SMALL MEDIUM ENTERPRISE WAREHOUSE SELECTION DURING COVID-19: ANP METHOD

THESIS

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By
Agung Aulya Perdana Tanjung (13522141)

INTERNATIONAL PROGRAM
DEPARTMENT OF INDUSTRIAL ENGINEERING
UNIVERSITAS ISLAM INDONESIA
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AUTHENTICITY STATEMENT

In the name of Allah SWT, I confess this work is on my own work except for the excerpts and the summaries that each of their sources has already been cited and mentioned. If in the future my confession is proved to be wrong and dishonest resulting the violence of the legal regulation of the papers and the intellectual property rights, then I would have the will to return my degree to be drawn back to Universitas Islam Indonesia.

Yogyakarta, 28th January 2021

Agung Aulya Perdana Tanjung

13522141

ii

THESIS APPROVAL OF SUPERVISOR

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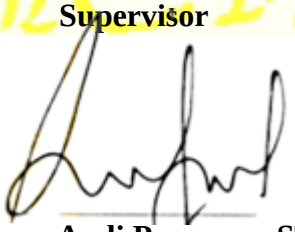
By:

Name : Agung Aulya Perdana Tanjung

Student Number : 13522141

Yogyakarta, 29th January 2021

Supervisor



(Muhammad Ridwan Andi Purnomo, ST., M.Sc., Ph.D)

THESIS APPROVAL OF EXAMINATION COMMITTEE

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By:

Name : Agung Aulya Perdana Tanjung

Student Number : 13522141

Had 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

Muhammad Ridwan Andi Purnomo, S.T., M.Sc., Ph.D
Examination Committee Chair

Agus Mansur, S.T., M.Eng.Sc.
Member I

Dr. Taufiq Immawan S.T., M.M..
Member II

Acknowledged by,

Head of Undergraduate Program- Department of Industrial Engineering

Faculty of Industrial Technology

Universitas Islam Indonesia

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

DEDICATION PAGE

This thesis dedicated to all of my beloved person in my life,

To my beloved parents, Father & Mother, Mr. Arifin Tanjung and Mrs. Masrelawati Nasution for infinity support, care, love, and pray

My brothers and sister, Ayu & Adit

My thesis supervisor,

All of my friends and family of, IP TI UII batch 2013 for colorful life during my bachelor degree, life lesson, and never ending love. Infinity Solidarity

And International Program Industrial Engineering Univeristas Islam Indonesia

Thank you for everything

MOTIVATION PAGE

“For each one are successive [angels] before and behind him who protect him by the decree of Allah. Indeed, Allah will not change the condition of a people until they change what is in themselves. And when God intends for a people ill, there is no repelling it. And any is not for them besides Him any patron.”

— Qs. Ar-Ra’du: 11

“For indeed, with hardship will be ease. Indeed, with hardship will be ease.”

— QS. Al-Insyirah: 5-6

“Travel in the earth and see what was the end of those before. Most of them were associators”.

— QS. Ar-Rum: 42

“Kegagalan hanya terjadi bila kita menyerah."

— B.J. Habibie

“Tidak ada gunanya IQ tinggi namun malas, tidak miliki disiplin. Yang penting adalah kamu sehat dan mau berkorban untuk masa depan yang cerah,"

— B.J. Habibie

PREFACE

Assalamualaikum Wr. Wb.

Alhamdulillahi Rabbil'alamin, gratitude and praise to Allah SWT for the strength, grace, and guidance, to help the Author in completing this thesis. During arranging this thesis, Author had faced so many challenges and problems. However, Author had obtained so many helps and supports, either directly or indirectly, from some parties involved. On this occasion, Author would like to appreciate and thank to all the parties below:

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Author realize that this thesis is still have some weaknesses so that Author really expect any suggestions from readers for the perfection of this report. Hopefully this report and information included will be useful for Author and give benefit to other parties who read this.

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Yogyakarta, January 2021

Agung Aulya Perdana Tanjung

ABSTRACT

The global pandemic of the corona virus, known as Covid-19, has spread throughout the world, and poses a threat to all countries, including Indonesia. The history of the Indonesian economy records the contribution of SME in facing various crises. As during the monetary crisis in 1998, SME became a national economic buffer and remained strong supporting the national economy. However, at this time, the SME sector will be the most vulnerable sector to the economic crisis caused by COVID-19 pandemic. The COVID-19 pandemic outbreak has forced many businesses to close, leading to an unprecedented disruption of commerce in most industry sectors. Unlike other sector, bicycle retail demand is rising, makes bicycle and its spare part are rare and difficult to find to fulfill the demand. Those need to stock up the bicycle and its spare part as make bicycle retailer need to find extra space, warehouse. This qualitative research aims to find the ideal warehouse location during Covid-19 pandemic and finding the suitable criteria that influence the decision making. In this research, researchers using ANP (Analytical Network Process) methodology. Researchers use ANP to know the best Warehouse location and COVID-19 pandemic outbreak effect on warehouses location selection. Economic, warehouse specification, local environment is found as criteria to find the best warehouse location.

Keyword: Covid-19, Pandemic, SME, Warehouse, ANP, Bicycle retailer

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

1.1 INRODUCTION

In this first chapter, it will be explained a brief introduction which elaborates the background, problem formulation, purpose, scope and benefit of the research, as well as the systematical writing

1.1.1 Background

It is widely acknowledged that small and medium enterprises (SMEs) play an important role in the social and economic development of the region and the country. The strong SME sector contributes significantly to the economy, contributes to the overall domestic productivity, by reducing unemployment, reducing poverty levels and promoting entrepreneurship. In Indonesia, SMEs are one of the mainstays of the economic system. According to the Indonesian Department of Industry, the contribution of the small and medium enterprise sector to gross domestic product has increased over the past five years from 57.84% to 60.34% since 2016. 97.22 percent at the same time. Industrial trade and highly competitive manufacturing lands have given SMEs excellent opportunities for development and expansion through cost-effectiveness and quality improvement (Tan et al., 2014).

However, many SMEs have failed in the first five years due to the various challenges they face on a regular basis (Lumbwe et al., 2018). This situation puts SMEs in a very dangerous position because they have to work in a very responsive way to constantly changing situations. In addition, SMEs compared to larger organizations have limited resources, and in many cases leadership lacks the long-term commitment required.

The business environment of SMEs is influenced by factors within and outside the organization, which contribute to the sustainability and success of the organization. According to Kolstad & Wiig, 2014, the internal environment incorporates elements of a business environment that is highly controlled by the business such as management skills and capabilities, financial access and technical skills. While the external environment is the external factors of the business that will contribute to its success. The effect can be positive or negative. An entity cannot control external factors such as economic and market differences; crime, corruption, infrastructure, regulation, natural disaster, epidemics etc.

Indonesia's economic history records the SME's contribution to addressing various issues. As in the period of the financial crisis in 1998, the SME became a national economic stumbling block and remained strong supporting the country's economy. However, at the moment, the SME sector will be the most vulnerable sector to the economic crisis caused by COVID-19. The outbreak of Coronavirus is causing global emergencies, as well as a global economic downturn. Trade, investment and employment are all affected and this critical situation will contribute to achieving the goals of sustainable development. The development of coronavirus outbreaks affects a variety of areas with a loss scale that is often very broad and multifaceted. Small and Medium Enterprises are a high risk business group because they do not have the resources to survive this crisis.

The global epidemic of corona virus, known as Covid-19, has spread worldwide, and is a threat to all countries, including Indonesia. As of September 20th 2020, based on data from the World Health Organization (WHO), 30,369,778 confirmed COVID-19 cases, including 948,795 deaths. According to official data from the Indonesian Government, the Directorate General of Disease Prevention and Control of the Ministry of Health, Indonesia has recorded 240,687 cases and 9,448 deaths.

With an epidemic of epidemics, it is extremely difficult to quantify its long-term effects. Although society has been plagued by many epidemics in the past, it is difficult to quantify long-term economic, moral, or social outcomes as these factors have not been

widely studied in the past. Some time after the epidemic, we are often less interested in investing and more interested in saving our money, which has led to slower economic growth. Given the current situation, where saving money means poor returns, there is absolutely no guarantee that we will preserve the environment as in the past (Donthu & Gustafsson, 2020).

