#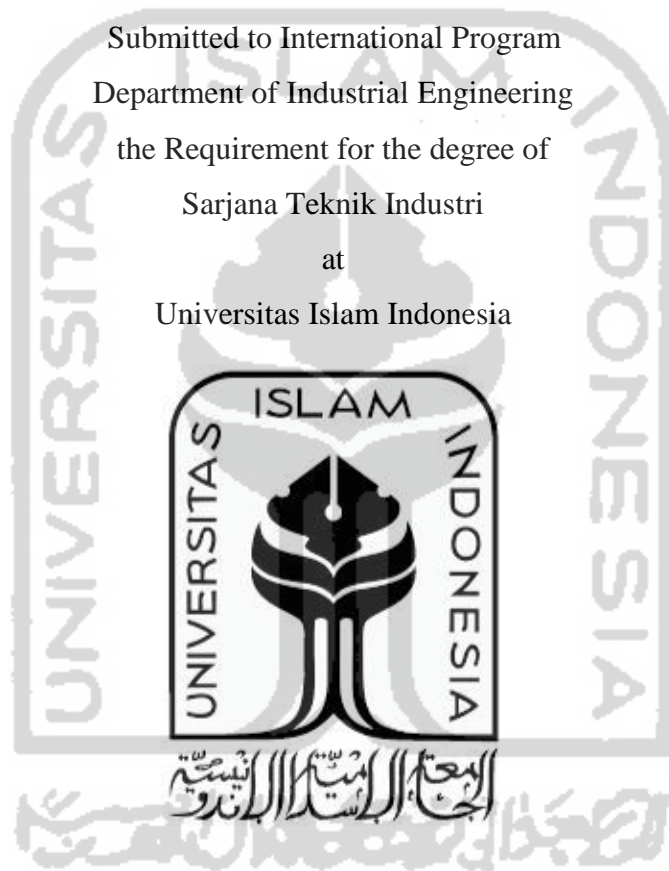 SUPPLY CHAIN RISK MANAGEMENT ON SCHOOL UNIFORM PROCUREMENT USING SUPPLY CHAIN OPERATIONAL REFERENCE (SCOR) AND HOUSE OF RISK (HOR) (AT SEKOLAH BINA NUSANTARA BATAM)

THESIS

Submitted to International Program

Department of Industrial Engineering

the Requirement for the degree of

Sarjana Teknik Industri

at

Universitas Islam Indonesia

By

Afif Al Akbar (16522121)

INTERNATIONAL PROGRAM

DEPARTMENT OF INDUSTRIAL ENGINEERING

UNIVERSITAS ISLAM INDONESIA

YOGYAKARTA

July 2020

AUTHENTICITY STATEMENT

AUTHENTICITY STATEMENT

For the sake of Allah SWT, I admit this work is the result of my own work except for the excerpts and summaries from which I have explained the source. If in the future it turns out that my confession is proven to be untrue and violates the legal regulations in the paper and intellectual property rights, then I am willing to get a diploma that I have received to be withdrawn by the Islamic University of Indonesia.
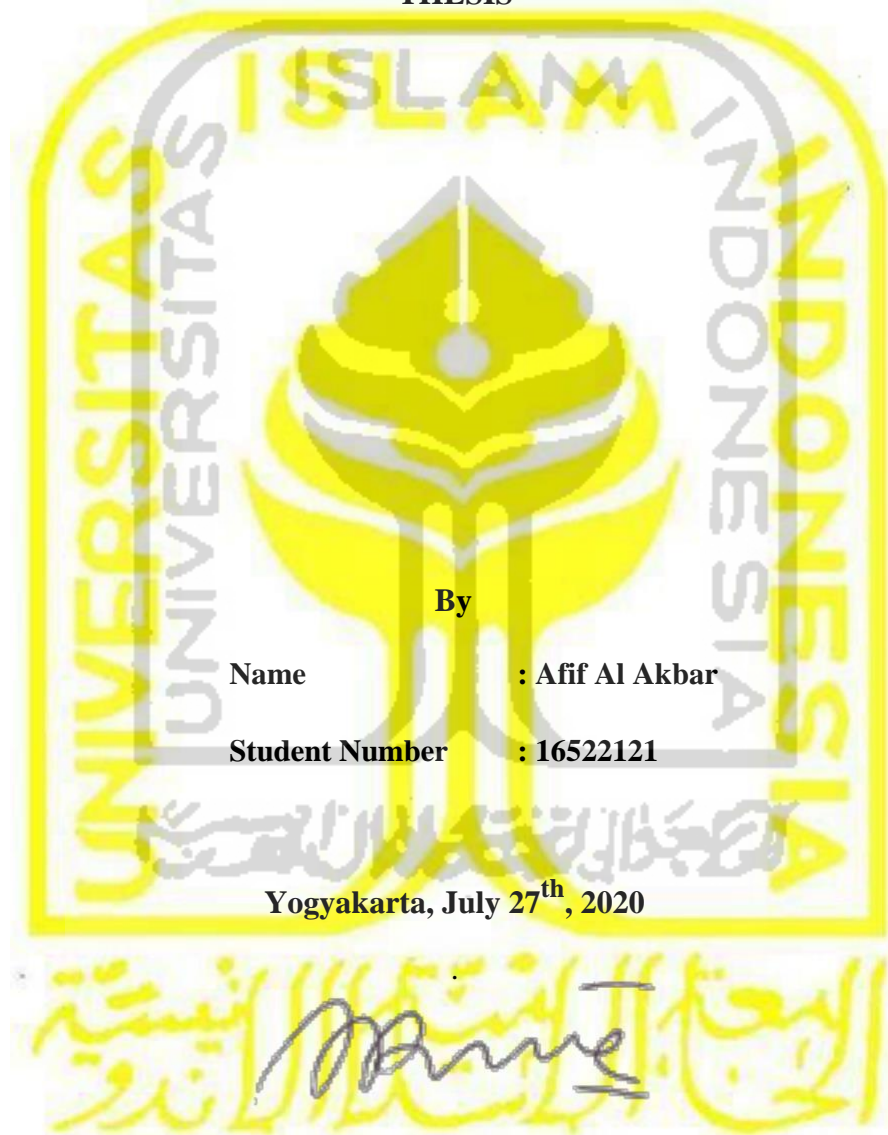
Yogyakarta, July 27th, 2020

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(Afif Al Akbar)

SUPPLY CHAIN RISK MANAGEMENT ON SCHOOL UNIFORM PROCUREMENT USING SUPPLY CHAIN OPERATIONAL REFERENCE (SCOR) AND HOUSE OF RISK (HOR) (AT SEKOLAH BINA NUSANTARA BATAM)

THESIS

By

Name   **: Afif Al Akbar**

Student Number   **: 16522121**

Yogyakarta, July 27th, 2020

(Dr. Ir. Elisa Kusrini, M.T., CPIM., CSCP.)

SUPPLY CHAIN RISK MANAGEMENT ON SCHOOL UNIFORM PROCUREMENT USING SUPPLY CHAIN OPERATIONAL REFERENCE (SCOR) AND HOUSE OF RISK (HOR) (AT SEKOLAH BINA NUSANTARA BATAM)

THESIS

By

Name   : Afif Al Akbar

Student Number   : 16522121

Has been defended in front of Examination Committee in Partial Fulfillment of the Requirement for Bachelor Degree of Industrial Engineering Department Universitas Islam Indonesia

Examination Committee

Dr. Ir. Elisa Kusrini, M.T., CPIM., CSCP.
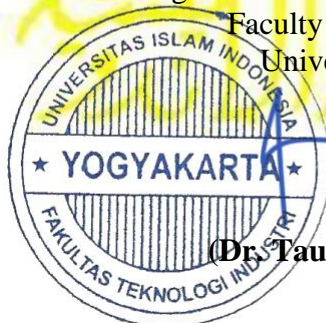Examination Committee Chair

Muhammad Ridwan Andi Purnomo, S.T., M.Sc., Ph.D.
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Winda Nur Cahyo, S.T., M.T., Ph.D.
Member I

Acknowledge by,
Head of Undergraduate Program-Department of Industrial Engineering
Faculty of Industrial Technology
Universitas Islam Indonesia

(Dr. Taufiq Immawan, ST., MM.)

YAYASAN BINA NUSANTARA

Yang bertanda tangan di bawah ini menerangkan bahwa

  Nama : Afif Al Akbar

  NIM : 16522121

Adalah mahasiswa Program Studi S1 Teknik Industri Fakultas Teknologi Industri Universitas Islam Indonesia yang telah selesai melaksanakan penelitian Tugas Akhir Di Yayasan Bina Nusantara Batam yang dilaksanakan pada tanggal 01 April s.d. 30 Juni 2020 .

Demikian Surat Keterangan ini dibuat untuk dapat di pergunakan sebagaimana mestinya.

             Batam, 30 Juni 2020
            Yayasan Bina Nusantara Batam

               Agung Nugroho, S.E
               Ketua Yayasan

DEDICATION

This thesis is dedicated to my beloved parent, Mr. Taufik Hazairin and Mrs. Amrina, who always give me affection and prays that make me able to through all these journeys.

This thesis also would not be possible to be completed without the assistance of my supervisor,

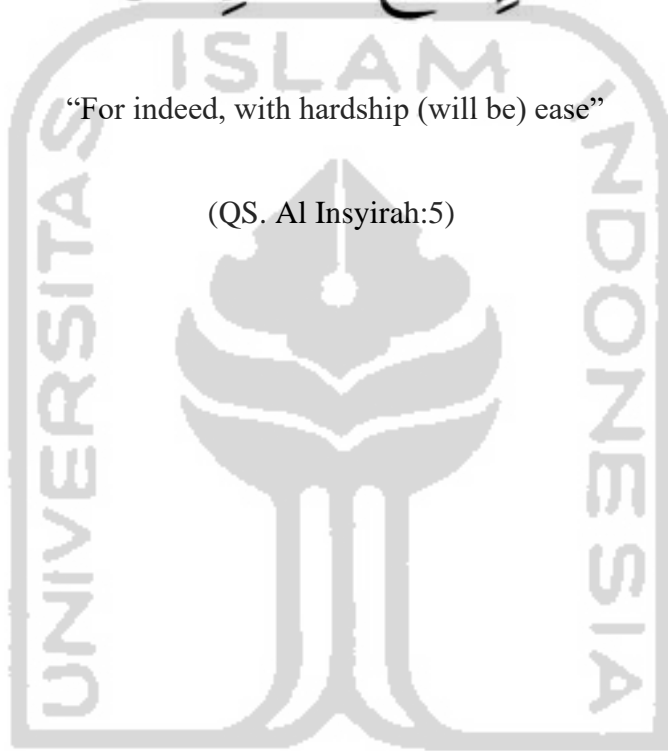*Dr. Ir. Elisa Kusrini, M.T., CPIM., CSCP.*

MOTIVATIONAL QUOTES

فَإِنَّ مَعَ ٱلْعُسْرِ يُسْرًا

"For indeed, with hardship (will be) ease"

(QS. Al Insyirah:5)

PREFACE

Assalamu'alaikum Warahmatullahi Wabarakatuh

Al-hamdu lillahi rabbil 'alamin and Gratitude are presented to Allah the Highest, Glory to Allah Unending, The Exalted, Who granted me the primary inspiration and stamina all along to complete this thesis in acquiring the degree of Sarjana Teknik, entitled **"Supply Chain Risk Management on School Uniform Procurement using Supply Chain Operational Reference (SCOR) and House of Risk (HOR)"**. Also Blessing of His grace so this thesis project in Sekolah Bina Nusantara Batam can be completed.

