et al., 2018). Gurning (2011) derived maritime disruptions into direct and indirect categories and proposed a management approach to mitigate maritime disruptions which include business continuity as one of the main strategies.

### **2.2 Business Continuity Management in Maritime Operations**

Business Continuity Management (BCM) according to (ISO, 2012) ISO:22301 is a comprehensive management process that identifies potential threats to an organization and the impacts to business operations. BCM performance depends on the implementation requirements that cover the organizational context, leadership commitment, planning, support, operational requirements, performance evaluation, and improvement (Okuna, 2014).

BCM goes beyond risk management to plan inevitable disasters. Risk management is the basis of BCM and provides basic analysis and decision making in decisions regarding resource allocation. Risk management is a continuous decision-making process that results in how risks are treated, whether received, avoided, reduced or transferred. BCM was used to prevent major disruptions and to reduce the impact of disturbances. (Hiles, 2007)

Development of BCM is also carried out for applications in the maritime industry. Some agencies are starting to realize that port facilities and shipping infrastructures are assets that will impacted most when they experience disruption, especially when the disruption comes in as a natural disaster (Ono, et al., 2016). When discontinuity occurs, especially in port & harbour services, various small impacts can be accumulated and disrupt the whole process of ship services, goods, transportation to and from the port as well logistics services (including distribution by sea) due to various risk events arises through a number of stages such as disturbance, delay, deviation and disruption (Yang, 2005; Gurning, 2011). In the specific context of port services, various literature are more focused on the issue of risk management and has not yet led to it post evaluation and risk management itself in the context of management continuity of port service business. The table below shows a number of the literature development on port risk handling services commercial and operational.

**Table 1** Previous risk management approach towards business continuity management

Year	Researcher	Topics	Approach
2010	Schachler & Navare	Terminal operation cooperation	Management allocation risk per risk
2011	Gurning & Cahoon	Shipping & port delay, deviation, and disruption from various risk events	Markov chain disruption management
2014	Mabrouki et. al	Terminal operation risk; Ro-ro service case study	Risk assessment with AHP
2014	Alises et. al	Commercial risk impact; container terminal study case	Estimation of financial calculation (overtopping value)
2014	Alyami et. al	Terminal planning, process and evaluation on port service operation	FMEA and Fuzzy rule-based Bayesian Networks (FRBN)
2015	Loh & Thai	Port operation and supply chain operation on port service	Structured risk equation model
2015	Lee-Lam & Shiling-Su	Risk operation impact cost	Inventory and transportation cost comparison
2015	Lee-Lam & Shiling-Su	Demonstration and natural disaster risk mitigation	Preventive and reactive framework to decrease likelihood and severity
2017	Lee-Lam & Lassa	Facility and cargo risks due to natural disaster & climate	Multi risk and consequence assessment
2017	Loh et. al	Evaluation and planning of port operation availability	Fuzzy based comprehensive method evaluation
2018	Heikkila	VGM effects on Finnish maritime operation	Survey regarding application of VGM in Finland



2019	Chao & Lee-Lam	Influence from bad weather & macro economic impact	Risk management model simulation
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Table 1 shows the previous researches regarding disruption at maritime operation. Furthermore, it appears that maritime operations are highly susceptible to disruptions. Firstly, some researches have shown that natural disaster made great impact to maritime business as it generated the highest impact due to disruption events such as economic loss and downtime (Lam & Su, 2015; Lam & Lassa, 2017; Cao, 2019). Another findings are operational risk like equipment breakdown or failure and shortage of facilities may are the key factors in causing great disruptions in maritime operations (Loh et al, 2017). Final findings from disruption in maritime operation are its economic impact (Alises, 2014). Port plays a crucial role in supply chain activities thus it's a risky activity. If port is disrupted, it induces to great economical loss but not limited to port operators only, it also affects other stakeholders in supply chain activities. Every disruption study mentioned above were acknowledged in risk assessment context and could be escalated to disruption scale if the risks are not properly handled. Therefore, disruption management is an important issue in the context of business continuity management system. Another important issue in the application of business continuity management is periodic evaluation of relevant stakeholders (Daszuta & Ghosh, 2018).

When an organization experiences business interruption or disruption and experience losses then to reduce such losses, steps can be taken to guarantee the continuity of business processes and in general these steps are consisted of 4 parts (Barnes, 2001; Hiles, 2007; Herbane, et al., 2010):

- 1 Protection measures, to maintain the system from disturbing events and prevent damage to the system. If the protection measures are successful, the business process will not be disrupted.
- 2 Mitigation steps, which are automatically activated when the protection step is fail and the initial damage has been caused by a disturbing event. The purpose of the mitigation step is to make changes from disruptive events in the initial stages of development, so that damage can be reduced.
- 3 Emergency actions, which occur when failed mitigation measures will contain damage, and often require significant human intervention.
- 4 Step recovery, which aims to rebuild normal operations.

BCMS performance depends on the implementation of BCMS requirements that cover organizational context, leadership commitment, planning, support, operational requirements, evaluation and performance improvement (Torabi, 2016). On a research conducted by (Benavente, 2016), one of the particular findings include the significance of business continuity plan (BCP) in line with requirements for the development of a business continuity management, as stated in ISO:22301.

## 2.3 Business Continuity Plan

Business continuity plan (BCP) is the process of creating a prevention and recovery system for potential threats to a company, mainly when facing major disruption such as natural disasters, technological operation errors, human error or terrorism



(Ozier, 1999; Watters & Watters, 2004; Snedaker & Rima, 2007). The purpose of the business continuity plan is to minimize the company's financial losses, provide services to customers and other stakeholders, and mitigate negative impacts that can disturb companies (Snedaker & Rima, 2007; ISO, 2012).

The BCP framework was made using a general format, to ensure that all plans are appropriate and to determine the priorities of testing and maintenance. Each plan must be clearly defined with the conditions under which the plan will be carried out, and the person responsible for carrying out each plan. Different approaches may be needed for each service, business function or part of the organization, it is recommended to add a plan to the additional parts added (Fani & Subriadi, 2019).

For BCP in the maritime industry, especially port and harbour, an example could be taken from the development of Business Continuity Management Plan for port operations after the aftermath of Great East Japan Earthquake in 2011 (GEJE2011) which causes serious damages to port facilities in the eastern Japan, resulting in huge economic losses due to long continued supply chain disruptions. Ono (2016) found that systematic analysis procedures for establishing business continuity planning in ports are vital for maintaining continuity of logistics infrastructure services and a variety of business activities in ports. The analysis of applying Area BCP for coordinated damage mitigation measures and recovery actions by (Baba, et al., 2014) suggests that BCP should provide essential information needed for estimating damages or for sharing business resources.