The outbreak of COVID-19 has forced many businesses to shut down, leading to unprecedented trade disruption in many industrial areas. Retailers and products face many short-term challenges, such as those related to health and safety, work capacity, personnel, cash flow, consumer demand, sales and marketing. However, successfully navigating these challenges does not guarantee a promising future, nor does it. This is because once we have passed through this epidemic, we will come from a very different world compared to that before the outbreak (Donthu & Gustafsson, 2020).

The COVID-19 crisis has had a lasting impact on many areas and many businesses. The bicycle industry sees the good and the bad by seeking a bicycle with its side part. Demand has doubled the cause of the shortage for months. The bicycle industry is struggling in many countries due to rising demand and demand.

Agung Jaya Bicycle Shop is one of the few medium-sized businesses affected by the increase in sales and cycling and the lack of a separate component in the ongoing COVID-19 epidemic. Founded in 1978 it starts as a family business. Today the Agung Jaya bicycle shop is already well established in Serang and Cilegon. It is one of the few official dealers in Banten province of Indonesia's well-known and leading brands such as Polygon, United Bike, Kenda, Swallow and Lucky Stone. Agung Jaya bike shop already has a plan to buy storage space before the onset of the COVID-19 epidemic. The outbreak of the COVID-19 has put many businesses in a precarious position as it has also forced the Agung Jaya Bicycle Store to close the store for an indefinite period of time. Forced to hold its plan to buy a new warehouse. When a new start is common with the city, business and people start to open up, cycling becomes a trend because of the trend. Since people are lonely and looking for another way to travel it is considered

1.2 Problem Formulation

Based on the description in the background above, the problems that come up in the research would be formulated and generate research questions as follows:

1. What cluster and node do influence the Agung Jaya Bicycle Store in selecting new warehouse during Covid-19 pandemic?
2. How is the result of analysis and recommendation of problem solution by using ANP method?

1.3 Research Objective

This paper is created to fulfill several objectives as mentioned as below:

1. To know which cluster and node that influences in decision making of Agung Jaya Bicycle new warehouse during Covid-19 pandemic.
2. To know the result of analysis and recommendation of problem solution by using ANP method

1.4 Scope of Research

There are some limitations that existed in this research, as mentioned as follows:

1. The data used are the results of literature research, interviews and questionnaires to the Agung Jaya Bicycle Store owner.
2. The research is carried out using ANP method.

1.5 Research Benefits

Based on the purpose of the research, this paper is developed to give the contribution as below:

1. To contribute in science and knowledge development.
2. To identify SMEs criteria on warehouse location selection during Covid-19 pandemic.
3. To identify COVID-19 pandemic outbreak impact on warehouse location selection.

1.6 Systematical Writing

Writing this study was based on the rules of scientific writing in accordance with the systematics as follows:

CHAPTER I INTRODUCTION

This chapter contains a preliminary description of research activities, on the background of the problem, formulation of the problem, the objectives to be achieved, the benefits of research and systematic writing.

CHAPTER II LITERATURE REVIEW

In this chapter, it is elaborated the theories of reference books and journals as well as the results of previous research related to the research problem which is used as reference for problem solving.

CHAPTER III RESEARCH METHODOLOGY

Contains the description of the framework and lines of inquiry, the research object to be studied and the methods used in the study.

CHAPTER IV COLLECTION AND PROCESSING DATA

Contains the data obtained during the research and how to analyze the data. Data processing result is displayed either in the form of tables and graphs. What is meant by processing the data also includes 7 analysis of the results obtained. This section is composed as reference to the discussion of the results to be written in Chapter V.

CHAPTER V DISCUSSION

Contains discussion of the results on data processing that has been done in the research. Compatibility with the objectives of research so as to produce a recommendation.

CHAPTER VI CONCLUSIONS AND RECOMMENDATIONS

Contains the conclusion of the analysis and any recommendations or suggestions on the results achieved in accordance with the problems identified during the study, so it should be considered for future studies.

REFERENCES

APPENDIX

CHAPTER II

LITERATURE REVIEW

This chapter will explain the literature review studies which divided into two, inductive and deductive. Inductive study is a study on previous reputable research. While, deductive study is study that explains about the basic theory that has relation with research that derived from the text books, etc. Inductive and deductive study need to be done to find out the gap between previous study and the current research and are conducted to avoid the plagiarism. This literature review will be divided in to several sub chapters.

2.1 Inductive Study

The inductive study that is also known as inductive reasoning is a literature study using previous research that has been documented in journals, books and or proceedings. The literature review is very helpful for the researcher to get appropriate theory and methods as guidance to conduct a research. The previous research for this study is explained as follows:

Sitharam & Hoque, 2016 learned about the role and contribution of SMEs at the national level. The purpose of this study was to identify internal and external factors affecting the performance of SMEs in KwaZulu-Natal, SA. This was a separate lesson for the 74 SME owners / managers who were members of the Durban Chamber of Commerce online using an anonymous questionnaire. The results show that advances in technology will improve business performance. In terms of the challenge, most respondents viewed competition as a major challenge. Almost all respondents indicated that crime and corruption affect business operations. Competition was the only thing between internal and external learning that revealed greater connections and performance of SMEs in KwaZulu-Natal ($p = 0.011$). SMEs need to see that they have to prepare for domestic and international competition. Collaboration between SMEs can be a way for SMEs to face competition.

Durak et al., 2017 conducted a study on the importance of storage space. In this study, it aims to find suitable storage space for a company that sells in four cities, Düzce, Bolu, Sakarya, Kocaeli, in the Eastern region of Marmara. Good decision-making methods and practices are determined by the experts of the three companies in each city and consult with the expert to create conditions first. Subsequently, data were obtained from the questionnaire and the four methods were divided into AHP and VIKOR methods. According to the results of the study, the sequences of Bolu, Düzce, Kocaeli and Sakarya were determined accordingly. This result shows that the firm is not in the right places, namely Düzce, at the moment. Because of the rare AHP and VIKOR techniques that are rarely used in the Turkish literature field, the study shows the real thing. One of the limitations of the study is that the number of identified professionals can be more than twelve.

Dixit et al., 2019 has studied the local decision of a local business. the study provides a novel perspective on assessing the impact of both economic and non-economic factors such as setting an example in business sector decisions. This paper expands the theory and practice by identifying and processing in addition to economic factors, the location of the images, that is, the concept of space, ownership (end items) and product image, visual image, and reputation (attractive). A very important issue in quantitative studies such as institutional space issues is the failure to identify quality features that were previously considered irrational.

García et al., 2014 analyzed site selection in companies. The purpose of this project is a practical approach to exploring suitable locations for new agricultural food stores. In addition, a literature review was conducted, an environmental analysis and the most common signs and techniques used in agricultural enterprises, as well as case studies with the aim of modeling the proposed approach. A multi-degree process called the Analytic Hierarchy Process has been selected as the basis for the research, and is used in the research process itself: the selection of a site for a new banana distribution area. Six general methods have been analyzed: location access, distance, cost, regional security, acceptance of the company's site, and its requirements. This process involves

assigning symbols to each common topic, as well as checking their value levels. Three different areas of Guadalajara, Jalisco, and Mexico DF have been surveyed for research, and the road used has been used to determine the best route.

Yang et al., 2008 found construction site decisions to be an integral part of the company's overall strategic plan. Objectives include producing a product or providing a service at a lower cost, with higher quality, or using a smaller amount of resources. This study proposes an AHP / ANP-based experimental model to assess environmental factors to help managers identify the pros and cons of a potential environment. In this study, an AHP / ANP-based evaluation model was proposed that supports management in identifying opportunities to select a profitable store location. A three-phase modeling process has been implemented which includes the development of the first process; resize and process details; and building a test model. Using the proposed model, the size and quantity of data reflects market attractiveness, consumer characteristics, and local qualifications. This size plays an important role in assessing store profitability in the service industry. The three tested areas were analyzed using the proposed model. The results of the proposed model and the data from the financial reports were compared to show actual performance.