The assistance, guidance, support and many helps, either directly or indirectly, from some parties involved. Therefore, thank for those who have been constantly sending supports and motivations in the completing of this internship rep. The author would like to thank:

1. Prof. Dr. Ir. Hari Purnomo, M.T. as the Dean of Faculty of Industrial Technology.
2. Muhammad Ridwan Andi Purnomo, S.T., M.Sc., Ph.D. as Head of the Department of Industrial Engineering, Faculty of Industrial Technology, Universitas Islam Indonesia.
3. Dr. Taufiq Immawan, S.T., M.M. as the Head of Undergraduate Program Department of Industrial Engineering Faculty of Industrial Technology Universitas Islam Indonesia.
4. Dr. Ir. Elisa Kusrini, M.T., CPIM., CSCP. as the supervisor who provides me the way in the time of confusions and bestows our knowledge to complete this report.
5. My parents who have prayed and given encouragement and moral and material support during the process of completion.
6. Mrs. Devy, as International Program administrator who patiently help the IP students, especially the author.
7. Agung Nugroho as Head of Sekolah Bina Nusantara Batam who has given permission to conduct the thesis project.
8. All parties who cannot be mentioned one by one by Author for the assistance in completing this Undergraduate Thesis.

The author realizes that there are still shortcomings as well as weaknesses in this report, so the suggestions and critics are fully expected. The author hopes this report would bring advantages for everyone who reads this.

Waasalamu'alaikum Warahmatullahi Wabarakatuh

Yogyakarta, July 27th, 2020

(Afif Al Akbar)

ABSTRACT

Education is an important aspect in human life to increase the quality of human resources. Sekolah Bina Nusantara (SBN) is one of private education institutions that offers formal education from kindergarten to senior high school in Batam. SBN is facing problems in uniform procurement that detected by only 75% of target uniform procurement can be fulfilled. Therefore, the objective of this research is to determine the priority risks in uniform procurement and the mitigation for the risks. The method of SCOR is used to arrange the metric of uniform procurement. Afterwards, the risk identification is done using HOR method to identified which are the priority risks. With the help of fishbone diagram, the causes are identified in order to get the proper mitigation strategy. The result shows that there are 10 risks priority which can be solved by 4 mitigation strategies.

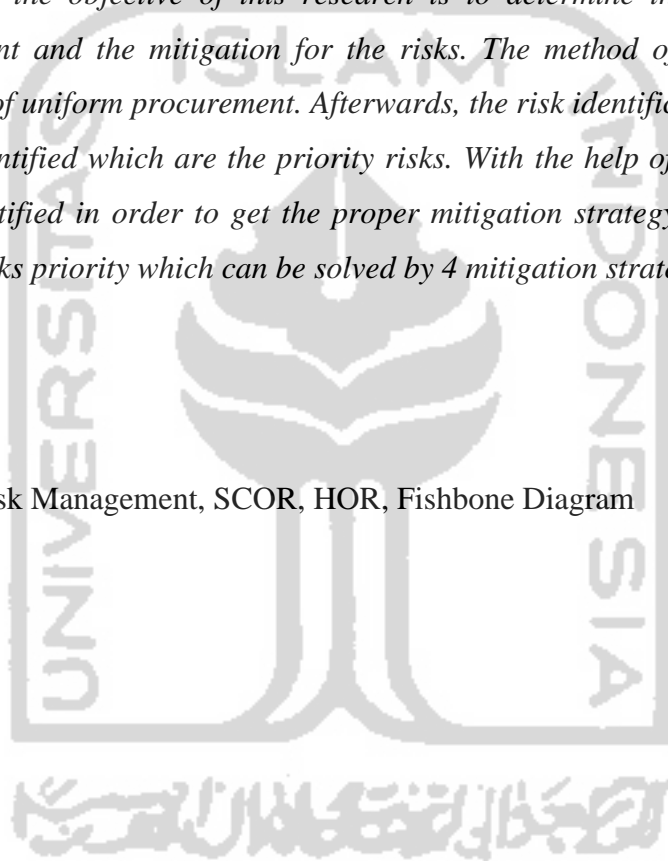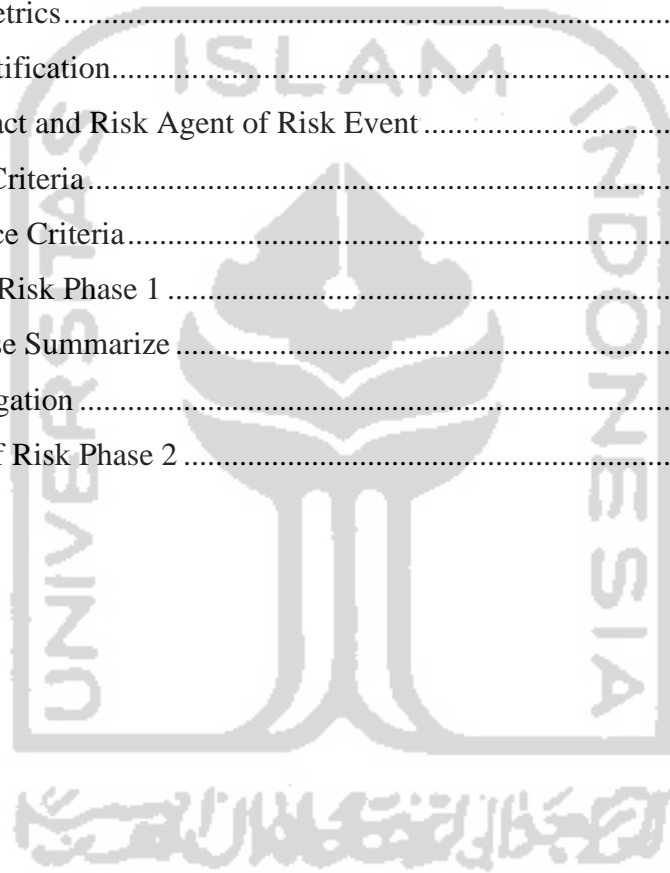Keywords: Risk, Risk Management, SCOR, HOR, Fishbone Diagram

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CHAPTER I

INTRODUCTION

1.1 Background

Indonesia, the fourth largest population in the world, has a high potential of human resource with its number of populations. However, the number of populations will not give a significance of advantages if the human resource is not educated well. Education is one of methods that can increase the quality of human resource. Education can be obtained either with formal or unformal ways. As the education is very important for the population, the government will emphasize the formal education, or school, as the way to increase the quality of human resource. According to Ministry of Education and Culture (2018), the total of public school in Indonesia is 169,378 schools which divided into kindergarten, extraordinary school, elementary school, junior high school, senior high school and vocational high school. In the line with the number of public schools, the existence of private schools in Indonesia also shows a high number which is 138,277 schools. The graph on Figure 1 represents the comparison of public school and private school in all level of education in Indonesia.
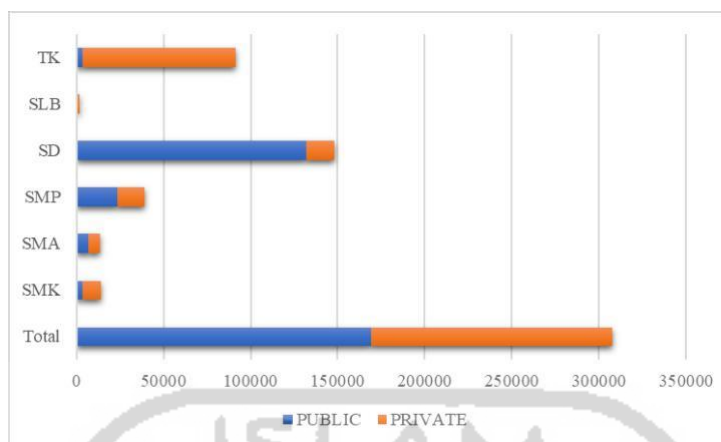
Figure 1.1 Comparison School in Indonesia

Source: Ministry of Education and Culture (2018)

According to the Figure 1.1, the total private school is almost comparable with the public school. This shows that many parents are believe to give education to their children at private school even though there is a striking difference between public school and private school in a financial aspect. The cost of education at private school is more expensive than public school since all the payment is completed by the parent of students without the help of government. Therefore, by this financial consideration, private schools might offer a better service quality for the students.

There are several private schools in Indonesia, one of them is Sekolah Bina Nusantara (SBN) Batam. The school, that was built since 2010, offers the formal education at level of kindergarten until senior high school. As the institution that offers education, Sekolah Bina Nusantara Batam is running in the line with the regulation of government. The national education standard, based on Government Regulation of Republic Indonesia Number 32 of 2013 Concerning Amendment to Government Regulation Number 19 of 2005, has been applied in the school including the curriculum and the facilities. However, the school is not always running nicely. The lack of management in school, usually makes the school facing some problems especially in the supply activity.

As the wider scope of education is present, the wider supply chain in the school are currently happens. There are many aspects of supply chain exist in the institution, for instance book supply, chair supply, uniform supply and many other supplies. According to the school management, the most common problem exists on the supply of school uniform. The big amount of uniform, with the certain specification, usually causing some problem in the supply, especially in procurement.

Each year, the school need to order hundreds of four pairs of school uniform which consists of a pair of SBN uniform, a pair of batik uniform, a pair of scout uniform and a pair of sport uniform. However, only 75% of uniform is fulfilled in the procurement. Usually, the order of uniform is not controlled properly since the school does not have a specific department regarding to the activity of procurement. Therefore, the school facing problems in procurement, for instance lateness of delivery, many of uniform have defects, which can cause big loss either in reputation or financial of the school.

To overcome the problems, the school management has changed the vendor every year but the problems still exists. This can be identified that the changing of vendor is not the only way to remove the problems in procurement. Moreover, the way of school management choosing the vendor is only consider the aspect of cost offers by the vendor without checking the quality of vendor.

School uniform is an important aspect to maintain the reputation of the school. It was an identity that differs the school one and the other. The absence of school uniform in the school can cause a big loss for the institution especially in the reputation. Meanwhile, reputation is an important aspect that should be maintained in the school. In the line with the decreasing reputation of the school, it can decrease the trust from parents to send their children to certain school. The absence of students in the school, especially private school, will cause the decrease of financial input to the school. Financial is an important aspect in every business. The big loss in financial impacting the unstable business running.

Therefore, as the reputation is the important aspect for maintaining the reputation, managing the procurement of school uniform is needed to prevent some big losses in reputation. In order to manage the supply chain, the method of Supply Chain Operations Reference (SCOR) model, House of Risk (HOR), Fishbone diagram and Pareto chart will be used to examine the procurement risk. These methods are used since every institution might has difference major activity. The SCOR model will identify the major activity of procurement in Sekolah Bina Nusantara therefore the analysis will focus on the major activity. Moreover, the method of HOR is used to determine the rank of risk at the procurement. This method is chosen because of its clarity in determining the rank of risk. The causes of the risk priority will be identified by using Fishbone diagram method. Moreover, the Pareto chart will be used to identified the priority causes therefore the mitigation can be pointed to the priority causes and preventing the reputation big loss.

1.2 Problem Formulation

Problem formulation that can be raised based on the background in this study are as follows:

1. What are the priority risks on school uniform supply chain at Sekolah Bina Nusantara Batam?
2. What are the mitigations for the risk of school uniform supply chain at Sekolah Bina Nuantara Batam?

1.3 Research Objectives

This research has the following objectives:

1. Determine the priority risk on school uniform supply chain at Sekolah Bina Nusantara Batam.
2. Determine the mitigation for the risk of school uniform supply chain at Sekolah Bina Nuantara Batam.

1.4 Research Limitation

The limitations of this research are:

1. This research does not observe the supply chain aspects other than the school uniform at Sekolah Bina Nusantara Batam.
2. This research does not observe the supply chain aspect other than the procurement of school uniform at Sekolah Bina Nusantara Batam.

1.5 Research Benefits

By doing this research, it is expected to provide benefits to some parties involved in this research. Expected benefits include as follows:

1. Adding the knowledge of the researchers and companies about the risk that exists in the process of procurement activity especially in the process of plan, source, deliver and return of school uniform procurement at Sekolah Bina Nusantara Batam.
2. Knowing the handling that needs to be done to manage the risks that exist in the process of school uniform procurement especially in the process of plan, source, deliver and return at Sekolah Bina Nusantara Batam.
3. Giving suggestion for the improvement at Sekolah Bina Nusantara Batam in managing the causes of risks.

1.6 Systematical Writing

In order to make this writing and compiling thesis is easy to understand, writing thesis uses the following writing system:

CHAPTER I   **INTRODUCTION**

This chapter contains a preliminary description of the research which consists of the background of the problem, formulation of the problem, the objective to be achieved, the benefits of the research and systematic writing.