## **2.4 Business Impact Analysis**

Business impact analysis (BIA) is an important part of BCM that functions to analyse business activities and the impact of incidents that may occur of these activities (ISO: 22301, 2012). BIA and Risk Assessment (RA) are the main products that can be able to the basis of developing strategies to reduce the impact of these incidents (Snedaker & Rima, 2014). The results of the BIA process are a list of the main products of business activities, measurement of maximum time period disruption (MTPD) and minimum business continuity objectives (MBCO) of each main product and identify important functions of each product (Torabi, 2016).

The maximum tolerable period of disruption is used to determine the maximum time after disruption where it needs to be fixed and the maximum length of time to recover under normal conditions. For the purpose of minimum business continuity objective is the level of activity that must be restarted (Hiles, 2007). BIA is used to analyze the organization to assess operational and financial losses. In operational losses related to non-monetary effects such as people, processes and technology affected by disruption incidents. For financial influence on revenue, costs and business sustainability (Snedaker & Rima, 2014). BIA will be combined by RA to develop mitigation strategies (Snedaker & Rima, 2007). In this study the method used by RA is the House of Risk. BIA will analyze the impact of each potential risk that can arise. With this BIA, it will be easier for organizations to prioritize business activities that are restored in the event of disruption.

## 2.5 House of Risk Method

House of Risk is a supply chain risk management model which is developed from House of Quality method and Failure Modes and Effect Analysis (FMEA) (Pujawan & Geraldin, 2009; Lutfi & Irawan, 2012). The main difference between FMEA and HOR is FMEA uses risk potential number (RPN), which only associates probability and severity with the risk events (Sinha, et al., 2004). In HOR, aggregate risk potential (ARP) is assigned from probability to the risk agents and the severity to the risk events (Pujawan & Geraldin, 2009). The main objective of HOR is identify the risks that could happen and the consequences if it happened. The risk agents and their associated probabilities are also assessed.

In the identification step, the supply chain model must be listed using Supply Chain Operation Reference (SCOR) Model which includes:

- 1 *Plan*: a process of balancing demand and supply to decides which action suits best to meet procurement, production, and delivery.
- 2 *Source*: procurement process of products/services to meet demand.
- 3 *Make*: process of changing raw goods into finished goods desired by customers.
- 4 *Deliver*: process of fulfilling the demands of goods and services
- 5 *Return*: process of returning or receiving a returned product for some certain reasons.

HOR model is modified slightly in order to accommodate maritime operation as a clustered business processes (Shi, et al., 2020), rather than viewing it as a supply chain process, maritime operation is analyzed as an interdependent business's functions. Furthermore, the modified model is still focused on the ranking risk agents aggregate risk potential. Therefore, it is necessary to identify the risk events and their risk agents. In this model House of Risk aims to acquire Aggregate Risk Potentials of the identified risk agents and can be used for prioritizing preventive actions. In making that decision, pareto principle will be used to determine which risk agents should be the primary concern. Using the 80/20 rules, ARP value under 80% will be clustered as the 20% groups.

## 3 Research Process

This chapter explains the approach taken for achieving the research's main goals as explained on the first chapter. Namely identifying & ranking disruptions, business impact analysis, and determining business continuity value. All carried out according to relevant theories explained on the second chapter.

### 3.1 House of Risk

The first step is to identify the potential risk events that any organization faced. The identified risk agents are assessed based on their severity. In this study, a questionnaire with four point rating scale (for correlation) five point rating scale (for

risk events and risk agents) was designed to measure the users' perceived value of the risk agent frequency, risk event severity, and the correlation between the two of them. The interview period is from February until June 2020 using online systematic questionnaires on the level of BIA, the previous BCP and specific strategies in managing the pandemic based disruptive risks, with the total of 40 respondents consisted of at least senior managers across 4 container terminals (Semarang container terminal, Teluk Lamong container terminal, Berlian container terminal, and Surabaya container terminal) & maritime operation company. It is important to note that the respondents are directly handling the maritime operation during the COVID-19 disruption, so the result will be mirroring the actual reality. Below are the identified risk events in container terminal, based on the results of questionnaire surveys to related employees.

**Table 2** List of identified risk event

<i>Code</i>	<i>Disruption Risk Event</i>	<i>Source</i>
E1	Interrupted stevedoring process	(Heikkila, 2018)
E2	Interrupted berthing operation	(Gurning & Cahoon, 2011)
E3	Reduced ship traffic	From direct interview with correspondent
E4	Human safety incident	(Schachler & Navare, 2010)
E5	Unavailable truck	(Alyami, 2014)
E6	Disrupted port schedule	(Heikkila, 2018)
E7	Negative company's image	From direct interview with correspondent
E8	Reduced tug availability	From direct interview with correspondent

The risk event identification table above shows multiple maritime operations that affected with the COVID-19. The list is collected from literature review and through interview with correspondents. Mainly, all activities are person-related as the corona virus attacks human being. All activities are potentially disrupted since the activities are conducted by person. Stevedoring activities are already risky before the pandemic due to container weight failure and it may disrupts port schedule (Heikkila, 2018) and increasing the risk of safety incident (Schachler & Navare, 2010), as the pandemic started it is affected since there is a restrictions to reduce staff at work and both operations might be disrupted. Same thing applies to truck availability and warehouse activity (Alyami, 2014), due to the restrictions there were no truck drivers available and the goods are piled up in the warehouse. From interview with correspondents, other potential disrupted activities are shown on the table as those are real impact that occurs in real maritime operations due to COVID-19.

The next step is to identify the risk agents that could cause the one or multiple risk events. Then assess the frequency of occurrence of each risk agents. Below are the identified risk agents.

**Table 3** List of identified risk agent

<i>Code</i>	<i>Disruption Risk Agent</i>	<i>Source</i>
A1	Power outage from port's electricity source	(Loh & Thai, 2015)
A2	Lack of employees due to restrictions	From direct interview with correspondent
A3	Cyber Attack from hackers	From direct interview with correspondent

A4	Failure due to communication system amongst operator	(Loh & Thai, 2015)
A5	Staffs and employees are infected with the virus	From direct interview with correspondent
A6	Ship owner decision due to COVID-19	From direct interview with correspondent

The risk agents on table 3 shows the agents which play an important role to an event to occurs, each agent could be the source of the risk events mentioned in table 2. As mentioned before, mainly the COVID-19 is affecting to activity conducted by a person. It should be noted that, the regular risk still has the probability to occurs without COVID19. Regular risk such power outage (Loh & Thai, 2015), cyber attack and communication issue (Loh & Thai, 2015) is even more often to occur under this pandemic. The highest concern under this pandemic is the shortage of staff due to restriction from government. In Indonesia, there is a regulation that the number of employees at work needs to be reduced due to the fear of spreading the virus at work.