In the Ozdagoglu study, 2012, a variety of approaches were developed for decision-making processes where an analytical approach to effective decision-making was needed; AHP is one of the best ways to determine between the structure of complex situations at different levels. In the meantime, the AHP approach approaches a variety of decision-making processes. Classical AHP requires determination testing; the ambiguous approach of the AHP was developed in relation to linguistic diversity when making decisions in uncertain conditions. The AHP and its extensions operate in a one-size-fits-all approach and do not allow for any interaction with other modes from different levels of senior leadership. The ANP has emerged within this AHP range and is a set of processes set to interact as a network in any way that incorporates sub-matrix processes and sub-processes based on traditional AHP comparison process

Lumbwe et al., 2018 contributes to enlightening the understanding of new businesses in the area of local decision-making; so that they can make informed

decisions that can improve the chances of survival of their businesses. This study provided an overview of the local decision of SMMEs in the city of Johannesburg. In particular, the study investigated the extent to which predictable variables (human resources, electronics, customer proximity, proximity to suppliers, proximity to competitors, and a safe and healthy environment) affect the variability of business operations. The business environment has a huge impact on business survival. Each location of choice offers a variety of opportunities, opportunities and threats that sometimes arise as a benefit or obstacle. It is therefore important that the business owner and managers pay close attention and consideration, those factors that will determine the quality of their local decisions.

In their study, Shukla et al., 2017 demonstrated how Fuzzy AHP can be used in selecting the location of modern agricultural depots using three methods, Availability, Cost and Market of the other three alternatives considered. The results show that Alternative1, Alternative 3, Alternative 2 are in order of suitability for storage space. It is clear that Fuzzy-AHP can be used to solve the problem of selecting good farming sites. This study supports the fact that, the use of Fuzzy AHP in problem solving problem selection seems to be the most effective and efficient way to select the most profitable location for modern storage space.

Jharkharia & Shankar, 2005 introduced a comprehensive approach to selecting a service provider. The proposed approach consists of two parts for initial providers of existing providers, and final selection based on the analytical process (ANP). The methods, appropriate for selecting a provider, were identified and used to build the ANP model. Subsequently, the use of the ANP in the provider's final selection is illustrated by an example. The results of this example show that the interaction between the user and the service providers is the most important decision, which influences the final selection process. This approach also gives decision makers a better understanding of the complex relationships of the right criteria in decision-making, which can also improve the credibility of the decision.

Cheng et al., 2005 introduced the analytics network (ANP) process hiring to select the best shopping site site. The ANP is a new and powerful multilateral decision-making process (MCDM) because it can provide a comprehensive framework for resolving social, government and business decision-making issues. However, there is a shortage of papers published in the construction industry that illustrate this approach with illustrative examples. In the present paper, it is suggested that the ANP is ready for the selection of a shopping area. An example is shown. To clarify the differences between the ANP and the high-throughput analysis (AHP), the findings of these two methods are comparable. Comparative results show that the ANP is a powerful tool for resolving a decision-making problem when dependent relationships have significant implications for the decision-making environment.

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Peker et al., 2016 addresses the problem of logistics center site selection, using Analytic Network Process/Benefits, Opportunities, Costs and Risks, which is a multi-criteria decision-making technique. The decision problem is applied to the city of Trabzon, which is an important city of the Eastern Black Sea Region in Turkey. First, the results are evaluated in terms of each sub-network and each group and, next, are consolidated for each alternative. They yield that Alternative A is the most appropriate logistics center location of all in Trabzon. Furthermore, the sensitivity analysis results emphasize that the decision model is robust.

Table 2.1 Literature Review

No.	Researcher	Title of Study	Method
1	Sitharam & Haque, 2016	Factors Affecting the Performance of Small and Medium Enterprises in Kwazulu-Natal, South Africa	Sample Size Decision
2	Durak et al., 2017	Warehouse Site Selection in Retail Sector: An Application of AHP (Analytical Hierarchy Process) and Vikor Methods	AHP & Vikor
3	Dixit et al., 2019	Strategic Business Location Decisions: Importance of Economic Factors and Place Image	Weighted Decision Matrix
4	Yang et al., 2008	Location Selection Based on AHP/ANP Approach	AHP & ANP
5	Ozdagoglu, 2012	A Multi-Criteria Decision-Making Methodology on The Selection of Facility Location: Fuzzy ANP	Fuzzy ANP
6	Lumbwe et al., 2018	The Impact of Location Decision on Small, Micro, and Medium	Quantitative Descriptive Survey
7	Shukla et al., 2017	Multicriteria Decision Making Based Solution to Location Selection for Modern Agri-Warehouses	
8	Shankar & Jharkharia, 2005	Selection of Logistics Service Provider: An Analytic Network Process (ANP) Approach	ANP
9	Cheng et al., 2005	The Analytic Network Process (ANP) Approach to Location Selection: A Shopping Mall Illustration	ANP
10	Peker et al., 2016	Logistics Center Site Selection by ANP/BOCR Analysis: A Case Study of Turkey	ANP & BCOR

2.2 Deductive Study

2.2.1 Small Medium Enterprise (SME)

Small and Medium Enterprise (SME) has different definitions in each literature, agencies, institutions, and even the law. In accordance with Law number 20 of 2008 concerning Micro, Small and Medium Enterprises, SME is defined as follows: (1) Micro enterprise is productive business owned by individual and /or individual business entity fulfilling the criteria of Micro Business as stipulated in law, (2) Small Business is a stand-alone productive economic enterprise, carried out by an individual or business entity which is not a subsidiary or not a branch of a company owned, controlled, or becomes part of either directly or indirectly of the Medium Business or Large Enterprises that meet the criteria of Small Business as referred to in this Law, (3) Medium Enterprises shall be stand-alone productive economic enterprises, carried out by individuals or business entities that are not subsidiaries or branches owned, controlled or be part directly or indirectly with Small Business or Big Business with total sum of net worth or annual sales proceeds as provided for in this Law.

Based on Indonesian Presidential Decree no. 99/1998, Small Enterprise is defined as "Small scale people economical activities with major business category in small business activities and need to protect from unhealthy business competition". The government of Indonesia defines small enterprises as firm with total asset up to Rp. 200 million excluding land and building, the total annual sales are not more than Rp. 1 billion owned by Indonesian citizens, not subsidiary or branch of medium or large enterprise, personal firm. While medium enterprises are firms with total asset more than Rp. 200 million but not exceed Rp. 10 billion excluding land and buildings. *Biro Pusat Statistik* (Center Bureau Statistics) defines SMEs based on number of employees. Small enterprise employs 5 to 19 people, medium enterprise employs 20-99 people.

According to Adiningsih, 2004 as cited in Hamdani & Wirawan, 2012, government and private sector in Indonesia paid less attention for SMEs in Indonesia before economic crisis 1997. But since Indonesian economic crisis, most SMEs can survive, even increasing in number This condition attract government and private to pay more attention.

Furthermore, most SMEs depend on their own capital, employ most workers, and contribute to economic growth (GDP) of Indonesia, make SMEs should have more attention.

The development of SMEs in Indonesia conducted by *Kantor Menteri Negara Koperasi dan Usaha Kecil Menengah* (KUKM) (Ministry of cooperation and small medium enterprise), Ministry of Industry and Trade, Ministry of Finance and Bank of Indonesia. Indonesian government uses business center and cluster to foster SMEs. Business center is activity center at certain location, where there are SMEs that are used similar raw material or facility, produce similar product and have prospect to develop as a cluster (SK Meneg KUKM no.32/Kep/M.KUKM/IV/2002). Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate (Hamdani & Wirawan, 2012). The purpose of the development is to encourage development of SMEs with technology competence, create conducive business system and climate, create SMEs operational financing assurance system, and provide technical support and managerial mentoring.

According to Tambunan & Supratikno, 2004, there are four types of industrial cluster in Indonesia. Dormant cluster is a cluster that dominated by informal sectors. Active cluster is a cluster that able to improve their technology and also their production quality, but they only sold their product domestically. Dynamic cluster is a cluster that able to improve their technology and their production quality. They also start to build networks to sell their product in international markets. Modern or advanced cluster, is a cluster that has applied advanced technology to produce their qualified product and able to sell it in either local market or global market. Most of Indonesian's cluster is a dormant cluster (Tambunan & Supratikno, 2004). Thus, the government tries to develop them into an advanced cluster. There are also some other characteristics of Indonesian's SME business center such as highest competition among industrial center member, low quality, cost and price oriented, low bargaining power to local middleman, market, low technology, low networking, low need for achievement and development.

SMEs have unique characteristics if compare with large company. These unique characteristics build several SMEs condition that must be considered carefully when developing them. Characteristic of small medium enterprises (Chesbrough, 2010):

a. Size. Their smaller size makes smaller markets attractive to SMEs while these markets would not be attractive for larger firms.
b. Focus. Their focus lets them execute very effectively against larger, diversified firms with more diffuse objectives.
c. Business specialization. SMEs can specialize their business more deeply in narrow fields.
d. Entrepreneurial persons. SMEs attract more entrepreneurial R&D employees.
e. Speed. Smaller firms take decisions faster and implement them more rapidly.