CHAPTER II   **LITERATURE REVIEW**

This chapter consists the theories from journals that support this research and the previous study that discussed the topic that related to this research.

CHAPTER III   **RESEARCH METHODOLOGY**

This chapter consists of explanation of the research framework in detail as well as the research subject, research object, data types, and the research flow.

CHAPTER IV   **DATA COLLECTING AND PROCESSING**

This chapter consists of the data obtained during the research in the form of description, table and the analysis. In this section is provided a reference for the discussion of the results to be written in Chapter V.

CHAPTER V   **DISCUSSION**

This chapter consists of further explanation of the result from the data processing that was held in chapter IV.

CHAPTER VI   CONCLUSION AND RECOMMENDATION

This chapter consists of the conclusion of the analysis and any
recommendation based on the result that have been analyzed
during the research.

REFERENCES

APPENDIX

CHAPTER II

LITERATURE REVIEW

The literature review explains the theoretical basis used in conducting research. There are two aspects explain in this chapter which are inductive and deductive study. The inductive study is reviewing about the previous research that has been done and like this research while deductive study is discussing the method will be used.

2.1 Inductive Study

Pujawan & Geraldin (2009) conducted research to provide a framework to proactively manage supply chain risks. The framework will enable the company to select a set of risk agents to be treated and then to prioritize the proactive actions, in order to reduce the aggregate impacts of the risk events induced by those risk agents. A framework called house of risk (HOR) is developed, which combines the basic ideas of two well-known tools: the house of quality of the quality function deployment and the failure mode and effect analysis. The paper shows that the innovative model presented here is simple but useful to use.

Kusnidah, et al (2014) conducted research at salt production company focusing on the supply chain activity to know the risks and risk agents that can occur in the supply chain companies, and design mitigation strategies that can be used to reduce the incidence of agents risk. The method of HOR to be able to determine priority of the handling strategy. In risk identification, the SCOR development method is used. The results showed there were 46 risks with 27 risk agents that has been identified. Based on the identification results, 6 risk agents will be selected the design of handling strategies. There are 13 proposed coping strategies to get reduce the probability of a risk agent arising in a company's supply chain.

Ulfah, et al (2016) conducted research on refined sugar supply chain to mitigate the risk at the process of supply chain. The research methods developed the formulation of potential risk value to determine the priority of risk agents which be mitigated by House of Risk approach. Risk mitigations which were prioritized to be realized were planning and performing routine maintenance, annual shutdown/maintenance, contracts with customers in one-year period, socialising the phone number of PIC transporters, preparing buffer stock, and training on maintenance

Islam, et al (2016) conducting research to evaluating the supply chain and business process at KMART. Structural efficiency of supply chain management is the focus for retail enterprises to maintain profit and growth. Fishbone analysis, also known as "Ishikawa Analysis", is one of the most effective methods' of analyzing any business process and measuring performance. This study intends to evaluate the efficiency of K-Mart's value chain and business process. It provides insight about the problems associated with software, process, people, material, environment and management and sorts out possible solution for those problems.

Bukhori, Widodo & Ismoyowati (2015) conducted research on poultry supply chain in XYZ slaughtering house Yogyakarta. Poultry is the highest consumed meat nowadays. There are some problems in poultry supply chain in XYZ slaughtering house. In addition to supply chain problem, people always need to consume poultry, not only from quality but also

from halal status on it. SCOR is a method of assessing supply chain performance created by Supply Chain Council from two perspectives those are internal business process and customer facing. Cause- Effect-Diagram is to find problem of performance and give alternative recommendation from the 3 worst measured performances. The alternative recommendation is given to XYZ by using Cause and effect Diagram such as the on-time order by consumer, on-time cycle time and standardized chicken from supplier.

Oger, et al (2018) conducted research related to automation supply chain risk management among logistics network stakeholder. The supply chain community observed and analysed over the past decades the evolution of how businesses are designing and challenging their supply chains. To be competitive, businesses try to identify and assess risks and opportunities, to identify and make decisions to mitigate the risks taking advantage of the opportunities. The SCOR model currently used to determine the major process of the supply chain. The result shows that the supply chain factor of success for businesses is their ability to keep a complete, accurate and up-to-date vision of their supply chain environment, and the risks and opportunities related to their supply chains.

Qazi, Akhtar, & Wieland (2020) conducting research on the concept of risk matrix to develop the new iterative process to bridge the gap between supply chain risk management process integrating risk appetite of the decision maker and all stages of the risk management process within an interdependent network of systemic risks. This research resulting the risk matrix driven supply chain risk management that utilising the method of cost-benefit analysis within an interdependent setting of interacting risks and risk mitigation strategies, we also propose a second approach that can help a decision maker determine a set of Pareto-optimal risk mitigation strategies and select optimal solutions subject to the budget constraint and specific risk appetite.

Table 2.1 Literature Review

No	Author	Year	Object	Supply Chain Operational Reference (SCOR)	House of Risk (HOR)	Pareto Chart	Fishbone Diagram
			Review				
1.	Pujawan & Geraldin	2009	Framework to proactively manage supply chain	√	√	√	
2.	Kusnidah, et al.	2014	Supply chain flow at salt production company	√	√	√	
3.	Ulfah, et al.	2016	Refined sugar supply chain	√	√	√	
4.	Bukhori, et al.	2015	Poultry supply chain in XYZ slaughtering house Yogyakarta	√			√
5.	Islam, et al.	2016	KMART value chain and business process				√
6.	Oger, et al.	2018	Automation supply chain risk management among logistics network stakeholder	√			
7.	Qazi, et al.	2018	Concept of risk matrix			√	
8.	Author	2020	School uniform supply chain risk management	√	√	√	√

This research will be held at Sekolah Bina Nusantara Batam on uniform supply chain risk management. Based on the previous research, it can be known that the difference between those researches and this research is on the scope of research and the method that used. Some research has observed the supply chain risk management on production activity,

agriculture, etc. However, this research will differ among those researches since this research is done in the procurement activity at school management. Moreover, the previous research combined the method of SCOR, HOR and Pareto chart simultaneously. This research will use the method of SCOR since this method standardize the supply chain process reference model and framework. However, this method has a few analytical tools for cause effect analysis and problem solving. The method of HOR is used to determine the potential risk agents based on the value of ARP (Aggregate Risk Potential) and the priority of implementing mitigation actions based on ETD (Effectiveness to Difficulty) value. To decide a better proposed mitigation, which differ this research among others, the method of fishbone diagram is used to analysed the causes of each risk agents. However, the causes from some aspects will be decided by using Pareto chart in order to determine which causes is should be prioritized.

Therefore, this research will be conducted at Sekolah Bina Nusantara Batam. The focus of this research is on the procurement activity of school uniform. The method used for this research is SCOR model, HOR, Pareto Chart and Fishbone diagram.

2.2 Deductive Study

Deductive study explains about the basic theory used in this research. Deductive study in this research are supply chain management, supply chain risk management, Supply Chain Operations Reference (SCOR) model, House of Risk (HOR), Fishbone Diagram and Pareto Chart.

2.2.1   Supply Chain Management

Supply chain management (SCM) has rapidly become the most significant management strategy among the world's top organizations. The importance of SCM has grown in the 1990s, although it was first introduced in early 1980s. SCM is defined as a management

approach to develop a strong relationship with suppliers and consumers to capture good market share and ultimately achieve maximum profit along the supply chain (Sarkar, Omair & Kim, 2019). Supply chain management itself is divided into four flows; material flow, business flow, capital flow, and information flow (Li & Liu, 2019). In this research, supply chain that will be observed is the business flow.

2.2.2   Supply Chain Risk Management

Supply chain risk management (SCRM) is the identification and management of risk for the supply chain, through a co-ordinate approach amongst supply chain members, to reduce supply chain vulnerability (Fan et all, 2016). The SCRM plays a major role in successfully managing business processes in a proactive manner. Companies must have a proper Supply Chain Risk Management (SCRM) to survive in a risky business environment. Thus, understanding how to mitigate these risks and manage supply chain risk has become a priority issue to prevent potential losses, poor relationships with other members of the supply chain, and conflict between stakeholders (Oliveira, Leiras and Ceryno, 2019). Supply chain risk management is defined as the process of risk mitigation achieved through collaboration, co-ordination and application of risk management tools among the partners, to ensure continuity coupled with long term profitability of the supply chain. The management of risk events is termed as supply chain risk management (SCRM), which has become a key part of the business strategy (Mavi, Goh and Mavi, 2016).

2.2.3   Supply Chain Operation Reference (SCOR)

Supply Chain Operation Reference (SCOR) model is developed by Supply Chain Council (SCC), to measure performance of the chain. It provides standard terminology which can be used for deciding, arranging and implementing supply chain processes (Delipinar & Kocaoglu, 2016). SCOR has several processes which represented in Figure 2.1 as follows:

Figure 2.1 SCOR Model

a. Plan

It is analysing the information and forecasting market trends of goods and services. Marketing and finance departments apply planning process by monthly and yearly reports.

b. Source

It is a procurement system with procurement model. It includes search, negotiation and evaluation agents to amend supplier selection, negotiation, and evaluation.

c. Make

It is the manufacturing of goods not only in terms of time but also about production belt and batch.

d. Deliver

It is the processes, which provides finished goods and services to reach planned or actual demand.

e. Return

It is processes, returning the goods or receiving the product.

2.2.4   House of Risk

House of Risk (HOR) is the development of the method of Failure Modes and Effect Analysis and Quality Function Development (Chayani, Pribadi and Baihaqi, 2016). In this research, the HOR model is used, because this model is different from the existing model in which HOR selected high risk Aggregate Risk Potentials, which means the risk agent has a high probability of occurrence and causes many risk events with severe impacts. Then mitigation measures are arranged for selected risk agents based on the ratio of total effectiveness to the level of difficulty and which mitigation measures can reduce many risk agents with high ARP values. HOR is divided into two phases.

1) First phase

a.   Identification of risk events (   ) and risk agents (   )
b.   Calculation of occurrence and severity of variablesand
c.   Construct a correlation matrixandwith provisions, 0: no correlation, 1: weak correlation, 3: moderate correlation and 9: strong correlation.
d.   ARP value calculation ofusing the formula:

$$= \quad \cdot \Sigma \quad \cdot$$

e.   ARP rating of each   .
f.   Making a pareto diagram(priority selection   ).

2) Second phase

a.   Preparation of mitigation or preventive action () based on priority   .
b.   Correlation betweenandwith provisions 0, 1, 3 and 9.
c.   Calculation of the value of the total effectiveness of eachwith the formula

$$= \Sigma(\cdot)$$

d. Measurement of degree of difficulty of application with a scale of difficulty of application 3: low, 4: medium and 5: high.

e. Effectiveness to difficulty ratio calculation using the formula:

$$=$$

f. Priority rankingbased on value.

2.2.5 Fishbone Diagram

Fishbone diagram (also called Ishikawa diagrams or cause-and-effect diagrams) is a graphical technique to show the several causes of a specific event or. In particular, a fishbone diagram (the shape is similar to a fish skeleton) is a common tool used for a cause and effect analysis to identify a complex interplay of causes for a specific problem or event. The fishbone diagram can be a comprehensive theoretical framework to represent and analyse the sources of innovation (Coccia, 2018). There are six classic categories of a fishbone diagram which are categorized as the main causes of any problems of business process. Those are people, equipment, materials, environment, management and process. The analysis of these six variables reveals the reasons of a problem irrespective of its type or severity (Ishikawa, 1986).
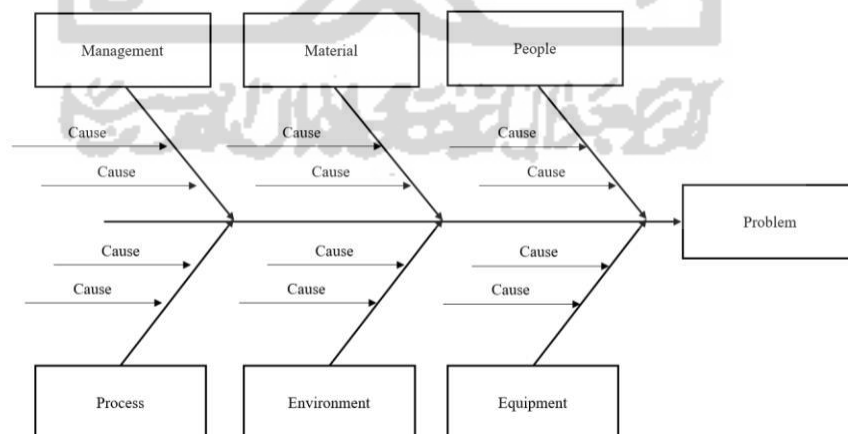
Figure 2.2 Fishbone Diagram

2.2.6   Pareto Chart

The Pareto chart is useful for non-numeric data, such as 'cause', 'type' or 'classification' and is useful to prioritize where action and process changes should be focused and are commonly used for identifying the downtime and other wastage (Hossen, et al., 2017). A Pareto chart is used to highlight the most frequently occurring defects, the most common causes of defects, or the most frequent causes of customer complaints (Nicolae, et al., 2015). The Pareto chart is a graphical display of the Pareto principle. When observing events, it is often a phenomenon that approximately 80% of events are due to 20% of the possible causes (Franch, et al., 2015).