The third step is to make a correlation table between risk events and risk agents. The causality risk events on table 2 and risk agents on table 3 are examined and put down together in the correlation table below.

**Table 4** Correlation between risk event and risk agent

<i>Code</i>	<i>Disruption Risk Event</i>	<i>Code</i>	<i>Disruption Risk Agent</i>
E1	Interrupted stevedoring process	A1	Power outage from port's electricity source
		A2	Lack of employees due to restrictions
		A4	Failure due to communication system amongst operator
		A5	Staffs and employees are infected with the virus
E2	Interrupted berthing operation	A2	Lack of employees due to restrictions
		A4	Failure due to communication system amongst operator
		A5	Staffs and employees are infected with the virus
E3	Reduced ship traffic	A1	Power outage from port's electricity source
		A6	Ship owner decision due to COVID-19
E4	Human safety incident	A2	Lack of employees due to restrictions
		A4	Failure due to communication system amongst operator
		A5	Staffs and employees are infected with the virus
E5	Unavailable truck	A2	Lack of employees due to restrictions
		A4	Failure due to communication system amongst operator
		A5	Staffs and employees are infected with the virus
E6	Disrupted port schedule	A2	Lack of employees due to restrictions

E7	Negative company's image	A4	Failure due to communication system amongst operator
		A5	Staffs and employees are infected with the virus
		A6	Ship owner decision due to COVID-19
		A2	Lack of employees due to restrictions
		A3	Cyber Attack from hackers
		A5	Staffs and employees are infected with the virus
E8	Reduced tug availability	A2	Lack of employees due to restrictions
		A4	Failure due to communication system amongst operator
		A5	Staffs and employees are infected with the virus

As mentioned before, every event shown on Table 4 is person related. Every event might happen due to shortage of staff. In Indonesia, restrictions are enforced to minimize the spread of the virus. Consequently, several operations might be disrupted due to shortage of staff or operator. Overall, every disruption risk event is induced by 3 main risk agents like lack of employees, failure of communication, and staff and employees are infected with the virus. Due to the restrictions, few companies might experience shortage of staff or due to the virus infection. The shortage itself is inflict failure of communication on the field.

Since one risk agent may lead to several risk events, it is necessary to calculate the aggregate risk potentials of each risk agents. The ARP could be calculated using the following formula. With  $S_i$  as the severity of each risk events and  $R_{ij}$  as the frequency of each risk agents.

$$\text{Aggregate Risk Potential (ARP)} = \sum_j S_i R_{ij} \quad (1)$$

### 3.2 Business Continuity Value Formulation

Business continuity management offers great potential benefit but the complexity of the problem is most BCM strategies are based on qualitative methods, and this limits practical application. Very few works concern the quantitative modeling and analysis of business continuity, most research about BCM and BCP is to produce a better approach on framework (Gibb & Buchanan, 2006) (Snedaker & Rima, 2007; Herbane, et al., 2010). No clearly-defined business metrics have been defined from previous studies, which makes it difficult to measure how a Business Continuity Management is performing under such tasks. (Zeng & Zio, 2017) define a set of quantitative business continuity metrics. The defined metrics are based on the estimated losses incurred by the disruptive event in the whole business process. The physical meaning of Business Continuity Value is the relative difference between the losses caused by the disruptive events and the maximum losses that an organization could stand.

$$BCV = 1 - (LT / LTol) \quad (2)$$

BCV is defined based on the expected losses LT which includes both direct losses and indirect losses, and Ltol represents the maximum tolerable losses for an organization for practical applicability. The standard deviation of business continuity value (SDBCv) is also measure with the following equation.

$$SDBCv = \sqrt{\frac{\sum (x_i - \mu)^2}{N}} \tag{3}$$

## 4 Results and Discussion

This chapter discusses the results and findings from carrying out the approach from the previous chapter, and how the results relates to each other.

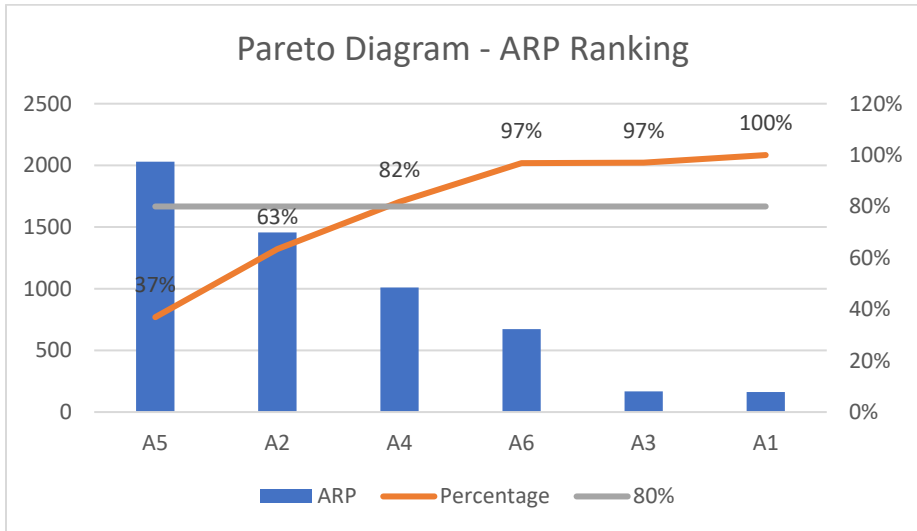
### 4.1 Major Disruption from House of Risk

**Table 5** ARP value result

<i>Code</i>	<i>Risk Agent</i>	<i>ARP</i>	<i>Rank</i>	<i>ARP%</i>
A5	Staffs and employees are infected with the virus	2030	1	36.9%
A2	Lack of employees due to restrictions	1456	2	26.5%
A4	Failure due to communication system amongst operator	1010	3	18.4%
A6	Ship owner decision due to COVID-19	672	4	12.2%
A3	Cyber attack hackers	168	5	3.1%
A1	Power outage from port's electricity source	162	6	2.9%

The table above shows every risk agent aggregate risk potential, calculated using equation (1). Based on the table above, the highest rank of risk result is A5 or staff and employees are infected with the virus. As mentioned before, the risks shown is person related because of the virus. A5 gets the highest result because it induces almost of every risk event as shown on table 4. While A5 is the highest, A1 or power outage is the lowest level because it only induces 2 events with low severity level.

Pareto rules stated that for many events, around 80% of these events originated from the 20% of the causes. Based on the diagram below, A5 and A2 contribute the most to maritime operations disruption due to COVID-19. A5 and A2 cause a big impact since they are the agents that directly infected with the virus. Both A5 and A2 are categorized as the 20% of the cause that contributing to the 80% of the events. If employees infected with the virus, company's operations might be disrupted since shortage of employees might interrupt the operations. The fact that employees might infected with the virus is justifying the restriction policy from the government. This restriction leads to shortage of employees on the field hence maritime disruptions is highly to occur.