2.2.2 Supply Chain Management (SCM)

According to Stock & Boyer, 2009 supply chain as the management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction.

Mentzer et al., 2001 also defined supply chain management as a set of many entities that directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer. So that, supply chain management is managing the chain of materials flow, information flow and finances flow from upstream to downstream in order to create valuable product for the customers.

According to Borade, 2014, Supply Chain Management is identified as an approach used to achieve efficient integration of suppliers, manufacturers, distributors, retailers, and customers, which means that goods are produced in the right amount, at the

right time, and in the right place for the purpose achieve a minimum cost of the overall system and also reach the desired service level.

Based on sources regarding the understanding of SCM, SCM is an integrated and coordinated system used to achieve efficient integration of suppliers, manufacturers, distributors, retailers, and customers to develop the company's long-term performance and overall supply chain with the aim of achieving a minimum cost of the overall system, and reaches the desired service level.

2.2.3 Warehouse

According to Rama et al., 2012 study on warehousing function is very critical in supply chain as it acts as a node in linking the material flows between the supplier and customer. In today's competitive market environment companies are continuously forced to improve their warehousing operations. Many companies have also customized their value proposition to increase their customer service levels, which has led to changes in the role of warehouses.

A warehouse is a facility in the supply chain to consolidate products to reduce transportation cost, achieve economies of scale in manufacturing or in purchasing or provide value added processes and shorten response time. Warehousing has also been recognized as one of the main operations where companies can provide tailored services for their customers and gain competitive advantage. Typical warehouse function and flow is shown in Figure 2.1.

Ganeshan, 1999 estimates that having these inventories can cost anywhere between 20 and 40% of their value per year. Although carrying inventories is essential to enhance customer service and reduce distribution costs (through multiple warehouses), managing these inventories in a scientific manner to maintain minimal levels makes economic sense.

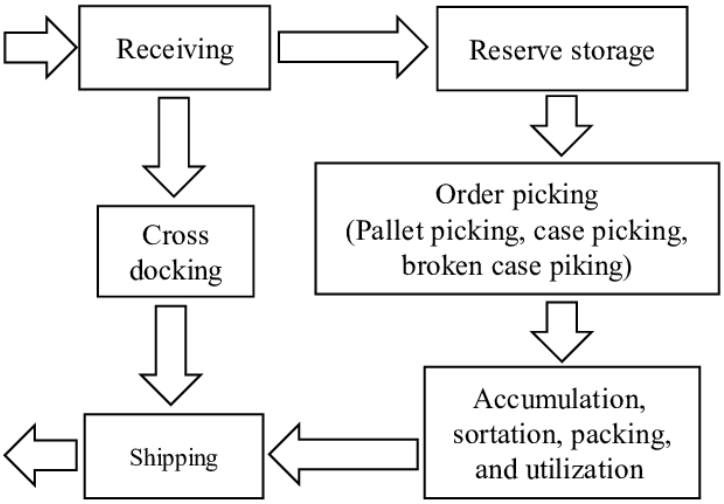

Figure 2.1 Typical Warehouse Function and Flow

2.2.4 Multi Criteria Decisions Making (MCDM)

MCDM is a sub-discipline of operations research that explicitly evaluates multiple conflicting criteria in decision making both in daily life and in settings such as business, government and medicine. According to Mukherjee, 2018 MCDM concerned with structuring and solving decision and planning problems involving multiple criteria. The purpose is to support decision-makers facing such problems. Typically, it does not exist a unique optimal solution for such problems and it is necessary to use decisionmaker's preferences to differentiate between solutions. Such problem can solve with multi criteria decision analysis (MCDA). Mukherjee, 2018 proposed following steps of MCDM:

1. Define the suitable criteria to achieve goal
2. Identify the alternatives for achieving desired goals
3. Evaluate each alternative
4. Use suitable multi criteria analysis tool or techniques
5. Accept the suitable alternative to achieve goal
6. If final solution is not feasible or not acceptable, then opt for next iteration until feasible solutions are not achieved.

Based on Mukherjee , 2018 there are several MCDA tools and technique that can applied to solve such problem, such as: AHP, VIKOR, ANP, TOPSIS, ELECTRE, and et

2.2.5 Analytic Network Process (ANP)

The Analytic Network Process (ANP) is a generalization of the Analytic Hierarchy Process (AHP), by considering the dependence between the elements of the hierarchy (Saaty, 2008). Saaty, 2004 defined Analytic Network Process (ANP) is a multicriteria theory of measurement used to derive relative priority scales of absolute numbers form individual judgements (or from actual measurements normalized to relative form) that also belong to a fundamental scale of absolute numbers. This method is useful to overcome complex problem that cannot be solved using AHP and it allows to give feedback among the inner and outer dependence elements of network.

ANP method is one method that was developed from the previous method which is AHP. ANP also can fix deficiencies AHP where its ability to accommodate the interconnection between the criteria or alternatives (Saaty, 2001). ANP is represented by a network, rather than a hierarchy. The feedback structure does not have the top-to-bottom form of a hierarchy but looks more like a network, with cycles connecting its components of elements, which we can no longer call levels, and with loops that connect a component to itself. It also has sources and sinks. A source node is an origin of paths of influence (importance) and never a destination of such paths. Linear hierarchies and feedback network on ANP is shown in Figure 2.2.

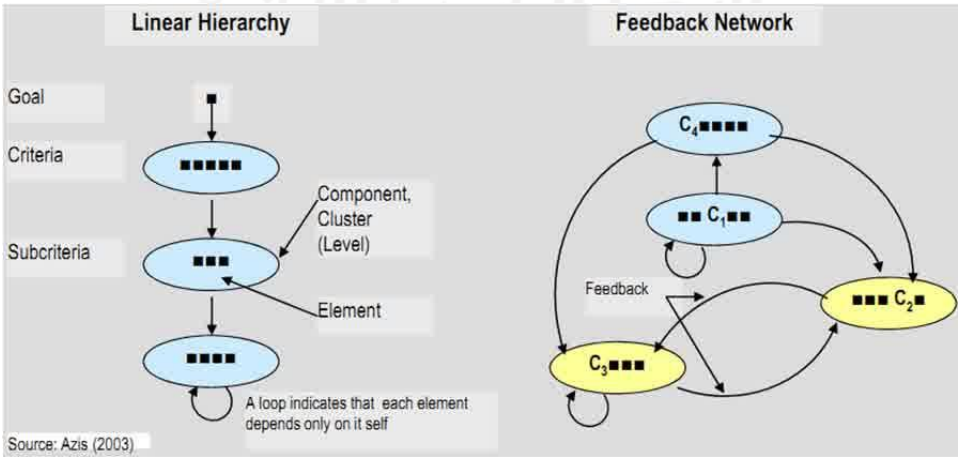

Figure 2.2 Linear Hierarchies and Feedback Network on ANP

A sink node is a destination of paths of influence and never an origin of such paths. A full network can include source nodes; intermediate nodes that fall on paths from source nodes, lie on cycles, or fall on paths to sink nodes; and finally sink nodes. Some networks can contain only source and sink nodes. Still others can include only source and cycle nodes or cycle and sink nodes or only cycle nodes. A decision problem involving feedback arises often in practice. It can take on the form of any of the networks just described.

The challenge is to determine the priorities of the elements in the network and in particular the alternatives of the decision and even more to justify the validity of the outcome. Because feedback involves cycles, and cycling is an infinite process, the operations needed to derive the priorities become more demanding than has been familiar with hierarchies.

The existence of these linkages causes ANP method more complex than AHP. ANP is a mathematical theory that allows one to treat dependence and feedback that can systematically capture and combine the factors tangible and intangible. ANP is one of the new theories in the decision-making process that provides a common framework in treating decisions without making assumptions about the independence of the elements at higher levels of the elements on the lower level and on the independence of the elements in a level.

By feedback, the alternatives can be dependent on criteria such as the hierarchy but can also dependent on each other alternatives. Meanwhile, feedback increases priorities derived from the judgments and make more accurate predictions. Therefore, the results of the ANP are expected to be more stable. Difference between hierarchy structure and network structure can be seen in Figure 2.3.