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Subject

This subject of this research is Sekolah Bina Nusantara, located at Plamo Garden Blok G3 & G4, Jl. Ahmad Yani, Baloi Permai, Kec. Batam Kota, Kota Batam, Kepulauan Riau. Sekolah Bina Nusantara Batam is the private education institution that offers the level of education from kindergarten until senior high school.

3.2 Research Object

The object of this research is risk management in the supply chain, especially in the process of procuring school uniform and supplier management with the SCOR model, where risk identification using House of Risk method and mitigation analysis using Fishbone diagram and Pareto chart.

3.3 Data Types

In this research, there are two types of data would be used. Those data will be explained as follows:

1. Primary Data

Primary data is the data that collected with the objective of identifying some specific factors needed in this research. In this research, primary data is obtained by using interview to parties that involved in this research.

2. Secondary Data

Secondary data is the data that collected by an available source of information such as books, newspapers, magazines, journals, repositories, online portals, etc. In this research, the researcher obtained data from some journals.

3.4 Research Flow

The flow of the research in this research is represented in the Figure 3.1 below.

Start

Problem Formulation

Finding information related to the supply chain management at Sekolah Bina Nusantara Batam. What is the highest supply chain risk existing at Sekolah Bina Nusantara Batam?

Literature Review

Collecting any literature from journals as the supporting information for the problem raised at Sekolah Bina Nusantara Batam. There are two aspects explain in this chapter which are deductive and inductive study. However, it will also conduct the inductive study about the previous research that has been done and similar to this research.

Data Collection

Data collection was done by interviewing the expert of Sekolah Bina Nusantara Batam. The data that be obtained from the interview are the profile of the institution, the supply chain activity and the risk identification.

A

Figure 3.1 Research Flow

The explanation of the research flow is as followed,

1.   Problem Formulation

Problem identification is the initial field study process to look for problem outlines that will be the topic of this research. The method used is interviews and the output obtained at this stage is to get the formulation of the problem.

2.   Literature Review

Literature review is used as a secondary source of data relating to the research to be conducted. Literature study is divided into two, namely:

a.   Inductive study, a study that explains (reviewed) previous research in which the sources used in the form of journals.

b.   Deductive study, is a study in which the sources used can be in the form of journals, official websites, and final project reports that discuss the same research object to serve as a theoretical basis.

3.   Data collection

Data collection in this research is done to collect the profile of the institution, the supply chain activity and the risk identification. Profile institution is collected to give an information about the place of this research. Moreover, the supply chain activity is collected to give a brief explanation about the supply chain activity at the institution, especially on the procurement activity on uniform. After the procurement is explained, the SCOR metric is defined based on the interview with expert at Sekolah Bina Nusantara Batam. Then, the risk identification is done to collect the data about the risk event based on the SCOR metric. The risk event is followed by the determination of risk agent. After risk agent is determined, the criteria of severity and occurrence is also determined to ease the processing data.

4. Data Processing

Processing data is the step of processing the output data collected in the previous step into more meaningful information. Data processing is done using House of Risk Phase 1, Fishbone diagram and House of Risk phase 2. The description is as follows.

a. House of Risk phase 1

In build the house of risk, there are several data that need to be found:

a1. Risk Event and Severity

Identify risk events that could happen in each business process. This can be done through mapping SC processes (such as plan, source, deliver, make, and return) and then identify "what can go wrong" in each of those processes. Moreover, Assess the impact (severity) of such risk event (if happened). The researcher used a 1-10 scale where 10 represents extremely severe or catastrophic impact. The severity of each risk event is put in the right column and indicated as S_i.

a2. Risk Agent and Occurrence

Identify risk agents and assess the likelihood of occurrence of each risk agent. Here, a scale of 1-10 is also applied where 1 means almost never occurred and a value of 10 means almost certain to happen. The risk agents (A_j) are placed on top row of the table and the associated occurrence are on the bottom row notated as O_j.

a3. Risk Relation Matrix

Develop a relationship matrix, i.e. relationship between each risk agent and each risk event, R_{ij} {0, 1, 3, 9} where 0 represents no correlation and 1, 3, and 9 represent, respectively, low, moderate, and high correlations.

a4. Aggregate Risk Potential (ARP)

Aggregate risk potential is determined as the product of the likelihood of occurrence of the risk agent j and the aggregate impacts generated by the risk events caused by the risk agent j as in equation below.

$$\text{ARPj} = 0j \cdot \Sigma Si \cdot Rij \qquad \qquad ...\,(3.1)$$

a5. Rank Risk Agent

Rank risk agents according to their aggregate risk potentials in a descending order (from large to low values). The recapitulation of the explanation above is represented in the Table 3.1 below.

Table 3.1 House of Risk Phase 1

Business Processes	Risk Event (E_i)	Risk Agents (A_j)							Severity of Risk Event i (S_i)
		A_1	A_2	A_3	A_4	A_5	A_6	A_7	
Plan	E_1	R_{11}	R_{12}	R_{13}					S_1
	E_2	R_{21}	R_{22}						S_2
Source	E_3	R_{31}							S_3
	E_4	R_{41}							S_4
Make	E_5								S_5
	E_6								S_6
Deliver	E_7								S_7
	E_8								S_8
Return	E_9								S_9
Occurrence of Agent j		O_1	O_2	O_3	O_4	O_5	O_6	O_7	
Aggregate Risk Potential j		ARP_1	ARP_2	ARP_3	ARP_4	ARP_5	ARP_6	ARP_7	
Priority Rank of Agent j									

The risk agent will be analysed using pareto chart to determine the priority risk that will be processed in the next step.

b. Fishbone Diagram

The output of risk priority from Pareto chart will be analysed by using fishbone diagram method to get the cause of the risk. This step is done by discussing with the owner of the school institution and the staff of supply chain management. The Figure 3.2 below represented the model of fishbone diagram.
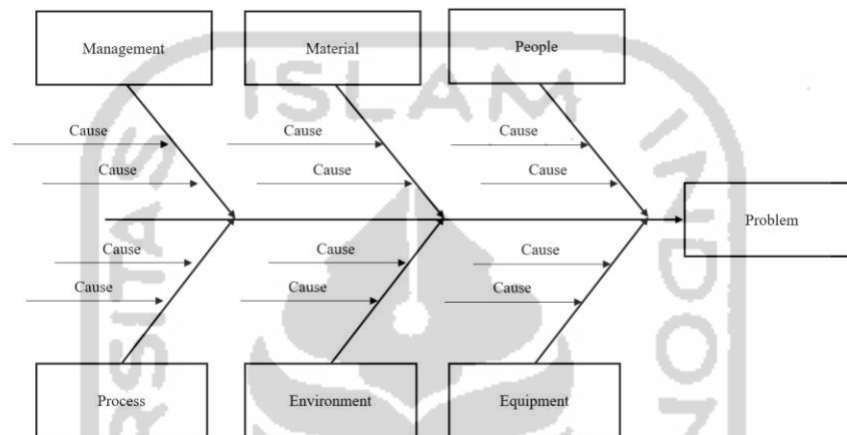
Figure 3.2 Fishbone Diagram

c. Pareto Chart

The output of fishbone diagram is the causes of the risk agent priority. Pareto chart is used to determine the priority causes that should be mitigated. The priority causes follow the theory of 80:20 of pareto chart.

d. House of Risk (HOR) Phase 2

House of risk (HOR) phase 2 is used to determine which actions are to be done first, considering their differing effectiveness as well as resources involved and the degree of difficulties in performing. The output of five whys in the form of root causes of risk priority of supply chain at Sekolah Bina Nusantara Batam will be used as the input in this process. To form the mitigation, there are several processes that will be explained as follows.

d1. Identify Actions

Identified actions considered relevant for preventing the risk agents. One risk agent could be tackled with more than one actions and one action could simultaneously reduce the likelihood of occurrence of more than one risk agent.

d2. Relation between each Preventive Action

Determine the relationship between each preventive action and each risk agent, Ejk. The values could be {0, 1, 3, 9} which represents, respectively, no, low, moderate, and high relationships between action k and agent j. This relationship (Ejk) could be considered as the degree of effectiveness of action k in reducing the likelihood of occurrence of risk agent j.

d3. Total Effectiveness

Calculating the total effectiveness of each action as follows:

$$TEk = \Sigma ARPj \cdot Ejk \qquad \text{... (3.2)}$$

d4. Degree of Difficulties

Assess the degree of difficulties in performing each action, Dk, and put those values in a row below the total effectiveness. The degree of difficulties, which can be represented by a scale (such as Likert or other scale), should reflect the fund and other resources needed in doing the action.

d5. Total Effectiveness to Difficulty Ratio

Calculate the total effectiveness to difficulty ratio as follows:

$$ETDk = Tek/Dk \qquad \text{... (3.3)}$$

d6. Priority Action

Assign rank of priority to each action (Rk) where Rank 1 is given to the action with the highest ETDk. The recapitulation of the explanation above is represented in the Table 3.2 below.

Table 3.2 House of Risk Phase 2

To be Treated Risk Agent (A_j)	Risk Mitigation (M_k)					Aggregate Risk Potentials (ARP_j)
	M_1	M_2	M_3	M_4	M_5	
A1	E_{11}	E_{12}	E_{13}			ARP_1
A2	E_{21}	E_{22}				ARP_2
A3	E_{31}					ARP_3
A4	E_{41}					ARP_4
Total Effectiveness of Action k	TE_1	TE_2	TE_3	TE_4	TE_5	
Degree of Difficulty Performing Action k	D_1	D_2	D_3	D_4	D_5	
Effectiveness to Difficulty Ratio	ETD_1	ETD_2	ETD_3	ETD_4	ETD_5	
Rank of Priority	R_1	R_2	R_3	R_4	R_5	

5. Analysis and Discussion

In this step, the result of house of risk will be analysed to get the conclusion of what are the highest supply chain risk should be prioritized and the mitigation action that suitable for the risk agents at Sekolah Bina Nusantara Batam.

6. Final Report

Compilation of reports from all data and information obtained, ranging from introduction to conclusions and suggestions. The conclusion for this research is the rank of supply chain risk at Sekolah Bina Nusantara Batam and the mitigation action of each supply chain risk priority. Whereas research suggestions are input for similar studies in the future with a lack of assessment in this study.

CHAPTER IV

DATA COLLECTING AND PROCESSING

4.1 Data Collecting

The collecting data was done by interviewing the management of Sekolah Bina Nusantara Batam which in this research also has a role as the expert for the research. The data that be obtained from the interview are the profile of the institution, the supply chain activity, the risk identification along with the causes of the risk.

4.1.1   Institution Profile

Institution profile consists of institution description, vision and mission, organizational structure and the location of the institution. The institution profile will be described as follows.

a.   Institution Description

Sekolah Bina Nusantara Batam is a private institution, owned by one person, that offered the formal education from kindergarten to senior high school located at Batam. This education

institution was founded in 2010 which consists of kindergarten education and elementary school. By the time goes by, the institution is growing and the grade of junior high school and senior high school was founded in the next years.