**Fig. 3** Pareto diagram of ARP

The orange line above is the distribution of the accumulation of the ARP value. Based on table 5 above, the contribution from each risk agent is shown by the percentage value. HOR method has no parameter to conclude if any ARP value is considered as major or minor. In order to determine the result, Pareto rules is used in here to conclude that decision. In order to obtain the 20% of the causes that contribute to the 80% of the events, accumulation of ARP value is added up sequentially based on the rank. From the accumulation value, each accumulation ARP value is calculated to get the accumulation percentage value. Based on the diagram below, A5 and A2 are concluded as the major risk as both valued under 80%. The intersection between the grey and orange line is the border that clustered the 80% group and 20% group It means, both risks contribute the most to the disruption events to occur.

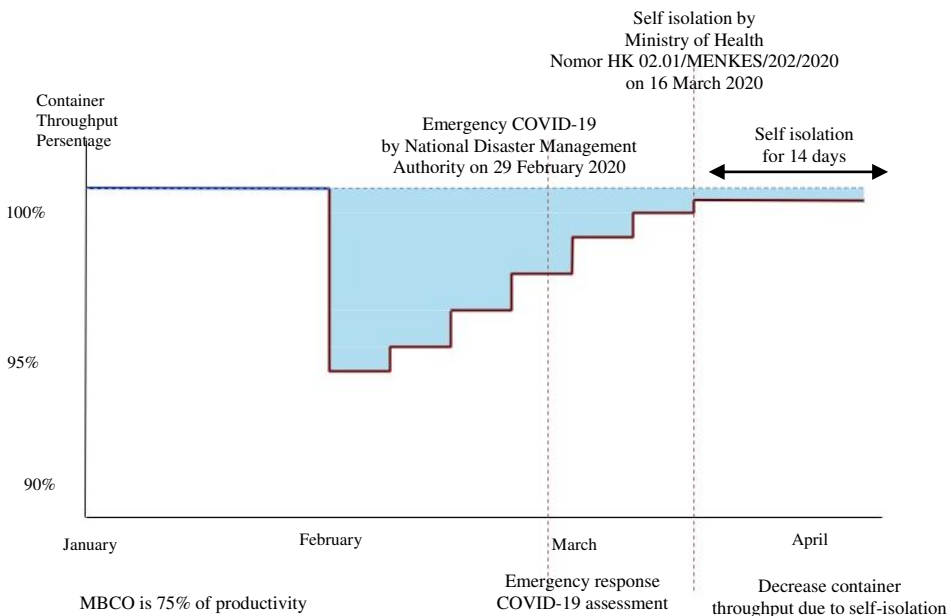
## 4.2 Business Impact Analysis and Business Continuity Value

After identifying and ranking the disruptions caused by the COVID-19 based on their aggregate risk potentials, the next analysis will be focused on how the disruptions impacted the business with business impact analysis (BIA), and measure how effective the implementation of business continuity management in the context of minimizing loss of productivity through business continuity value (BCV). Torabi (2014) states that it is necessary to determine a business continuity objective or productivity, and maximum tolerable period of disruption in order to measure the impact of a disruption. For measuring the disruption impact on maritime operation, container throughput is used as a quantitative metric for productivity. The company’s risk register acts as the risk appetite, indicating the company’s tolerance and behaviour towards risk, which is important in determining the maximum tolerable period. The risk register determines the MBCO is 75% of the normal productivity, so the reduction cannot be more than 25% from the previous period (2019).

Below is a graph showing further analysis of business productivity during

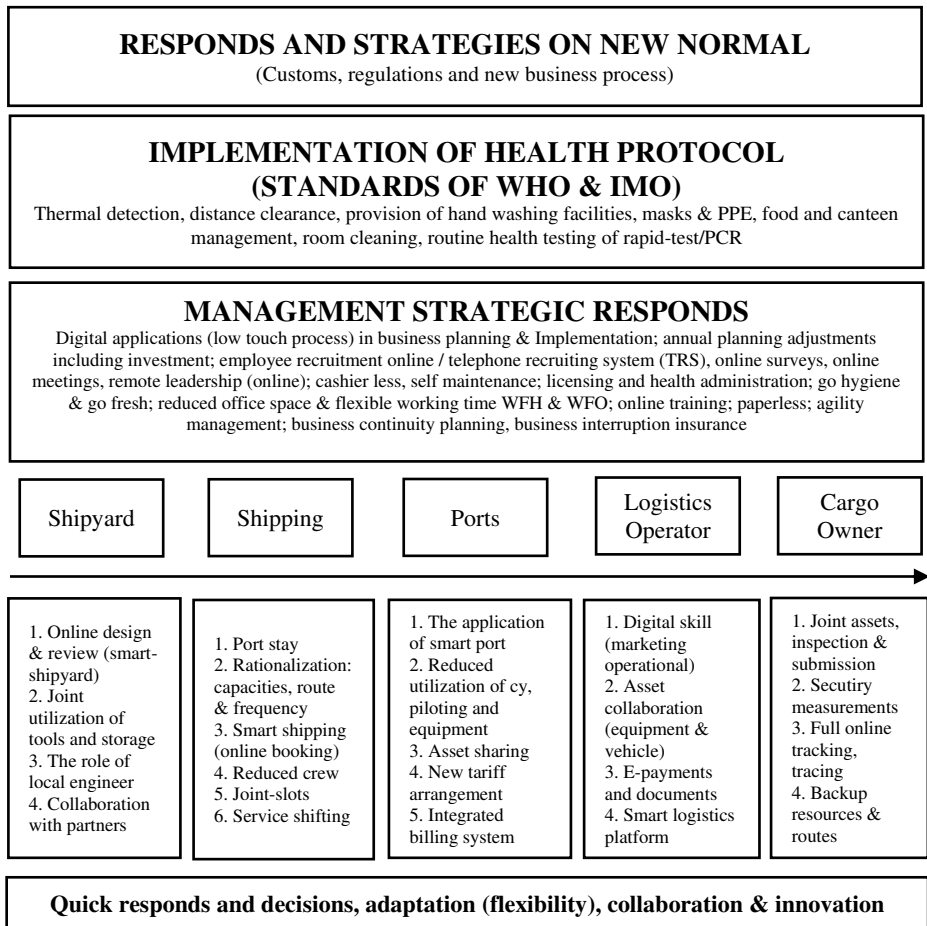


COVID-19 from figure 2. Figure 4 shows the impact analysis of COVID-19 on continuous throughput on maritime operations, as seen previously on Figure 2. Seen on the graph, there was a decrease in activity in the month from normal conditions (100%) to 93.6% in February. This decrease can be caused by risk agents in table 4, such as: failure due to communication system amongst operator, power outage from port's electricity source, cyber attack from hackers, staffs and employees are infected from COVID-19, lack of employees due to social restrictions and contaminated good. After conducting a risk assessment at the HOR stage it was found that the highest risk occurred was the staff and employees are infected from COVID-19, those risks which have the potential to cause a decrease in container throughput. But the graph shows there was an increase slowly from 93.63% on February to 97.93% on March and continue to increase until 99.38 % on April.