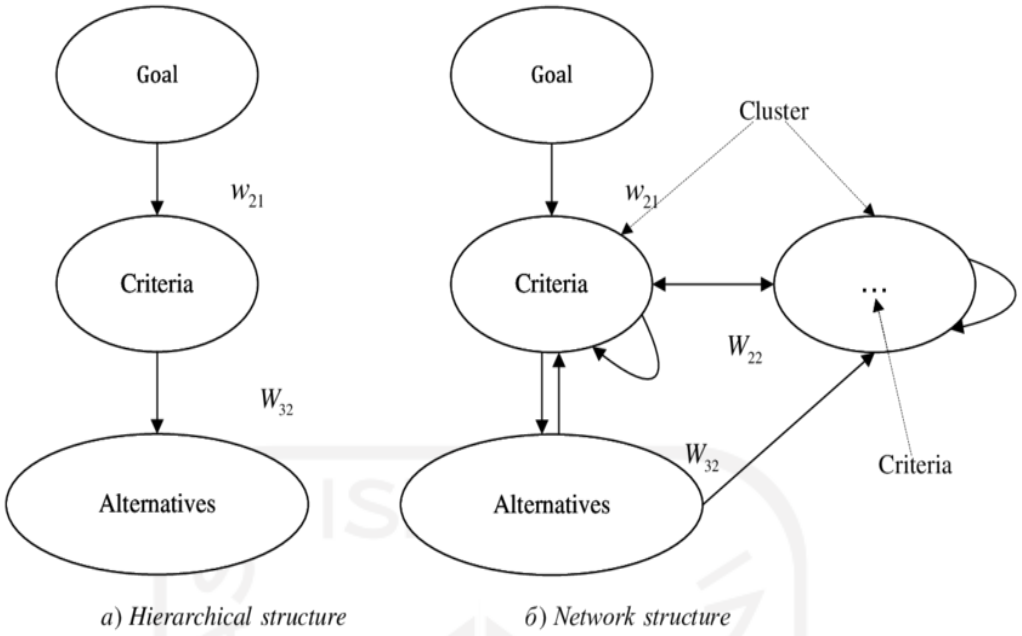

Figure 2.3 Difference between Hierarchy Structure and Network Structure

ANP is desired in knowing the overall effect of all the elements. Therefore, all the criteria must be set up and made a priority within the framework of the control hierarchy or network, perform comparisons and synthesis to obtain the order of priority of this set of criteria. Then we derive the influence of elements in the feedback system with attention to each criterion. Finally, the results of this effect are weighted by the importance of the criteria, and added to obtain the overall effect of each element.

ANP is a combination of two parts. The first part consists of a hierarchy of control or network of criteria and sub-criteria that control the interaction. The second part is a network of influences between elements and clusters.

AHP and ANP are both using the scale ratio. Priorities in a ratio scale is a fundamental figure that allows to do basic arithmetic calculations such as addition and subtraction in the same scale, multiplication and division of a different scale, and combining them with appropriate weighting and adding different scales to obtain a scale of one dimension. Keep in mind that the scale ratio is also an absolute scale. Both scales were obtained from pairwise comparison (paired comparisons) using the ratio of dominance judgments or partner by using actual measurements. In terms of the use of judgments, in AHP someone asked: "Which is more preferable or more important?", While the ANP someone asked: "Which has a bigger influence?" The last question clearly

requires a factual observation and knowledge to produce answers valid, which makes the second question is more objective than the first question.

According to Tanjung & Devi, 2013 there are three main functions of the ANP, namely:

1. Structuring Complexity

   Complex problems if not structured properly will be difficult to decipher it. As in everything and anything as complex as the problems encountered, ANP assist in structuring the problem

2. Measurement on the Ratio Scale

   Measurements in this ratio scale is necessary to reflect proportions. Each method with hierarchical structure should use a ratio scale priority for elements above the lowest level of the hierarchy. This is important because the priorities (weights) of elements at any level of the hierarchy is determined by multiplying the priority of the parent element. Since the result of the multiplication of two mathematically interval level measurement has no meaning, the ratio scale is required for this multiplication. ANP using the scale ratio in all the lowest level of the hierarchy / network, including the lowest level (alternative choice model). Ratio scale is becoming increasingly important if the priority is not only used for the application of choice, but for other applications, such as applications for resource allocation.

3. Synthesis

   Synthesis means to unite all the parts into a single unit. Because of the complexity, the situation is important decisions, or forecasts, or the allocation of resources, often involve too many dimensions for humans to be able to perform synthesis intuitively, we need a way to do a synthesis of many dimensions. More important function in the ANP is its ability to assist decision makers in making measurements and synthesis of a number of factors in the hierarchy or network.

Based on Saaty, 1996, ANP method is the development of AHP. ANP is a measurement theory which usually applies to the dominance of influence among some stakeholders or alternatives with respect to an attribute or a criteria. ANP network structure is described by the arrow two lines (arcs) that presents the interdependence of grouping or if in the levels of the same factors will form a loop. Directions arc indicates dependence. Arc derived from control attributes that connect with other attributes that can affect each other. The relative importance of the element / elements measured by the ratio scale. ANP is able to handle the interdependence of elements with a combined weight gain through the development of Supermatrix. Saaty, 2005 describes the concept as parallel Supermatrix on Markov Chain process.

In a system with N components that consist of elements that will provide mutual influence, can be denoted that the component C is symbolized by the number N Ch where h = 1, 2,3, ... N. Elements Owned by the component will be denoted by eh1, eh2, ... ehn. Value of Supermatrix given as a result of assessment of the priority scale derived from pairwise comparisons such as the AHP. The relationship between the elements represented by the vector-derived priorities in AHP pairwise comparisons. Matrix prepared to describe the flow of interest between both components of the inner and outer dependence. In general, the relationship between the interests of the elements in a network with other elements in the network can be represented follow Supermatrix, as shown in Figure 2.4.

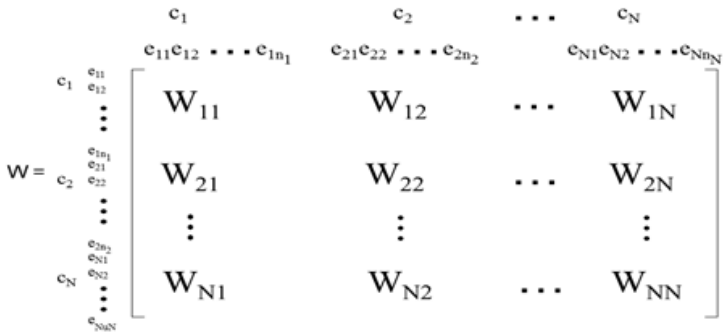

Figure 2.4 Supermatrix of Network

Form of Wij in Supermatrix is called as Supermatrix block and followed by matrix as shown in Figure 2.5.

$$W_{ij} = \begin{bmatrix} W_{i1}^{(j_1)} & W_{i1}^{(j_2)} & \cdots & W_{i1}^{(jn_j)} \\ W_{i2}^{(j_1)} & W_{i2}^{(j_2)} & \cdots & W_{i2}^{(jn_j)} \\ \vdots & \vdots & & \vdots \\ W_{in_i}^{(j_1)} & W_{in_i}^{(j_2)} & \cdots & W_{in_i}^{(jn_j)} \end{bmatrix}$$

Figure 2.5 Supermatrix Component of Network

Each column on Wij is eigen vectors that show the interest of the elements in the i-th component of the network on an element in the j-th component. Some entries that show the zero relationship on elements mean there is no interest in such elements. If this happens then the element is not used in pairwise comparisons to lower eigen vector. So things to be used are the elements that generate the interest is not zero.

Each criterion taken into consideration decision certainly has some advantages and disadvantage for the decision makers. Some of these criteria could be something definite or even uncertain occurrence. That is why, in general, a definite advantage for something called benefits while the disadvantage is cost. While the advantages for something that is not definitely known as opportunities (opportunities) while its disadvantage is risk which is something that is uncertain and likely to be faced by decision makers. A simple form of network analysis of Benefit, Cost, Opportunity, and Risk (BCOR) is a network effect (impact network) as the form of ANP network in general. This network has two separate networks in the chart, which for positive influence, and for the negative influence (Tanjung and Devi, 2013).

Lin, 2011 explained the ANP method consists of four steps: (1) building a hierarchical structure; (2) generating a pairwise matrix and calculating the eigenvectors; (3) creating supermatrix and calculating the weights; and (4) select the best alternatives solution (Meade & Sarkis, 1999; Cheng & Li, 2005; Lin, et al., 2011). The steps as follows:

1. Build a hierarchical structure

This research set goals according to the characteristic of the problem, defines the criteria and sub-criteria and determines mutual influences among the criteria. If the criteria are influenced by each other, there is an outer dependence among them. If the sub-criteria are influenced by each other, there is an interdependence among them.