In 2020, the total students registered at Sekolah Bina Nusantara Batam is 485 students from kindergarten to senior high school. This institution is managed by 53 employees including teachers. Every year, the institution accepts and graduate 150 students in average.

b.   Organizational Structure

The organizational structure of Sekolah Bina Nusantara Batam is represented in Figure 4.1 as follows.
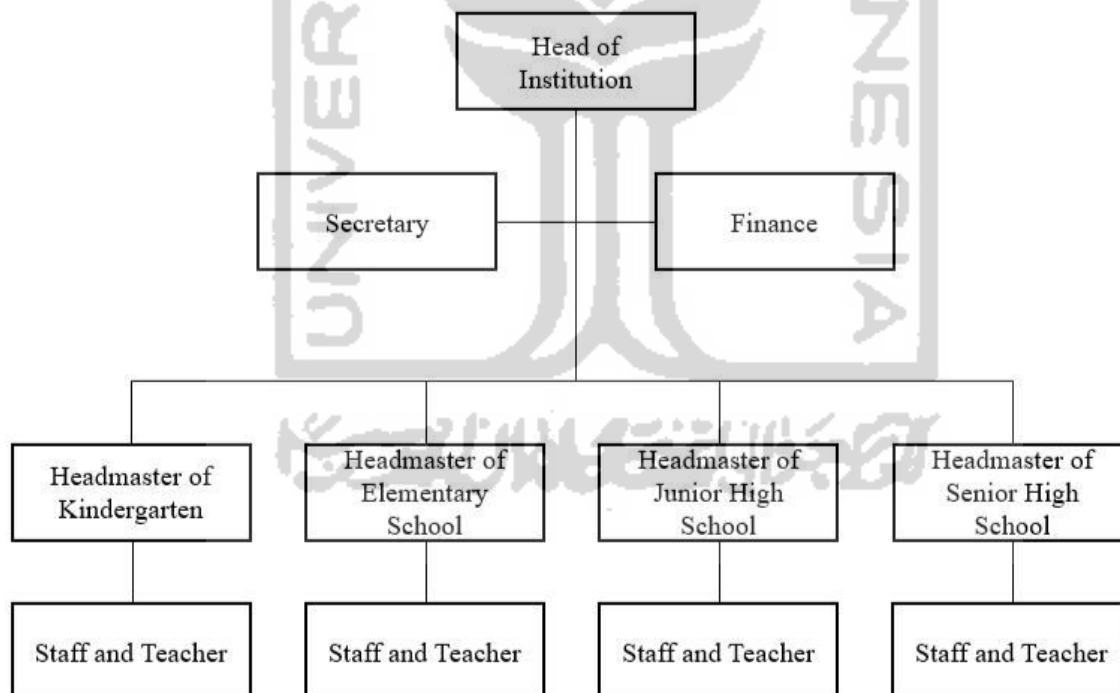
Figure 4.1 Organization Structure of Sekolah Bina Nusantara Batam

The organizational structure will be explained as follows:

1. Head of Institution

Head of institution is obligated to lead and supervise the whole institution. Moreover, the head of institution also obligated to decide the decision for the institution.

2. Secretary

Secretary is obligated to assist the head of institution in carrying out daily tasks, both routine and specific.

3. Finance

Finance is obligated to help head of institution to prepare RKAS, manage and administer school finances.

4. Headmaster

Headmaster is obligated to lead the school and decided the decision for the school with the approval from the head institution.

5. Staff and Teacher

Staff is obligated to help the headmasters in running the school activities.

Teacher is obligated to provide education / teaching theory and practice, managing classes and teaching, and carrying out teacher administration with full awareness and responsibility.

c. Location

The location of Sekolah Bina Nusantara Batam is located at Plamo Garden Blok G3 & G4, Jl. Ahmad Yani, Baloi Permai, Kec. Batam Kota, Kota Batam, Kepulauan Riau. The location of Sekolah Bina Nusantara Batam in a map is represented in the Figure 4.2.
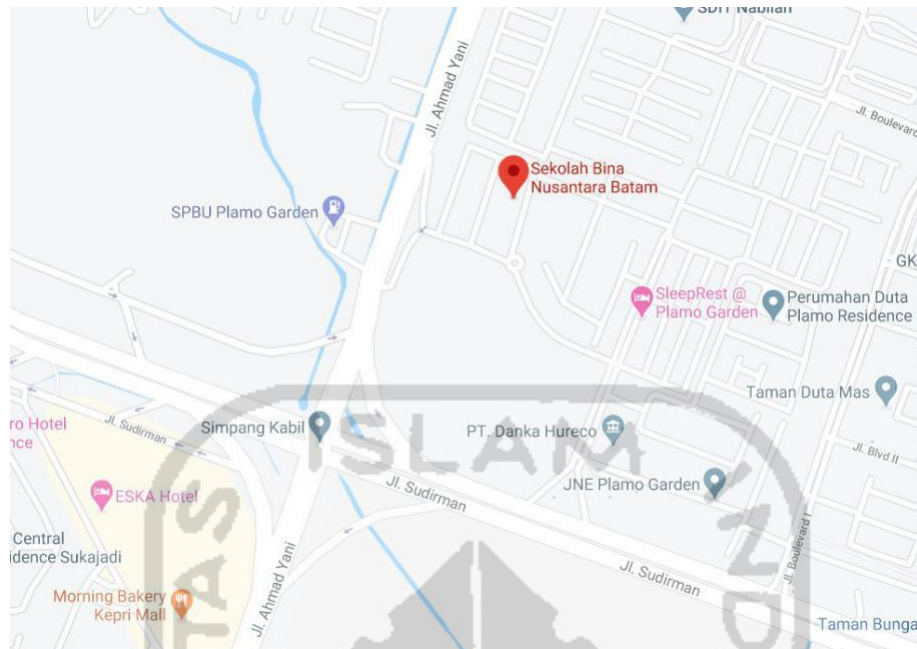
Figure 4.2 Institution Location

The institution is located near Ahmad Yani street and Sudirman street which connect to some important place at Batam for instance airport and city center. Moreover, this institution is in the central government.

4.1.2 Supply Chain Activity

In this institution, the supply chain activity exists in the activity of fulfilling the needs of institution that support the teaching and learning process. One of the supporting needs is the uniform for the students. The supply chain activity starts from the procurement uniform until to the distribution of uniform to the students. The process of uniform supply chain activity is represented in Figure 4.3 below.

```
┌──────────────┐     ┌──────────────┐     ┌──────────────┐     ┌──────────────┐
│   Uniform    │ →   │              │ →   │   Uniform    │ →   │   Uniform    │
│  Procurement │     │ Warehousing  │     │ Distribution │     │ Received by  │
│              │     │              │     │ to all Grades│     │  Students    │
└──────────────┘     └──────────────┘     └──────────────┘     └──────────────┘
```
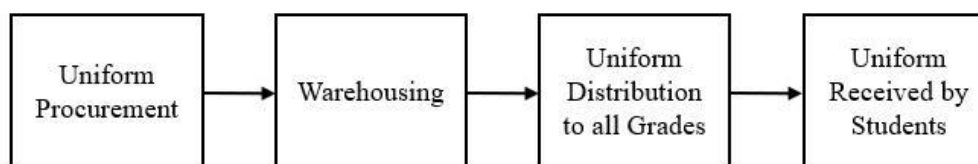
Figure 4.3 Uniform Supply Chain

The process of uniform supply chain starts from the procurement activity of uniform. The procurement is done by the top management of the institution since in Sekolah Bina Nusantara Batam there is no specific department for procurement. The management start procuring the uniform to selected vendor in three months after the school registration is opened. The number of school uniform ordered is based on the forecast of the previous procuring data. The procurement process is about two months including the quality control and returning defect uniform.

After the uniform is finished to procure, the management store the uniform to the warehouse until the registration period is closed which is two weeks before the first day of school is started. In the warehouse, the uniform is separated into several types; a pair of SBN uniform, a pair of batik uniform, a pair of scout uniform and a pair of sport uniform for each grade from kindergarten until senior high school.

After the registration period is closed, the headmaster of each grade will recap the real number of students have registered and report it to the head of institution. Afterwards, the uniform will be distributed through the headmasters of each grade in accordance to the number of students registered. In this step, the management of each grade separated the uniform specifically for each student.

In the first day of the school, which is school introduction period, the uniform will be distributed to the students. In a day, the students can return the uniform to the management if there are some defect or size error. Then the management will change the uniform.

4.1.3   Business Process

This research is focused on the procurement process of the supply chain activity at Sekolah Bina Nusantara Batam. Specifically, the procurement process consists of plan, source, receive and return. The flow of procurement process will be explained clearly in Figure 4.4 below.
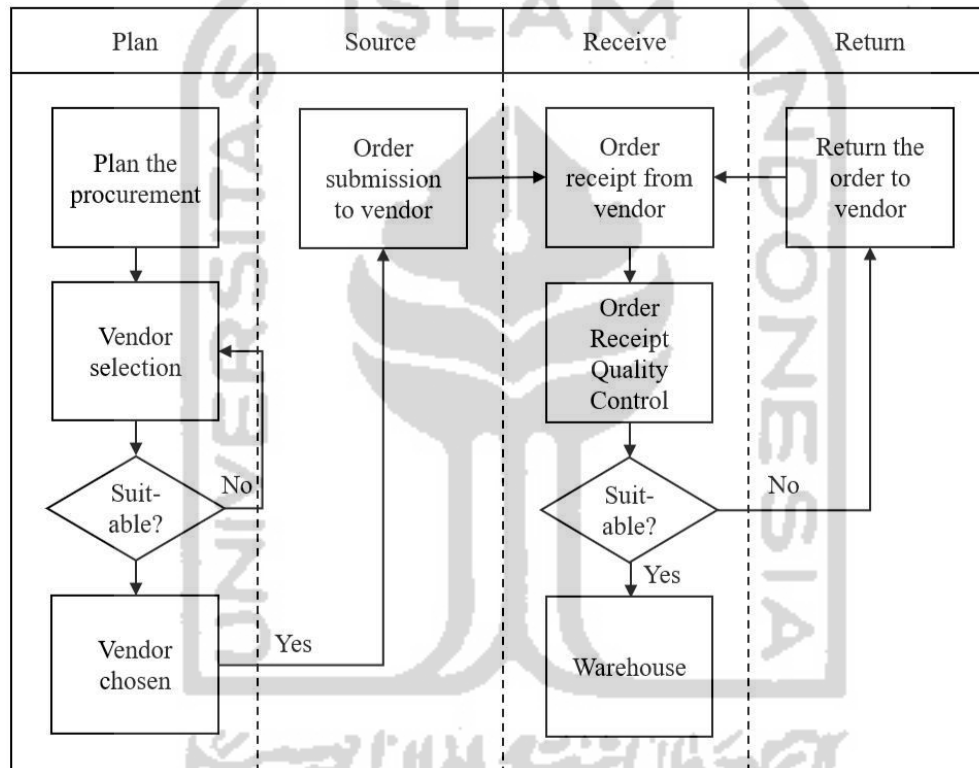
Figure 4.4 Uniform Procurement Flow

The process of uniform procurement at Sekolah Bina Nusantara Batam will be explained as follows:

1. Plan

Plan is the beginning process of the procurement process. In the planning process, the top institution management determine the detail criteria for procurement including the uniform design, quantity order and the vendor criteria to be chosen. Plan process starts from the planning of procurement such stated at request for quotation. After the planning of procurement, the school management start to do vendor selection in order to get the vendor as specification. The institution selects the vendor based on the lowest cost, if the cost not suitable, then the institution will select another vendor which more suitable.

2. Source

After getting the required vendor, the top institution management starts to make an order to the vendor. The order will be fulfilled by the vendor start from the raw material until the finish good.

3. Receive

The finish uniform will be received by the top institution management in certain date that was promised in the vendor selection. Afterwards, the receipt order uniforms will be checked either it has fulfilled the qualification or not. The qualified uniform will be stored to warehouse. However, any defect or unmet uniform specification will be returned to the vendor.

4. Return

Return is the process of returning unmet uniform specification or defect uniform to the vendor. The vendor will be given a certain time to repair the uniform as required by the school management. After repairing done, the uniform will be given again to the school management. If all uniform has met the specification, the procurement process is finished.