**Fig. 4** Business impact analysis during COVID-19

In February there was a decline from the optimal conditions in container throughput in maritime operations. This can occur due to lack of preparation from the maritime operations in response to COVID-19 until the percentage of continuous throughput decreased from normal condition by 7%. However, this condition has increased from February to April. This increase was due to the management of maritime operations taking action to anticipate the COVID-19 pandemic since the announce from Indonesia National Disaster Management Authority (NDMA) of COVID-19 became a national threat and even in February the prevention was carried out. With this action, the business function in the maritime operations will continue to recover. In 4 months, the impact of COVID-19 on maritime operations is not significant, the impact is far from the minimum business continuity objectives that have been set. Especially after the implementation of mitigation based on BCM in every operational activity related to applicable regulations so as to make an insignificant impact.



**Fig. 5** Diagram of respond and strategies for COVID-19 pandemic

The figure above is a diagram that underlines important concepts in dealing with COVID-19 disruption in each component of maritime operations. In its implementation, each component has some technical differences in implementation in the field, but has one thing in common, namely the use of health protocols created by World Health Organization & International Maritime Organization, such as thermal detection, physical distancing, supervision of hand washing facilities, and routine health tests using rapid-test / Polymerase Chain Reaction. The management strategy that underlies every technical implementation also remains the same, such as the use of online platforms for meetings, surveys, training, payments and other interests will become the new normal in every component of maritime operations. The exercises of working from home also could benefit using online platform. Business Continuity Planning is one of the responses that must be implemented because its flexible framework can be used in different configuration of the company, and also has standards that can be used as guides & guarantees that its implementation is not careless. Business Continuity Planning will bring up different procedures in each company, such as in Shipping Companies, Port Stay &

Capacities rationalization will be the main consideration in developing response procedures to COVID-19. When in a Port Company, the application of smart ports and new tariff arrangements will be crucial to the implementation procedures when business functions cannot run 100%. While as a Logistics Operator, the use of digital skills for operational marketing and full exercise of smart logistics platforms will prove to be valuable when it is no longer possible to meet customers face to face. All of the above technical steps will be more likely to be executed properly when the decision response is fast, and there is an appropriate adaptation in collaboration and innovation. Implementing the concepts above will result in fast and gradual recovery as seen on figure 4.

The causality between gradual recovery and business continuity management can be measured through the business continuity value. A negative value of BCV means that the total loss is higher than tolerable loss which is unacceptable. When BCV value of  $0 < BCV < 1$  meaning the business has actually make profit from the utilization of Business Continuity Plan. The formulation will use throughput productivity growth data from January until April, compared to the previous year that is considered as the ‘normal’ productivity growth level before COVID-19 pandemic February is considered as the start of COVID19 pandemic & the start of Business Continuity Planning utilization on the company. The maximum tolerable loss is acquired from the company’s risk register. Result of calculation based on equation (2) can be seen on table 6.

**Table 6** Business continuity value based during COVID-19 affected period

<i>Period</i>	<i>Loss of Productivity (<math>L_T</math>)</i>	<i>Maximum Tolerable Loss (<math>L_{tol}</math>)</i>	<i>Business Continuity Value (BCV)</i>
January – February	(-) 20,338 TEUs	248,145 TEUs	0.918
February – March	(+) 4,526 TEUs	233,471 TEUs	1.019
March – April	(+) 3,012 TEUs	265,184 TEUs	1.011

The business continuity value shows that the company does not suffer any significant loss during the COVID-19 disruption. With the standard deviation (SDBCv) derived from equation (3) is 0.046, this means that the loss caused by COVID-19 disruption is subject to 0.046 standard deviation. January-February period experience loss of productivity growth in the amount of 20,338 TEUs. Compared to the previous year, it measured as 6.1% of decreased productivity growth, which makes the business continuity value below 1, loss is experienced but still in the tolerable area. However, February-March and March-April does experience direct loss of productivity as seen on figure 2, which noted (+) on table 6. But compared to the previous year, the productivity growth during February-March and March-April has actually increased. To be exact the productivity growth has increased 1.5% and 0.9% respectively, making the business continuity value greater than 1 which means the business continuity management is already making profit for the company. This is most likely due to correct implementation of business continuity management as seen on figure 4.

### 4.3 Recommendation

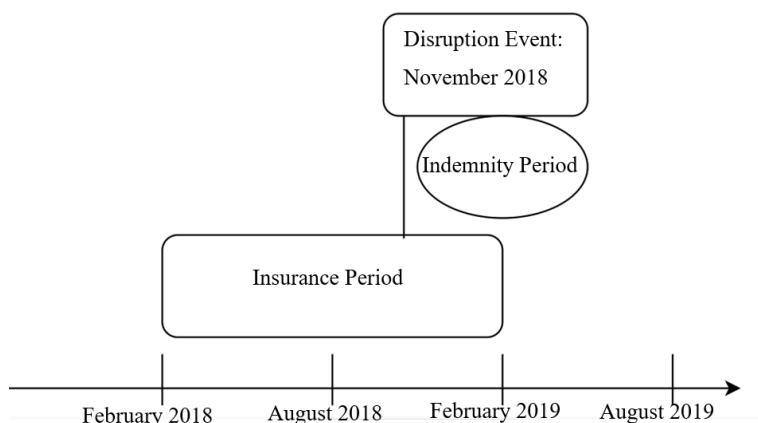
Business continuity plan is a crucial instrument for any organization to recover from disruptions. Amongst many other important things, economic recovery plan plays a pivotal role in the aftermath of a disaster. A tool to overcome this issue is insurance. Insurance is an agreement between two parties where one party has an obligation to pay premiums, while the other has an obligation to give compensation to the insured as disruption occurs. Based on (Chen, 2016) study, insurance is a tool to help transferring the risk from the insured to the insurer party. Under the risk management concept, the risks faced are moved to insurer.

Business Interruption Insurance has been widely used by all lines of industry as a method of business recovery from disruption. BII is an insurance that provides compensation to the insured party from all events that disrupt their business. Business Interruption Insurance is an extension of All Risk Property Insurance (PAR). This includes disturbances such as fire, lightning, explosion, flood or any event that causes material damage. Therefore, the insured cannot make a profit because his assets are damaged and cannot generate profits.