2. Create a pairwise matrix and calculate the eigenvectors

For ANP the comparative pairwise is conducted same as AHP, following the 1-9 scale method (Saaty, 1980). For instance, the 1/9 scale indicates that the vertical criteria are much more important than horizontal criteria. The eigenvector is calculated according to each matrix comparison and used as the value of the supermatrix to indicate interdependence and relative importance.

The computational ANP involves three matrix, including the unweighted, weighted and limit supermatrix. The formula as follows:

$$\mathbf{A} \times \mathbf{w} = \boldsymbol{\lambda}_{\mathbf{max}} \times \mathbf{w}$$

…(2.1)

Where A indicates an *n x n* pairwise comparison matrix, w is the eigenvector and **λmax** is the maximum eigenvalue of Matrix **A**. **A** consistency test is then conducted according to the maximum eigenvalue; in other words, it calculates the CI and CR to judge the decision-makers' consistency (as expressed in Equation 2.2 and 2.3).

$$CI = \frac{\breve{}_{\max} - n}{n - 1}$$

…(2.2)

$$CR = \frac{CI}{RI}$$

…(2.3)

If $0 \leq CR \leq 0.1$, the judgement of experts is consistent (Saaty, 1996).

3. Form the supermatrix

A Supermatrix is conceivable, the eigenvector calculated by pairwise comparison is used as the weight value of each submatrix and value indicates the relationship between two nodes (such as criteria or groups) in decision-making system (Meade & Sarkis, 1999; Cheng & Li, 2005; Lin, et al., 2011). It is assumed that decision-making system ***Ci*** comprises (***i*** = 1, 2, …, n) criteria and each criterion ***Ci*** comprises ***ni*** sub-criteria. If matrix elements are dependent on each other, a fixed intersection extremum will be obtained after the matrix is subjected to reiterate multiplication.

$$W = \begin{array}{c} \\ C_1 \\ e_{11}e_{12}\cdots e_{1n1} \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_i \end{array} \\ \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1i} \\ w_{21} & w_{22} & \cdots & w_{2i} \\ \vdots & \vdots & \ddots & \vdots \\ w_{i1} & w_{i2} & \cdots & w_{ii} \end{bmatrix} \end{array} \begin{array}{c} \\ C_2 \\ e_{21}e_{22}\cdots e_{2n2} \end{array} \begin{array}{c} \\ \vdots \\ \\ \end{array} \begin{array}{c} \\ C_i \\ e_{i1}e_{i2}\cdots e_{ini} \end{array}$$

…(2.4)

The computational ANP contains three matrix. Specifically, the weight of the unweighted Supermatrix is the weight calculated through the original pairwise comparison, the weight of the weighted Supermatrix is that of the same criterion in the unweighted Supermatrix multiplied by the related group weight and the limit Supermatrix squares the weighted Supermatrix several times until the

numbers in all columns are equal. Saaty, 1996 argues that, if supermatrix W is irreducible, all column vectors in the supermatrix share the save values; in other words, the convergence effect is attained. Equation (2.5) is a supermatrix with a three-layer hierarchy, as indicated by Wh.

$$W_h = \begin{bmatrix} 0 & 0 & 0 \\ W_{21} & 0 & 0 \\ 0 & W_{32} & I \end{bmatrix} \quad \ldots(2.5)$$

Where ***W*21** is the eigenvector of a criterion under the decision-making goals, ***W*32** is the pairwise comparison matrix of the alternative solution under each criterion, ***I*** is the unit matrix and **0** is the independence of the same criterion or between sub-criteria. The primary function of this matrix is to evaluate outer and inner dependence. If there is dependence between criteria, a network structure needs to be used instead of the hierarchical structure. Then, ***W*22** indicates the dependence between these criteria and the supermatrix can be expressed by Saaty (1996) Equation (2.6)

$$W_n = \begin{bmatrix} 0 & 0 & 0 \\ W_{21} & W_{22} & 0 \\ 0 & W_{32} & I \end{bmatrix} \quad \ldots(2.6)$$

Any "**0**" in supermatrix ***Wn*** can be replaced with a matrix based on the dependence relationship between criteria or groups. There is naturally a dependence relationship between groups in a network structure; therefore, the supermatrix usually contains the weights of multiple interdependent columns. Such a supermatrix is then referred to as an unweighted supermatrix; in other words, the weights are obtained by combining and permutating the eigenvectors of the original pairwise comparison matrix.

To meet the mathematical reasoning logic, the supermatrix must first be normalized so that the sum of the weight values of each column is equal to 1. Such a supermatrix is then referred to as a weighted supermatrix. If the sum of the weight values in each column of an unweighted supermatrix is equal to 1, it becomes a weighted supermatrix. This study uses the ANP method to calculate the weight of main and sub-criteria. Therefore, the unweighted supermatrix ***Wn*** needs to be modified into a weighted supermatrix ***W'n*** as expressed by Saaty, 1996 in Equation (2.6).

Where ***W*22** and ***W*33** indicate the weight of dependence between criteria and sub-criteria, respectively. To attain convergence, the weighted supermatrix ***Wn*** is multiplied to the power of $2k + 1$ ($k \longrightarrow \infty$), as expressed in Equation (2.8). Finally, this study obtains a new limit supermatrix ***WANP*** (Saaty, 1996).

$$W_{ANP} = \lim_{k \to \infty} \left(W'_n\right)^{2k+1} \quad \ldots(2.7)$$

4. Select the best alternatives solution

The weights of the limit supermatrix ***WANP*** obtained in Step 3 can be used as the basis for ranking the alternative solutions.

CHAPTER III

RESEARCH METHODOLOGY

In this chapter there are several stages that will be done that consist of research object, research flow, type of data, data collection method and data processing. The research methodology will be explained below.

3.1 Research Object

This research of Analytical Network Process (ANP) conducted in Agung Jaya Bicycle Store located in Serang, Banten. Agung Jaya Bicycle Store is bicycle retail shop than sell bicycle and its accessories. Agung Jaya Bicycle Store is one of the oldest bicycle stores in Serang or even in Banten province. Established in 1978 as a small family business that run by the owner sister and brother. Nowadays Agung Jaya Bicycle store is still one of the biggest stores in Serang and has become an official store of famous bicycle brand.

3.2 Problem Formulation

This research focusses on finding the best alternative and how COVID-19 Pandemic justified criteria and result. Problem formulation being used to direct the solution from the problem and as a foundation to make a conclusion.

3.3 Data Collection Method

In this research, the researchers use some methods to get the data. They are observation, interview, questionnaire and sources derived from several journals and literatures. The researchers carried out the observation at Agung Jaya Bicycle store in Serang. After performing the observation, the researchers interviewed the owner's daughter that currently runs the business, Mrs. Niar Nasution. After interviewing Mrs. Niar Nasution, the researchers also asked her to fill out the questionnaire for rating of the cluster, node

and alternative that influence one another, which is taken by the researches from the result of the interview as well as from journals and literatures.

3.3.1 Interview

The interview was carried out in order to identify and validate proposed criteria already given, whether it is often be used or not, in conducting vendor performance assessment, also for identifying most critically vendor in hospitality-based industry based.

3.3.2 Questionnaire

To fulfill the framework of vendor performance assessment, the researcher needs to collect the data for identifying important criteria, criteria weight, and vendor final score. Important criteria determination applies Likert scale from 1 to 10. This questionnaire was filled by Agung Jaya Bicycle store owner. To weight the important criteria, pairwise comparison questionnaire was employed that later will be calculated by using ANP.

3.4 Type of Data

This research uses two types of data, namely primary data and secondary data.

3.4.1 Primary Data

Primary data is the data that directly obtained from the sources. Primary data of this research were obtained from the Agung Jaya Bicycle Store Owner. The data obtained using pairwise comparison questionnaire.

3.4.2 Secondary Data

Secondary data is the data obtained from an appropriate literature review, such as journals, proceedings, books. In this research, the secondary data were used to support the research hypothesis and statement in this research. This research performed both deductive and inductive study as a literature review. The deductive study was carried out

to gain relevant basis theory and to test theory whether suitable or not. Then it followed by conducting the inductive study to gain related information in previous research in order to position this research to show the uniqueness of this research.