To maintain the process of uniform procurement at Sekolah Bina Nusantara Batam, the key performance indicator (KPI) is designed. The KPI is used to assess the performance of

procurement. Table 4.1 shows the key performance indicator of uniform procurement at Sekolah Bina Nusantara Batam.

Table 4.1 Key Performance Indicator

Business Process	Activity	Key Performance Indicator (KPI)			Actual (%)
		Description	Formula	%	
Plan	Procurement planning	Meet order quantity	$100 - \dfrac{}{} \times 100\%$ $10 - \dfrac{}{} \times 100\%$	100	75
		Planning done maximum in 100 days after the registration is opened	$50 \dfrac{}{} \times 100\%$ $\dfrac{}{} \times 100\%$ $\times 100\%$	100	75
	Vendor selection	Vendor selection is done in 10 days after the procurement planning is done	$\dfrac{100 -}{100} \times 100\%$ $\times 100\%$	100	70
Source	Product procurement	Total cost does not exceed the budget	$10 \dfrac{}{} \times 100\%$ $\times 100\%$	100	75
		Production process finish in 50 days		100	70
Receive	Order receipt	Uniform is receipt in maximum 10 days after production finished		100	75
	Quality control	Uniforms meet the requirement		100	70
		Uniforms do not have any defect		100	70
		Order receipt is suitable with the order number		100	70
Return	Return order	Return time is maximum 10 days		100	60
		Return costs borne by the vendor		100	60

4.1.4 SCOR Metric

Based on the explained business processes of uniform procurement above, therefore it was arranged the SCOR metrics based on its attribute that explained in Table 4.2 as follows:

Table 4.2 SCOR Metrics

No.	SCOR		Metrics	Attribute
	Level 1	Level 2		
1.	Plan	Procurement Planning	Accuracy planning	Reliability
2.			RS.3.99 Plan Source Cycle Time	Responsiveness
3.			CO.3.2 Cost to Plan Source	Cost
4.		Vendor Selection	RS.3.125 Select Supplier and Negotiate Cycle Time	Responsiveness
5.	Source	Product Procurement	RL.3.18 % Orders Processed Complete	Reliability
6.			RL.3.21 % Orders Received with Correct Content	
7.			RS.3.123 Schedule Production Activities Cycle Time	Responsiveness
8.			CO.3.7 Cost to Receive Product	Cost
9.	Receive	Receive Finish Product	R.L.3.20 % Order Received On-Time to Demand Requirement	Reliability
10.			RL.3.33 Delivery Item Accuracy	
11.			RL.3.35 Delivery Quantity Accuracy	
12.			RL.3.42 Order Delivered Defect Free Conformance	
13.			RL.3.47 Return Shipments Shipped on Time	
14.			RL.3.50 Shipping Documentation Accuracy	
15.			RS.3.24 Deliver Cycle Time	Responsiveness
16.	Return	Return Product to Vendor	RL.3.56 Warranty Costs	Reliability
17.			RS3.22 Current Supplier Return Order Cycle Time	Responsiveness

SCOR metrics is done based on the activity in the procurement activity in the school which consists of plan, source, receive and return activity. Definition of each SCOR metrics table will be explained as follows:

1. Planning Process

Planning is the process of arranged the procurement criteria for school uniform. This process is done by top management of the institution to plan every needs of procurement which consists of procurement planning and vendor selection. The metrics of planning process is arranged based on SCOR approach which will be described as follows:

a. Procurement Planning

Procurement planning is done to arrange the criteria of order for instance the quantity of order, the financial planning, due date of order and many more. This process will be very important as the foundation of the whole process. The metrics of this process is arranged to prevent any undesirable situation in the procurement process. The metrics is described as follows:

a1. Accuracy Planning

Accuracy planning is used to know the accuracy of order quantity planning. The formula for calculating the accuracy planning is as follow:

$$\frac{}{} \times 100\%$$ ... (4.1)

If the calculation result is less than 100%, it means that there is a shortage in the procurement. If the calculation result is higher than 100% it means that the procurement is exceeded the needs of school uniform.

a2. Plan Source Cycle Time

Plan source cycle time is done to find out how much is the average time needed to make a uniform procurement decision.

a3. Cost to Plan Source

Cost to plan source is used to calculate the cost that needed in a procurement activity.

b. Vendor selection

Vendor selection is done to choose which vendor will be used to produce the school uniform. The metrics of this arrange to prevent any undesirable situation in choosing the vendor which will affect to another next process. The metrics is described as follows:

b1. Select Supplier and Negotiate Cycle Time

Select supplier and negotiate cycle time is used to know the time average needed to do the vendor selection for uniform school production.

2.   Source Process

Source is the process to procure the uniform school. The vendor chosen will carry out any duty of making school uniform start from raw material until the finished good. The metrics is arranged to prevent any undesirable situation of procurement process of school uniform. The metrics of source process is arranged based on SCOR approach which will be described as follows:

a.   % Orders Processed Complete

Percentage of process complete is used to calculate the number of orders that have been completely shipped by the supplier. The formula for calculating the order process complete is as follow:

$$\frac{h}{h} \times 100\% \qquad \text{... (4.2)}$$

b.   % Orders Received with Correct Content

Percentage of order received with correct content is used to calculate the order with correct specification over the total of order. The formula for calculating the order received with correct content is as follow:

$$\frac{h}{{}_h} \times 100\% \qquad\qquad \text{... (4.3)}$$

c. Schedule Production Activities Cycle Time

Schedule production activities cycle time is used to know the average time of production activities of school uniform.

d. Cost to Receive Product

Cost to receive product is used to know the average cost of sourcing activity. Start from the order process until the item is delivered to the destination.

3. Receive Process

Receive is the process of receiving order item from the vendor. The metrics of receive process is arranged based on SCOR approach which will be described as follows:

a. Order Received On-Time to Demand Requirement

Order receive on-time to demand requirement is used to know the discipline of the vendor to deliver the item on the time of as the promised. This metrics applies for the receive or the returning delivery

b. Delivery Item Accuracy

Delivery item accuracy is used to know the number of accurate items that was delivered by the vendor and received by the institute. Accurate item is the item that delivered as the ordered. The formula for calculating the delivery item accuracy is as follow:

$$\frac{h}{{}_h} \times 100\% \qquad\qquad \text{... (4.4)}$$

c.   Delivery Quantity Accuracy

Delivery quantity accuracy is used to know the accuracy of quantity of item delivered by the vendor. The formula for calculating the delivery quantity accuracy is as follow:

$$\frac{h}{h} \times 100\% \qquad \qquad \text{... (4.5)}$$

d.   Order Delivered Defect Free Conformance

Order delivered defect free conformance is used to know the number of items that delivered with any defect. The examples of defect are there is a hole in the uniform, the stiches are not neat, etc. The formula for calculating the order delivered defect free conformance is as follow:

$$\frac{h}{h} \times 100\% \qquad \qquad \text{... (4.6)}$$

e.   Shipping Documentation Accuracy

Shipping documentation accuracy is used to know the number of accuracies for shipping documentation. The examples of accurate shipping documentation are the shipping documentation is free from incorrect order quantity number, the incorrect date of shipping, etc. The formula for calculating the shipping documentation accuracy is as follow:

$$\frac{h \quad h}{h \quad h} \times 100\% \qquad \qquad \text{... (4.7)}$$

f.   Deliver Cycle Time

Deliver cycle time is used to know the average time of the item delivery process from vendor to the destination.

4. Return Process

Return is the process of returning the item that was ordered from the vendor. The returning process is done because of some reasons for instance the item that not produced as desired design, defect item, etc. The metrics for returning item is arranged in order to prevent any undesired condition when the return process is done. The metrics of returning process is arranged based on SCOR approach which will be described as follows:

a. Warranty Cost

Warranty cost is used to know how much is the vendor will cover the costs related to the returning item because of the fault of vendor. The formula for calculating the percentage of warranty cost from vendor is as follow:

$$\frac{h}{k} \times 100\% \qquad \text{... (4.8)}$$

b. Current Supplier Return Order Cycle Time

Current supplier return order cycle time is used to know the average time of the returning item from supplier.

4.1.5 Risk Identification

According to the SCOR metrics in procurement of school uniform at Sekolah Bina Nusantara Batam, therefore it was found some risk related to the activity of plan, source, deliver and return completely with its risk owner. The risks that was identified in each procurement process based on the SCOR metrics is explained in Table 4.3 as follows.

Table 4.3 Risk Identification

No.	SCOR Level 1	SCOR Level 2	Metrics	Risk Event	Risk Owner	Risk Event Code
1.		Plan Procurement Planning	Accuracy planning	Overload of product	Institution	PE1
2.				Shortage of product	Institution	PE2
3.			RS.3.99 Plan Source Cycle Time	Planning process is not on time	Institution	PE3
4.			CO.3.2 Cost to Plan Source	Cost for sourcing is over cost	Institution	PE4
5.		Vendor Selection	RS.3.125 Select Supplier and Negotiate Cycle Time	Vendor selection process is too long	Institution	PE5
6.	Source	Product Procurement	RL.3.18 % Orders Processed Complete	Problem when producing order	Vendor	SE1
7.			RL.3.21 % Orders Received with Correct Content	Order item does not meet specification	Institution	SE2
8.			RS.3.123 Schedule Production Activities Cycle Time	Production process is done too long	Vendor	SE3
9.			CO.3.7 Cost to Receive Product	The total cost is over price	Institution	SE4

No.	SCOR Level 1	Level 2	Metrics	Risk Event	Risk Owner	Risk Event Code
10.	Receive	Receive Finish Product	R.L.3.20 % Order Received On-Time to Demand Requirement	The order is late to be received	Institution	DE1
11.			RL.3.33 Delivery Item Accuracy	The received order is not match from the order plan	Institution	DE2
12.			RL.3.35 Delivery Quantity Accuracy	The received order item is not fulfilling the stock	Institution	DE3
13.			RL.3.42 Order Delivered Defect Free Conformance	The received order has defect	Institution	DE4
14.			RL.3.47 Return Shipments Shipped on Time	Return of order is not on time	Institution	DE5
15.			RL.3.50 Shipping Documentation Accuracy	Invalid shipping documentation	Institution	DE6
16.			RS.3.24 Deliver Cycle Time	Delivery time is too long	Institution	DE7
17.	Return	Return Product to Vendor	RL.3.56 Warranty Costs	Return cost is not guaranteed	Institution	RE1
18.			RS3.22 Current Supplier Return Order Cycle Time	The time of return order is too long	Institution	RE2

According to the Table 4.3, it can be known that the risks are owned by two parties; institution and vendor. However, since the risk at vendor is uncontrol able, therefore the risks at vendor are ignored. After determining the risk event of each metrics in procurement of uniform, the

risk impact in the line with the risk agent are given by the head of institution which is the expert in Sekolah Bina Nusantara Batam related to the procurement activity. The Table 4.4 represents the risk impact and risk agent of each risk event in procurement of uniform.

Table 4.4 Risk Impact and Risk Agent of Risk Event

Risk Event Code	Risk Event	Risk Impact	Risk Agent	Risk Owner	Risk Agent Code
PE1	Overload of product	Waste cost	Inaccurate prediction number	Institution	A1
PE2	Shortage of product	Customer complain	Inaccurate prediction number	Institution	
PE3	Planning process is not on time	Distribution process is inhibited	Late starting planning time	Institution	A2
PE4	Cost for sourcing is over cost	Financial loss	Inaccurate plan for cost	Institution	A3
PE5	Vendor selection process is too long	Distribution process is inhibited	Does not have business partners	Institution	A4
SE2	Order item does not meet specification	Customer complain	Vendor cannot handle all specifications	Vendor	A6
SE4	The total cost is over price	Financial loss	Vendor break the cost agreement	Vendor	A8
DE1	The order is late to be received	Distribution process is inhibited	Problem on delivery	Distributor	A9
DE2	The received order is not match from the order plan	Customer complain	Absence of quality control by vendor	Vendor	A10
DE3	The received order item is not fulfilling the stock	Customer complain	Absence of quality control by vendor	Vendor	
DE4	The received order has defect	Customer complain	Absence of quality control by vendor	Vendor	
DE5	Return of order is not on time	Distribution process is inhibited	Slow respond vendor	Vendor	A11
DE6	Invalid shipping documentation	Shipments cannot be traced	Unchecking the document by vendor	Vendor	A12

Risk Event Code	Risk Event	Risk Impact	Risk Agent	Risk Owner	Risk Agent Code
DE7	Delivery time is too long	Distribution process is inhibited	Does not have agreement with vendor	Institution	A13
RE1	Return cost is not guaranteed	Financial loss	Does not have agreement with vendor	Institution	
RE2	The time of return order is too long	Distribution process is inhibited	Much repair requirement of return product	Institution	A14

Risk impact and risk agent of each risk event have been identified. Based on the risk agent, there are three kinds of risk owner which are institution, vendor and distributor. However, only the risks owned by institution that will be more discovered since the risks owned by vendor and distributor is uncontrol able.