BII will bear the costs incurred by the insured to maintain their business and loss of net income during the indemnity period. Each expense is referred as an increase cost of works and the net profit of the business will refer to net income one year prior the disturbing event. One research regarding disruption of logistics business is applying BII (Zhen et al, 2016) as their recovery method. It shows a vigorous reason to apply BII to reduce profit loss due to disruptions and to minimize the downtime period.

Figure 6 depicts how the BII policy applies. It is illustrated that disruption events began in November 2018 until May 2019. BII insurance covers all loss incurred from the event. The indemnity period is over when the disruption ends. It means BII will replace all losses arising from disruption so this insurance policy can be used as a recovery tool. From table 6 above, it shows from January – February they suffer loss of productivity as many as 20,338 TEUs. With the help of BII, those loss could be covered by insurance. On top of that, one thing to consider is if the probability of disruption is less than the premium rate, then BII is not necessary (Zhen et al, 2016). The world has seen the COVID-19 virus spread across the world. The impact it had on the economy has been devastating.

This pandemic can be considered as a disruption since this virus is interrupting both small and big scale businesses. Referring to Business Interruption Insurance, this policy has played a major role in business recovery from disruptions. Under any common disruptions, BII is widely used to protect their business from loss. Both (Dong & Thomlin, 2012) have made their research the interplay between operations and insurance. They have found that the value of insurance coverage is noteworthy when disruptions occurred in long period and extremely rare. It is important to note that in insurance industry, the premium rate of BII tend to be expensive. It covers business losses but at great price of premium rate. If the business is facing a great potential disruption, it might worth considering taking BII to protect the business.



**Fig. 6** Business interruption insurance

To make sure if any business is protected from loss due to COVID-19, the management should check what perils is covered under their insurance policy. Most BII requires physical damage on the policy, but since the Severe Acute Respiratory Syndrome (SARS) outbreak there has been a policy called communicable disease rider. It is an expansion of policy scope to protect from pandemic and other outbreak that gives compensation if the business is forced to close due to a disease. Under some conditions, it might not be accepted if the claim for losses is not linked directly to property damage. As this pandemic already happened, the claim can't just be done because insurance company won't cover loss that already happened or it won't cover for a pre-existing loss. This extension coverage might be needed again in the future as we have witnessed the impact from outbreak has given to business. Regarding maintaining the availability of the workforce, it also recommended to establish cooperation with outsourcing organization. Utilizing the outsourced resources also have to consider the company's structure and how the business processes are influenced by outsourcing in various levels, parameters should be set in order to clarify the responsibility held the outsourced workers (Vaxevanou & Konstantopoulos, 2014).

In order to minimize the number of employees getting infected by the COVID-19, the company is also recommended to tackle this issue by implementing staff and crew substitution. According to (Azizi, et al., 2010), employee's boredom and effect of substitution intervals could deteriorate the worker's motivation and skill in learning. So in order to avoid further increase of employee number of infection, the company need to take into account the worker's level of productivity when implementing the rotation plan

## 5 Conclusion

This paper focuses on the effect of performing business continuity management

during COVID-19 disruption on maritime operation. A disruption risk identification using House of Risk method is conducted in order to identify the major contributors of loss from disruption. It is found infection of the virus to employees is the biggest contributor towards loss from disruption, followed by lack of employees due to restrictions. Furthermore, business impact analysis is also conducted to understand the timeline of how the company recovers from the disruption, taking important dates into account, resulting the graph on figure 4. In addition, business continuity value is determined by analysing the productivity growth data during COVID-19 affected months and comparing it to previous year. It is proven that the expected business continuity value is 0.985 with standard deviation of 0.051, which means the business loss is still on the tolerable area. Insurance might be the alternative as recovery resources from disruptions. Suitable insurance should be selected in accordance with the disruptions faced, since common Business Interruption Insurance is not suitable with pandemic disruption. Under the constraint of time and resources, it is concluded that implementing business continuity management could significantly lessen loss caused by disruption on maritime operation

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# Figures



Figure 1

BCM research trend 2000-2020

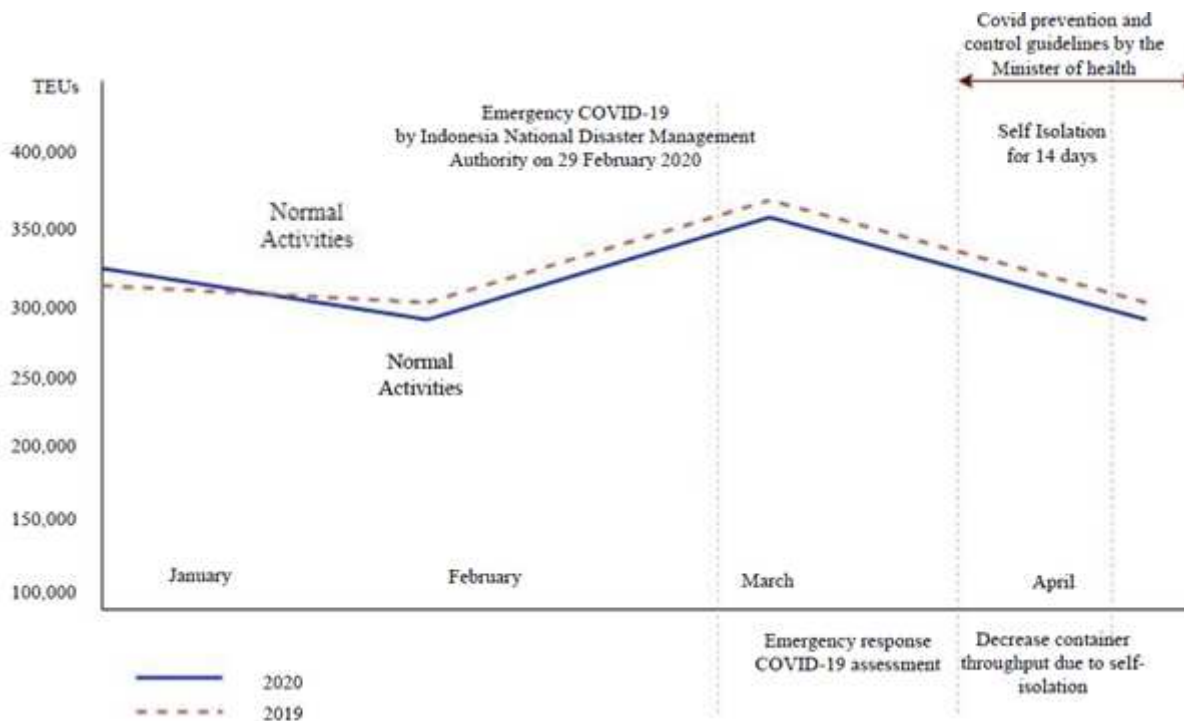
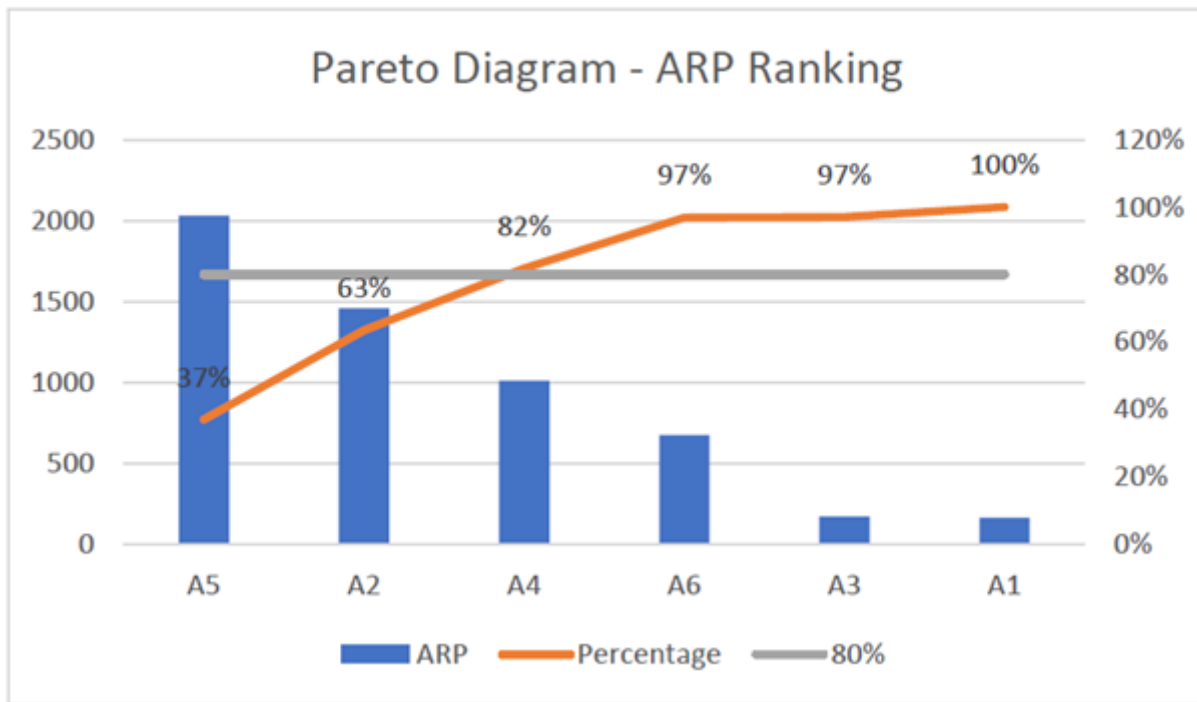