3.5 Data Processing

In this research, data processed using Analytical Network Process (ANP). Data that already collected will be processed using application Super Decision as an instrument of this research. The result will show the criteria weight and the best alternative based on the data obtained from Agung Jaya Bicycle Store owner.

3.5.1 Analytic Network Process (ANP)

Analytic Network Process is adopted to select the best risk mitigation strategy for reducing risks and to maintain company supply chain sustainability. The Cluster and Node are from the brainstorming with the Owner were used as the alternatives in ANP model and the sustainable dimensions; namely economic, warehouse attraction and local environment aspects were used as the criteria. The steps of creating ANP in this research as follows:

1. Step 1. Model construction and problem structuring. The first step is to construct a model to be evaluated. The model development will require the delinea- tion of criteria at each level and a definition of their relationships.

2. Step 2. Pairwise comparisons matrix of interdependent component levels. Eliciting preferences of various components and criteria will require a series of pairwise comparisons where the decision maker will compare two components at a time with respect to an upper level “control” criterion. These comparisons are collected in a pairwise comparison matrix. Based on Saaty, 1988, for every problems, based on scale 1 to 9 is the best scale to express the opinin. The scoring paired comparation ratio can be seen in Table 3.1

Table 3.1 Scoring Paired Comparation Ratio

Importance Level	Definition	Explanation
1	Same effect.	2 factors has same effect.
3	A little bigger effect.	One factor scoring is a little bigger than its pair.
5	One factor has bigger effect.	One factor scoring is stronger than the paired factor.
7	One factor is very bigger effect.	A factor is stronger and the domination is more shown than its pair.
9	One factor is absolutely has bigger effect.	Clearly that the factor is very more important that its paired.
2, 4, 6,8	Middle score as the compromi between 2 close scoring.	Given if there is a doubt between 2 close scoring.
Opposite*aij=1/aij*	For activity I got a number compare with the J avtivity, So J has Opposite score than I.	

3. Step 3. Super matrix formation. The supermatrixsuper matrix allows for a resolution of the effects of interdependence that exists between the elements of the ANP network. The supermatrixsuper matrix is a partitioned matrix where each sub-matrix is composed of the pairwise comparison matrices formed in step 2 or is zero sub-matrices (all the elements in a zero sub-matrix are zero).

4. Step 4. Each alternative will need to be evaluated on each of the criteria. This evaluation is completed by making a pairwise comparison of the performance or impact of each alternative on each criterion.

5. Step 5. Selection of best alternative. The selection of the best alternative depends on the calculation of the “desirability index” for an alternative i.

3.6 Research Flowchart

This research flowchart is used to show the steps of the design model of warehouse location selection in the small medium enterprise (SME). Research flowchart explains the steps of conducting research from the beginning until the end of the research. The research flowchart is shown in Figure 3.1 below:

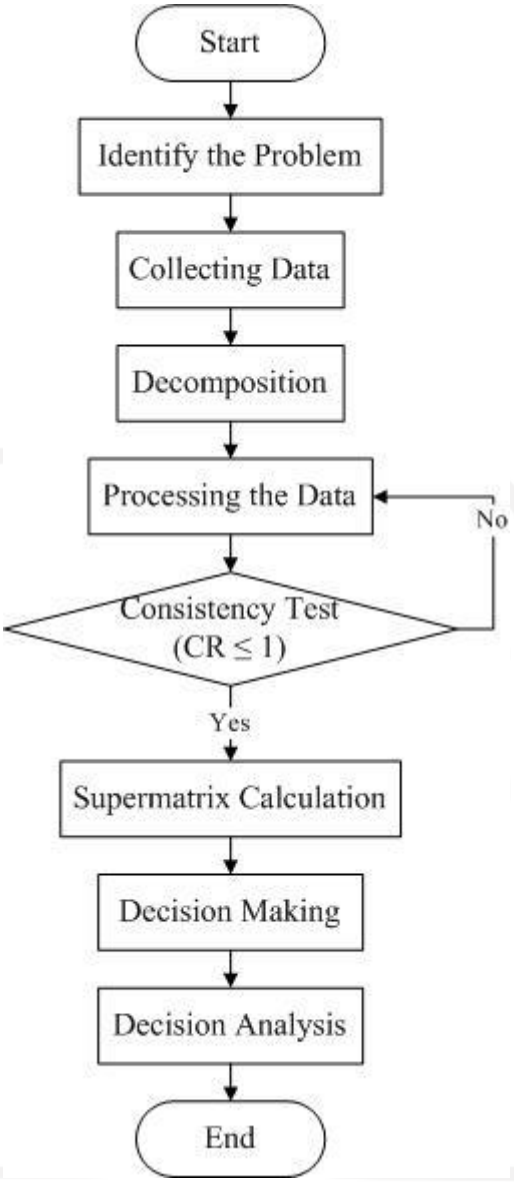

Figure 3.1 Research Flowchart

In this research, the researchers have some steps to do. The steps are identifying the problem, collecting data, decomposition, processing the data, Supermatrix calculation, making the decision, and analyzing the decision. There are:

1. In identifying the problem, the researchers discuss what the best control criteria that want be observed is.
2. The researchers did the observation by coming to the shop and doing interview with the expert in that shop to get the data that can be the cluster, node and alternative for this case.

3. In decomposition, the researchers found some literatures to choose the cluster, node and alternative. After that, the researchers make the network in super decision software with its relation each other.
4. The next step is processing the data. After make the network with its relation in super decision software, the researchers did the pairwise comparison, and identify if it is consistence or not.
5. In the consistency test, if the consistency ratio is lower than 0.1 ($CR \leq 0.1$), the calculation result can be justified then the researchers can continue to the next step, but if the result is bigger than 0.1 ($CR > 0.1$), the researchers have to take and process the data again.
6. After that, the researchers do Supermatrix calculation. Matrix of pairwise comparison result is represented in the form of vertical and horizontal and shaped stochastic matrix is called as Supermatrix. The Supermatrix consists of three phases which are un-weighted Supermatrix stage, weighted Supermatrix stage and limiting Supermatrix stage.
7. In decision making, the researchers do the selection of best alternatives with three steps. The first one is calculation of raw, which is gotten from the limiting Supermatrix. Then calculate the normal value by divided raw value of each alternative with the total raw. The next step is calculating the ideal value by divided the normal value of each alternative with the biggest normal value among the alternatives. The decision taken from the alternative that has 1 result from the ideal calculation (the value of ideal is 1).
8. In analyzing the decision, the researchers did analysis from the decision which has been found before based on the literature then make the conclusion from it and decide the best alternative of the marketing strategic for the shop.

3.7 Result and Discussion

After data processing finished, the next step is analysis and discussion from the result of the calculation that performed by using ANP. In this section, it is explained in detail how the result of the theory that applied in the selected object. Besides, this section is the basis suggestion in the conclusion and recommendation section.

3.8 Conclusion and Recommendation

This section would provide the answers to all the problem formulations that have been formulated at the beginning of the research, Moreover, there are several suggestions from the researcher for the company and future research.

CHAPTER IV

DATA COLLECTING AND PROCESSING

4.1 Data Collection

This research was taken in Agung Jaya Bicycle Store located in Serang, Banten. It is established in 1978 starting as family business. Nowadays, Agung Jaya Bicycle Store is already well established in Serang and Cilegon. It is one of few official dealers in Banten Province of some well-known and leading brand in Indonesia such as Polygon, United Bike, Kenda, Swallow and Lucky Stone.

This research studies about Covid-19 effect on small medium enterprise warehouse selection especially in retail small medium enterprise. First data were obtained from literature review, brainstorming and discussion with the store owner. The second data is the assessments of pairwise comparison to get weight's comparison of initial ANP before and after COVID-19. Third the data assessed with the proposed model that already made. This research is defined as the expert judgments research, where the research was conducted by involving the owner of Agung Jaya Bicycle Store. The detailed data for this research will be shown below.

4.1.1 Warehouse Selection Criteria

Based on the literature review, brainstorming and discussion with the owner of the Agung Jaya bike shop, several key and important criteria were obtained that were in accordance with the needs of the its new warehouse. These criteria are shown in Table 4.1.