After the risk impact and risk agent are discovered, therefore it can be known the criteria of severity in each risk event along with the occurrence of each risk agent in the process of school uniform procurement at Sekolah Bina Nusantara Batam. These criteria are based on the interview with expert at Sekolah Bina Nusantara Batam. Table 4.5 represented the criteria of severity in the risk event of in the process of school uniform procurement at Sekolah Bina Nusantara Batam.

Table 4.5 Severity Criteria

Risk Event Code	Risk Impact	Criteria				
		1 (None)	2 (Very Minor)	3 (Minor)	4 (Very Low)	5 (Low)
PE1	Waste cost	>10 million	10-19 million	20-29 million	30-39 million	40-49 million
PE2	Customer complain	1-5 people in 1 order	6-10 people in 1 order	11-15 people in 1 order	16-20 people in 1 order	21-25 people in 1 order

Risk Event Code	Risk Impact	1 (None)	2 (Very Minor)	Criteria 3 (Minor)	4 (Very Low)	5 (Low)
PE3	Distribution process is inhibited	1 day	2 days	3 days	4 days	5 days
PE4	Financial loss	>10 million	10-19 million	20-29 million	30-39 million	40-49 million
PE5	Distribution process is inhibited	1 day	2 days	3 days	4 days	5 days
SE2	Customer complain	1-5 people in 1 order	6-10 people in 1 order	11-15 people in 1 order	16-20 people in 1 order	21-25 people in 1 order
SE4	Financial loss	<10 million	10-19 million	20-29 million	30-39 million	40-49 million
DE1	Distribution process is inhibited	1 day	2 days	3 days	4 days	5 days
DE2	Customer complain	1-5 people in 1 order	6-10 people in 1 order	11-15 people in 1 order	16-20 people in 1 order	21-25 people in 1 order
DE3	Customer complain	1-5 people in 1 order	6-10 people in 1 order	11-15 people in 1 order	16-20 people in 1 order	21-25 people in 1 order
DE4	Customer complain	1-5 people in 1 order	6-10 people in 1 order	11-15 people in 1 order	16-20 people in 1 order	21-25 people in 1 order
DE5	Distribution process is inhibited	1 day	2 days	3 days	4 days	5 days
DE6	Shipments cannot be traced	1 shipment	2 shipments	3 shipment	4 shipment	5 shipment
DE7	Distribution process is inhibited	1 day	2 days	3 days	4 days	5 days
RE1	Financial loss	>10 million	10-19 million	20-29 million	30-39 million	40-49 million
RE2	Distribution process is inhibited	1 day	2 days	3 days	4 days	5 days

Risk Event Code	Risk Impact	Criteria				
		6 (Moderate)	7 (High)	8 (Very High)	9 (Extremely High)	10 (Dangerously High)
PE1	Waste cost	50-59 million	60-69 million	70-79 million	80-89 million	>90 million
PE2	Customer complain	26-30 people in 1 order	35-40 people in 1 order	45-50 people in 1 order	51-55 people in 1 order	>55 people in 1 order
PE3	Distribution process is inhibited	6 day	7 days	8 days	9 days	10 days
PE4	Financial loss	50-59 million	60-69 million	70-79 million	80-89 million	>90 million
PE5	Distribution process is inhibited	6 day	7 days	8 days	9 days	10 days
SE2	Customer complain	26-30 people in 1 order	35-40 people in 1 order	45-50 people in 1 order	51-55 people in 1 order	>55 people in 1 order
SE4	Financial loss	50-59 million	60-69 million	70-79 million	80-89 million	>90 million
DE1	Distribution process is inhibited	6 day	7 days	8 days	9 days	10 days
DE2	Customer complain	26-30 people in 1 order	35-40 people in 1 order	45-50 people in 1 order	51-55 people in 1 order	>55 people in 1 order
DE3	Customer complain	26-30 people in 1 order	35-40 people in 1 order	45-50 people in 1 order	51-55 people in 1 order	>55 people in 1 order
DE4	Customer complain	26-30 people in 1 order	35-40 people in 1 order	45-50 people in 1 order	51-55 people in 1 order	>55 people in 1 order
DE5	Distribution process is inhibited	6 day	7 days	8 days	9 days	10 days
DE6	Shipments cannot be traced	6 shipment	7 shipments	8 shipment	9 shipment	>9 shipment

Risk Event Code	Risk Impact	Criteria				
		6 (Moderate)	7 (High)	8 (Very High)	9 (Extremely High)	10 (Dangerously High)
DE7	Distribution process is inhibited	6 day	7 days	8 days	9 days	10 days
RE1	Financial loss	50-59 million	60-69 million	70-79 million	80-89 million	>90 million
RE2	Distribution process is inhibited	6 day	7 days	8 days	9 days	10 days

After determining the criteria of severity in procurement activity of school uniform at Sekolah Bina Nusantara Batam, therefore the criteria of occurrence of the risk agent also will be determined. The criteria of occurrence of the risk agent is represented in Table 4.6 below.

Table 4.6 Occurrence Criteria

Risk Agent Code	Risk Agent	Criteria				
		1 (Remote)	2 (Very Minor)	3 (Minor)	4 (Very Low)	5 (Low)
A1	Inaccurate prediction number	1 time in 5 years	2 times in 5 years	3 times in 5 years	4 times in 5 years	5 times in 5 years
A2	Late starting planning time	1 time in 5 years	2 times in 5 years	3 times in 5 years	4 times in 5 years	5 times in 5 years
A3	Inaccurate plan for cost	1 time in 5 years	2 times in 5 years	3 times in 5 years	4 times in 5 years	5 times in 5 years
A4	Does not have business partners	>10 business partners in 5 years	9 business partners in 5 years	8 business partners in 5 years	7 business partners in 5 years	6 business partners in 5 years
A13	Does not have agreement with vendor	6 time in 5 years	7 times in 5 years	8 times in 5 years	9 times in 5 years	>9 times in 5 years
A14	Much repair requirement	6 repair requireme	7 repair requireme	8 repair requiremen	9 repair requiremen	>9 repair requiremen

	of return product	nts in one order	nts in one order	ts in one order	ts in one order	ts in one order

| Risk Agent Code | Risk Agent | Criteria | | | | |
		6 (Moderate)	7 (High)	8 (Very High)	9 (Extremely High)	10 (Dangerously High)
A1	Inaccurate prediction number	6 time in 5 years	7 times in 5 years	8 times in 5 years	9 times in 5 years	>9 times in 5 years
A2	Late starting planning time	6 time in 5 years	7 times in 5 years	8 times in 5 years	9 times in 5 years	>9 times in 5 years
A3	Inaccurate plan for cost	6 time in 5 years	7 times in 5 years	8 times in 5 years	9 times in 5 years	>9 times in 5 years
A4	Does not have business partners	5 business partners in 5 years	4 business partners in 5 years	3 business partners in 5 years	2 business partners in 5 years	1 business partners in 5 years
A13	Does not have agreement with vendor	6 time in 5 years	7 times in 5 years	8 times in 5 years	9 times in 5 years	>9 times in 5 years
A14	Much repair requirement of return product	6 repair requirements in one order	7 repair requirements in one order	8 repair requirements in one order	9 repair requirements in one order	>9 repair requirements in one order

4.2 Data Processing

Data processing is done to process the collecting data from the previous step. Data processing is done in the form of house of risk phase 1, five why and house of risk phase 2.

4.2.1 House of Risk Phase 1

House of risk phase 1 is used to rank the risk agent occurred in the procurement process of school uniform at Sekolah Bina Nusantara Batam. The house of risk is done based on the interview with the expert of procurement activity at Sekolah Bina Nusantara Batam. The house of risk phase 1 is represented in the Table 4.7 below.

Table 4.7 House of Risk Phase 1

Business Processes	Risk Event (E_i)	Risk Agents (A_j)						Severity of Risk Event i (S_i)
		A_1	A_2	A_3	A_4	A_{13}	A_{14}	
Plan	PE1	9	3					5
	PE2	9	3					5
	PE3		9		3			5
	PE4	3		9				5
	PE5				9			7
Source	SE2					9		7
	SE4			9		9		8
Deliver	DE1		1			3		7
	DE2					9		9
	DE3					9		6
	DE4					9		6
	DE5						3	4
	DE6							5
	DE7					9		7
Return	RE1					9		4
	RE2					1	9	6
Occurrence of agent j		8	6	4	8	5	8	
Aggregate risk potential j		840	492	468	624	2250	528	
Priority rank of agent j		2	5	6	3	1	4	

The result of house of risk resulted the rank of aggregate risk potential of risk agent. There are six ranks of risk agents from the first phase of house of risk. The pareto chart is used to determine which priority risks agent that will be processed in the next step. The pareto chart is presented in Figure 4.5 below.
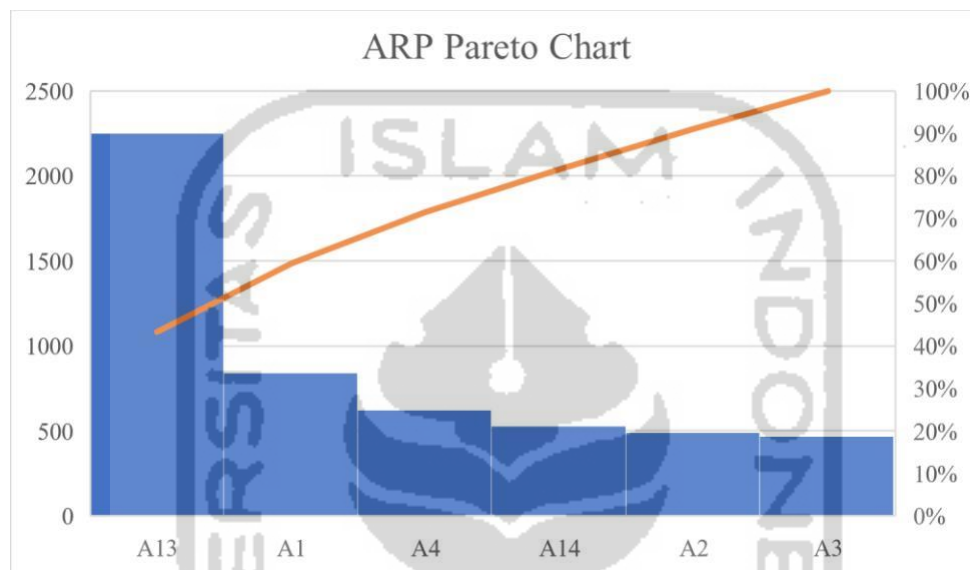

Figure 4.5 ARP Pareto Chart

According to pareto chart, the 80% of risk agents affecting the procurement of school uniform in Sekolah Bina Nusantara Batam are does not have agreement with vendor (A13), inaccurate prediction number (A1), inaccurate plan for cost (A4) and much repair requirement of return product (A14).