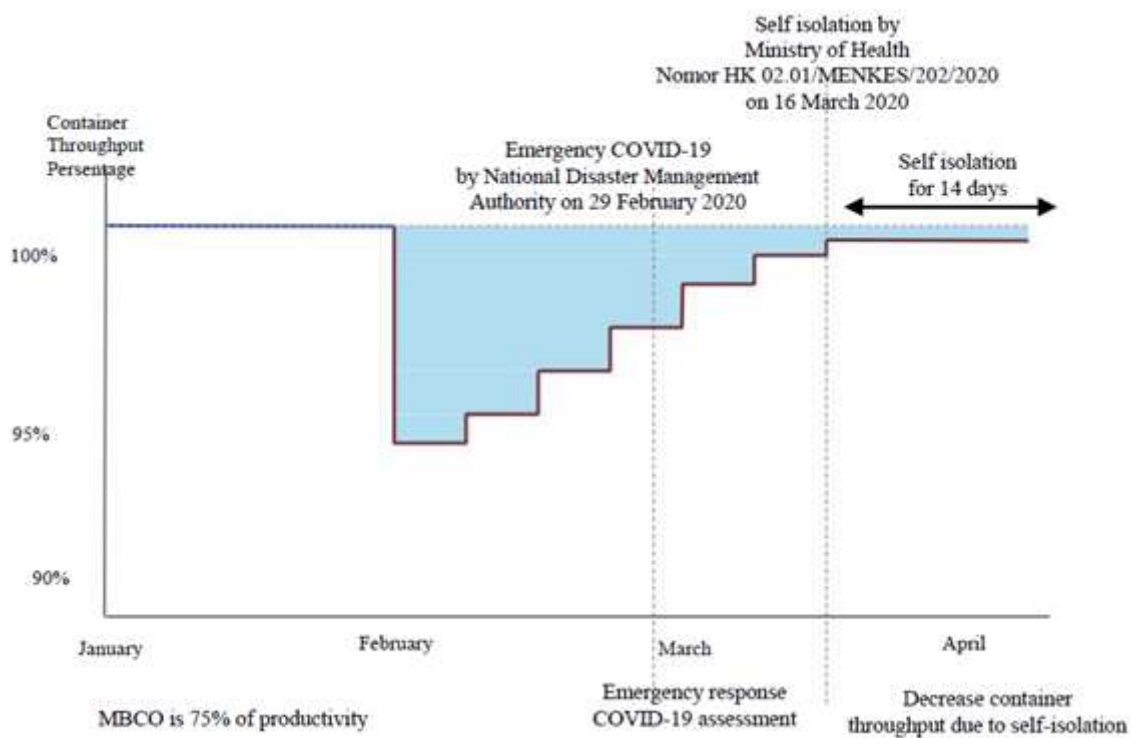
Figure 2

Productivity changes during COVID-19 pandemic



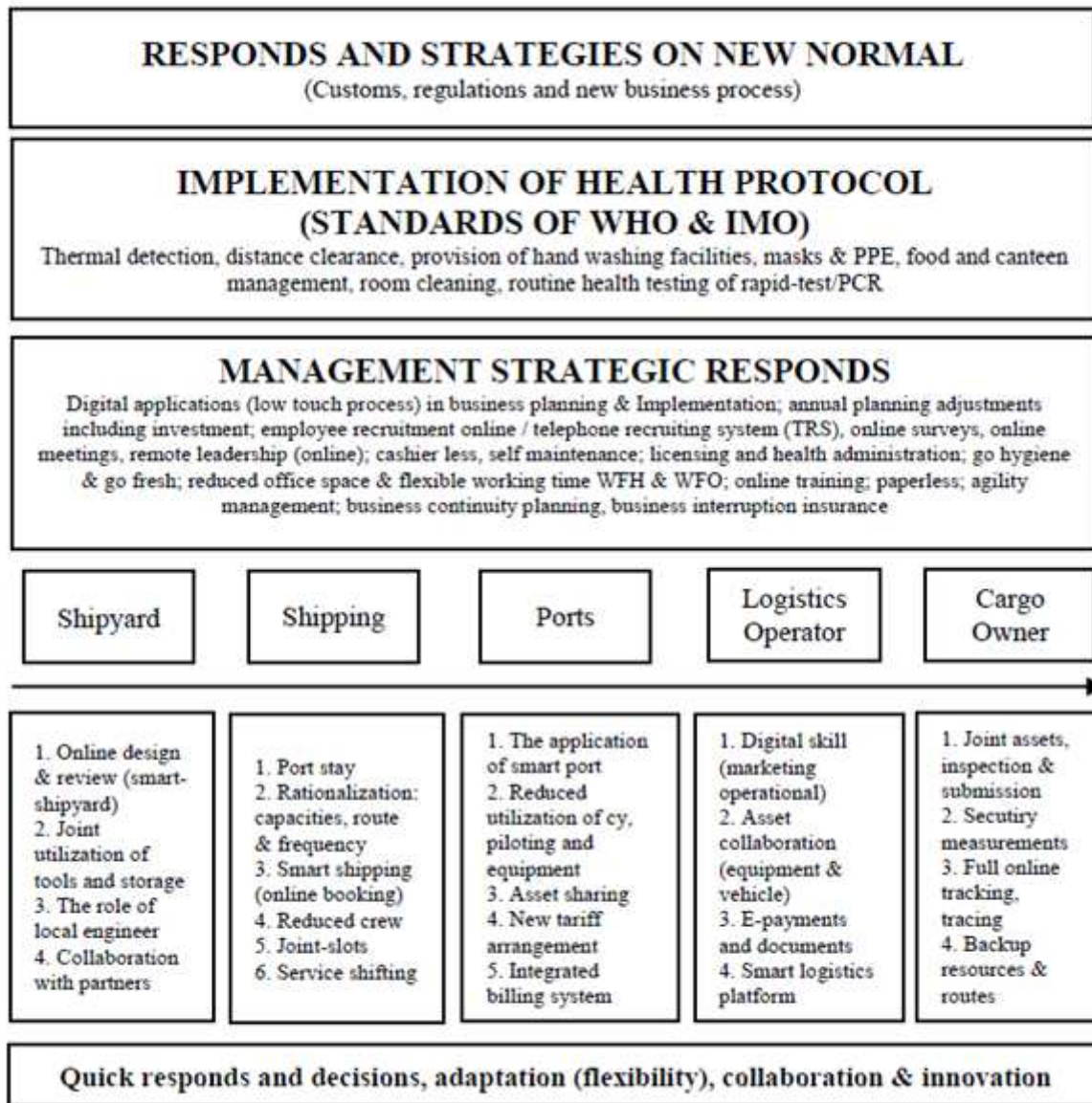
**Figure 3**

Pareto diagram of ARP