4.2.1   Fishbone Diagram

Based on the risk identification by using house of risk, it was found that there are four priority risk agents of procurement of school uniform at Sekolah Bina Nusantara Batam. Therefore, the causes analysis is done by using fishbone diagram method to make a better decision of

mitigation. Fishbone diagram of the highest risk agent will be presented in Figure 4.6 as follow.
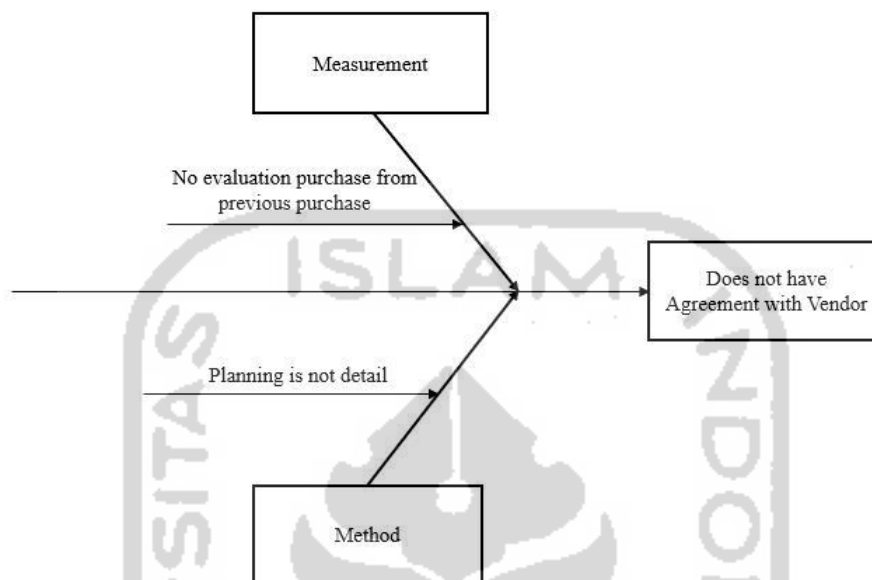

Figure 4.6 Causes of A14

The fishbone diagram shows that the absence of agreement with vendor is caused by the planning is not detail and there no evaluation from the previous purchase. Moreover, another fishbone diagram of the four highest risk of procurement school uniform at Sekolah Bina Nusantara shows many kinds of causes that summarized in the Table 4.8 below.

Table 4.8 Risk Cause Summarize

No	Risk Cause	Cause Code
1.	No evaluation purchase from previous purchase	C1
2.	Planning is not detail	C2
3.	Purchase requirement is not detail	C3
4.	Time of purchasing is too short	C4
5.	Too much workload	C5

After the risk causes is analyzed, then the pareto chart will be used to determine which causes are should be prioritized. The value of each cause is obtained from the breakdown of risk agent occurrence. The result of pareto chart is represent in Figure 4.7 as follows.
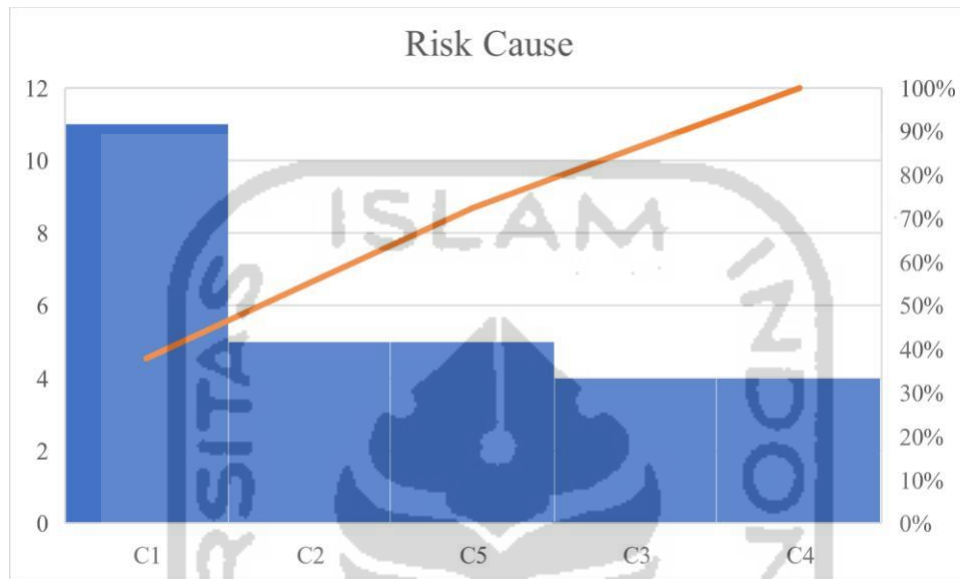

Figure 4.7 Risk Cause Pareto Chart

Based on the pareto chart, the causes which affect 80% of the risk agent are no evaluation purchase from previous purchase (C1), planning is not detail (C2), too much workload (C5), and purchase requirement is not detail (C3).

4.2.2 Mitigation Strategy

The mitigation risk strategy to the risk agent priority is done to reduce the 80% of risk event that caused by the risk agent based on the principle of 80:20. The risk mitigation strategy for the institution based on the causes of each risk agent is explained in Table 4.9.

Table 4.9 Risk Mitigation

Cause Code	Cause Description	Risk Mitigation	Risk Mitigation Code
C1	No evaluation purchase from previous purchase	Annual evaluation of purchasing school uniform	M1
		Make an evaluation recap of purchasing school uniform	M2
C2	Planning is not detail	Design a standard operational procedure (SOP) of purchasing school uniform	M3
C5	Too much workload	Create aschool uniform purchaser team	M4
C3	Purchase requirement is not detail	Design a standard operational procedure (SOP) of purchasing school uniform	M3

4.2.3 House of Risk Phase 2

House of risk phase 2 is used to determine which actions are to be done first, considering their differing effectiveness as well as resources involved and the degree of difficulties in performing. The house of risk phase 2 is represented in Table 4.10.

Table 4.10 House of Risk Phase 2

To be Treated Risk Agent (A_i)	Risk Mitigation (M_k)				Aggregate Risk Potential (ARP_i)
	M_1	M_2	M_3	M_4	
A13	9	3	9	3	2250
A1	9	9			840
A4	9	9			624
A14	3	3	9	3	528
Total Effectiveness of Action k	35010	21510	25002	8334	
Degree of Difficulty Performing Action k	2	3	5	3	
Effectiveness to Difficulty Ratio	17505	10755	12501	4167	
Rank of Priority	1	3	2	4	

According to the result of house of risk phase 2, the mitigation priority is to make the annual evaluation of purchasing school uniform. The second is to make the evaluation recap of purchasing school uniform. The third is designing an SOP of purchasing school uniform and the last is creating a school uniform purchaser team.

CHAPTER V

DISCUSSION

5.1 SCOR Metric

Based on the collecting data and processing, the SCOR metric is developed based on the purchasing process of school uniform at Sekolah Bina Nusantara Batam. The purchasing process is mainly divided into plan, source, receive and return. In plan process, there are 4 metrics that comes from reliability, responsiveness and cost. In source process, there are 4 metrics that comes from reliability, responsiveness and cost. In receive process, there are 7 metrics that comes from reliability and responsiveness. While in return process, there are 2 metrics that comes from reliability and responsiveness.

The total metrics for purchasing of school uniform activity at Sekolah Bina Nusantara Batam is 17 metrics. The arranged SCOR metrics has been explained based on the definition in the line with the formula. Therefore, the SCOR metrics will be continued to define the its risk event.

5.1 Risk Identification

Based on the SCOR metric, the risk identification is started by identifying the risk event of each activity of uniform procurement at Sekolah Bina Nusantara Batam. Risk event is identified based on the business process and SCOR metric that has been developed. In plan activity, there are 5 risk events. In source activity, there are 4 risk events. In receive activity, there are 7 risk events. While in return activity, there are 2 risk events. The risk owner also identified to know the risks belong to the institution. From the total of 18 risk events in procurement school uniform, there are two risks that belong to the vendor which will be ignored for the next identification.

After determining the risk events, the risk agents then are analyzed. The risk agents are identified based on the risk events occurred in the uniform procurement activity. Based on the identification, there are 4 risk agents in plan activity. In source activity, there are 4 risk agents identified. In the receive activity, there are 4 risk agents. While in return activity, there are 2 risk agents. Moreover, the risk owner also identified. From the total of 14 risk agents in uniform procurement at Sekolah Bina Nusantara Batam, only six risk agents belong to institution, a risk belongs to distributor and the rest are belonged to vendor. Therefore, the only six risk agents will be proceeded for the next step.

The risk agents have been identified, then the criteria of severity and occurrence are identified. The severity criteria are determined based on the impact of risk agents to the risk events. While the occurrence criteria are determined based on the probability of risk agents happened in the risk events. The determination is obtained from the interview to the expert of Sekolah Bina Nusantara Batam.

Afterwards, the risk assessment is done using house of risk (HOR). There are two phases done to assess the risk agents. In first phase, the assessment is done by giving the severity scale of risk events and occurrence scale of risk agents along with the correlation value between risk events and risk agents from the expert by discussion. Then, the aggregate

risk potential (ARP) is calculated using certain formula therefore the rank of risk agents is obtained.

5.2 Risk Mitigation

Based on the first phase of HOR, the priority risks are chosen using Pareto chart which resulted four risk agent priority. Each of risk agents is identified their causes using Fishbone diagram. From the Fishbone diagram, there are five causes of risk agents in uniform procurement at Sekolah Bina Nusantara Batam. To determine which causes are most prioritized, the used of Pareto chart is done then resulting four risk cause priority.

The first is the absence of evaluation purchase from previous purchasing activity. Every year, after the uniform is purchased, there is no evaluation program to evaluate the weakness of purchase which should be improved in the next purchase. However, the evaluation is important to analyze the detail of purchasing activity, either what need to be maintained or what need to be improved. Therefore, the mitigation strategies are scheduled the evaluation of purchasing activity and make a recap of the evaluation to enable the institution reviewing the purchase evaluation in the next purchase activity.

The second is the planning of purchasing school uniform is not detail. The school uniform is an important aspect related to the identity for the school. The detail of each planning should be considered to maintain the quality of the uniform. The planning procurement includes the team of purchaser along with the responsibility, the budget of the purchasing, the schedule of purchasing, the requirement of vendor needed, the school uniform detail, etc. The detail is better to be noted into the standard of purchasing procedure to make ease the purchaser in charge. Therefore, to prevent the risk, the mitigation strategy is designing the standard operational procedure (SOP) of purchasing activity.

The third is too much workload of school uniform purchaser. Currently, the purchaser of anything needed for the school is done by the top management. The workload is high because in the same time they will purchase many needs such as uniform, book, etc. Therefore, to breakdown the workload, the mitigation is creating the school uniform purchaser team. The team can consist of 2 or 3 people adopting from the current employee in the institution. This team will focus on the procurement of uniform only.

The forth is the purchase requirement is not detail. The detail of requirement of the uniform is important to maintain the standard quality of the uniform. The color of the uniform, the material, the design, etc. This requirement should be told to the vendor in detail. Therefore, the mitigation is by creating the SOP of purchasing activity.

From each explanation of four causes, therefore, the mitigations are identified into 4; schedule an annual evaluation of purchasing activity, make a recap of purchasing evaluation, design an SOP of purchasing and create the purchaser team. After determine the mitigation strategy, the second phase of HOR is done to determine which strategy should be prioritized. The correlation value of each risk agent and risk mitigation along with the degree of difficulty for each risk mitigation are determined by the expert at Sekolah Bina Nusantara Batam. Then the value of effectiveness to difficulty ratio is obtained which resulted the priority risk mitigation; scheduled annual evaluation of purchasing activity.

CHAPTER VI

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Based on the discussion, it can be concluded that:

1. There are four risk agent priority in the activity of uniform procurement at Sekolah Bina Nusantara Batam, which are does not have agreement with vendor, inaccurate prediction number, inaccurate plan for cost and much repair requirement of return product.

2. The mitigation strategy to prevent any risks in uniform procurement at Sekolah Bina Nusantara Batam are schedule an annual evaluation of purchasing activity, make a recap of purchasing evaluation, design an SOP of purchasing and create the purchaser team. With the priority risk mitigation is to schedule annual evaluation of purchasing activity.

6.2 Recommendation

The recommendations for the future research are:

1. Apply the monitoring and evaluation of the proposed mitigation for the company.
2. Apply another method to evaluate and mitigate the risk at supply chain, especially at procurement activity.

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APPENDIX