**Figure 4**

Business impact analysis during COVID-19



**Figure 5**

Diagram of respond and strategies for COVID-19 pandemic

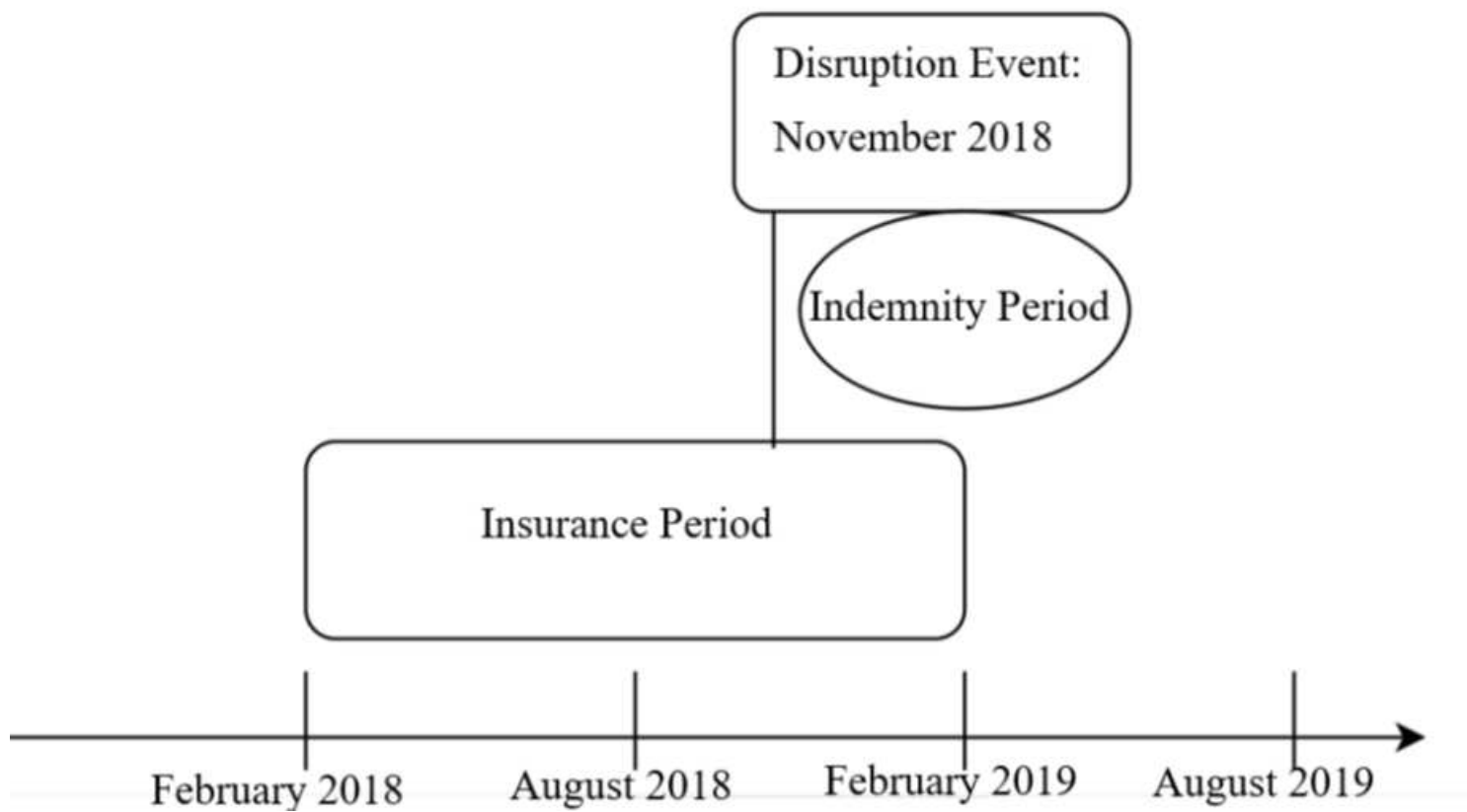


Figure 6

Business interruption insurance