Table 4.1 Criteria for Warehouse Location Selection

No	Criteria	Sub-criteria
1	Economy	Fixed Cost
		Operational Cost
		Warehouse Lending

No	Criteria	Sub-criteria
2	Warehouse Specification	Capacity
		Location
		Physical condition and Facility
3	Local Environment	Cleanliness & Hygiene
		Lockdown-proof & Location status zone
		Safety and Security

Total of the criteria are 3 with 3 of sub-criteria each. Above are the criteria the most suitable on what Agung Jaya bike store looking for a new warehouse. Further step prioritized the criteria to get the important criteria through questionnaire, the questionnaire here employed Likert scale. Table 4.2 is the result of first questionnaire for each of criterion from 1 to 10 accordance to the importance.

4.1.2 Economic

Economic factors are the factors that affect the economy like, fixed cost, operational cost and installment credit. These factors are in direct relation with the business also influences the investment value in the future. Economic factors are connected with goods, services, and money.

4.1.2.1 Fixed Cost

Fixed cost in a cost are expenses that have to be paid by a company, independent of any specific business activities. In this case how much money Agung Jaya Store must pay to purchase the potential warehouse. In this research lower fixed cost are better.

4.1.2.2 Operational Cost

Operational cost is cost related with maintenance and administration of business on daily, monthly or yearly basis. Operational cost is a variable cost, mean its value may change on short of time. Operational cost covers, such as electricity bills, water bills and etc. In this research lower operational cost is better.

4.1.2.3 Warehouse lending

Warehouse lending is Instalment credit or loan that must paid to pay the warehouse mortgage of the warehouse property. In this research the easiest credit is better.

4.1.2.4 Warehouse Attraction

Warehouse specification is the characteristic of the warehouse building and its location. Describe warehouse advantages and disadvantages.

4.1.2.5 Capacity

Capacity is how many the warehouse space can be dedicated for storage. In this research it will be determine in meter squared (m^2).

4.1.2.6 Location

Location that used in this research in the proximity of warehouse to physical store also access and infrastructure for online shopping.

4.1.2.7 Physical condition and Facility

Physical condition and Facility are the warehouse building state and condition to be employed as a storage.

4.1.3 Local Environment

Location status zone impact the business process. In the severe or black pandemic status zone, all business and activities shut down that can stop and delay business. Warehouse in low pandemic status zone will ensure the business process.

4.1.3.1 Cleanliness and Hygiene

Cleanliness and Hygiene of the warehouse and its surrounding area become important factor to prevent the virus contagion that will affect business.

4.1.3.2 Location pandemic status zone and Lockdown-proof

Location status zone impact the business process. In the severe or black pandemic status zone, all business and activities shut down that can stop and delay business. Warehouse in low pandemic status zone will make sure the business process.

4.1.3.3 Safety and security

Safety and security are the warehouse relatively safe from fire, natural disaster, virus contagion and etc. Security is warehouse security from crime and so on.

4.2 Warehouse Alternative

Based on discussion and interview there are 3 alternative warehouse that considered the best and ideal according to the criteria or cluster which is economic, warehouse specification and local environment. The alternative further writes as location A, B, and C. The locations are:

4.2.1 Warehouse A

Warehouse A is located in Kramatwatu, Serang, Banten. Building size is 414 m2 and land size is 656 m2. Only 10 kilometers away from the store. Priced Rp. 5.000.000.000--. The outside and inside look of Warehouse A can be seen in Figure 4.1 and Figure 4.2 respectively.

Figure 4.1 Outside look of Warehouse A

Figure 4.2 Inside look of Warehouse A

4.2.2 Warehouse B

Warehouse B is located in Cikande, Serang, Banten. Building Size is 960 m^2 and land size 1150 m^2. 25 km away from the physical store. Priced Rp. 6.500.000.000-. The outside and inside look of Warehouse B can be seen in Figure 4.3 and Figure 4.4 respectively.

Figure 4.3 Outside look Warehouse B

Figure 4.4 Inside look Warehouse B

4.2.3 Warehouse C

Warehouse C is located in Cikande, Serang, Banten. Located 33 km^2 away from the store. Building size is 180 m^2 and land size 260 m^2. Priced Rp. 2.600.000.000-. The outside and inside look of Warehouse C can be seen in Figure 4.5 and Figure 4.6 respectively.

Figure 4.5 Outside look Warehouse C

Figure 4.6 Inside look Warehouse C

4.3 Structure Model of ANP

From the criteria that has been defined before, the structure model of ANP was built. The ANP network warehouse location selection was constructed using Super Decision software. The structure model can be seen in Figure 4.7.

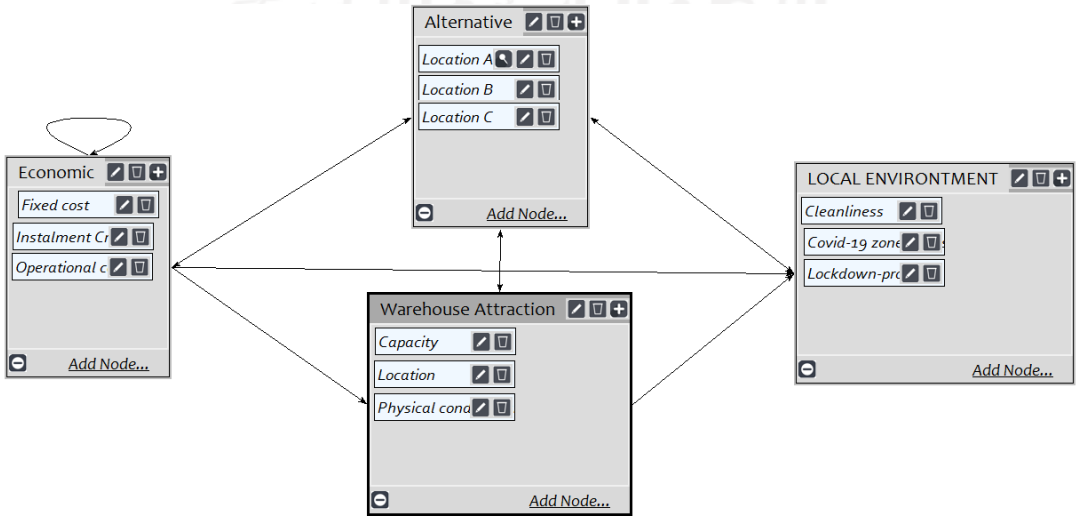

Figure 4.7 Structure model of ANP

The analysis of structure model of ANP are as follows:

1. All alternatives and clusters are influencing each other because the clusters and nodes become the criteria factors in choosing the best marketing strategy
2. Fixed cost is influencing capacity of warehouse, location, and physical condition (outer dependent).
    a. Fix cost influences capacity of warehouse because bigger capacity or size cost more expenses.
    b. Fix cost influences location because the store located in ideal and well-known area for business means more cost, if the warehouse nearer to store.
    c. Fix cost influences physical condition, it means more money for new and better building physical condition.
3. Operational cost is influencing capacity and physical condition (outer dependent).
    a. Operational cost influences capacity, since bigger operational cost can keep well maintenance to the building affecting the capacity.
    b. Operational cost is influencing physical condition, since bigger operational cost leads to better building maintenance.
4. Capacity influencing fixed cost and operational cost (outer dependent).
    a. Capacity influences fixed cost since bigger size means more fixed cost to spend.
    b. Capacity influences operational cost since bigger capacity means more operational cost to maintain the warehouse.
5. Distance to store influences fixed cost and investment potential.
    a. Distance to store influences fixed cost since the warehouse that is located in ideal and well-known area for business needs more cost to obtain it.
6. Physical condition is influence fixed cost, operational cost, and Cleanliness and hygiene.
    a. Physical condition influences fixed cost because better building condition costs more expenses to buy it.
    b. Physical condition influences operational cost, it means newer and better building condition lead to lower operational cost.
    c. Physical condition influences Cleanliness and hygiene because better building condition leads to cleaner and hygiene building.
7. Cleanliness influences physical condition and operational cost.

a. Cleanliness influences physical condition since maintaining the cleanliness will properly preserve condition of the building.
b. Cleanliness influences the operational cost, because cleaning the warehouse needs operational cost.

8. Lockdown-proof influences the fixed cost.
9. Safety and Security influences the operational cost
    a. Safety and Security influences the operational cost, it takes operational cost to maintain extra security and safety.

4.4 Result of Pairwise Comparison and Consistency Test Cluster

After the ANP structure was constructed, then the researcher can the interview with the expert. Figure below are the result of the questionnaire from the from expert before COVID-19 pandemic outbreak. Figure 4.8 shows the pairwise comparison with respect to Alternative.

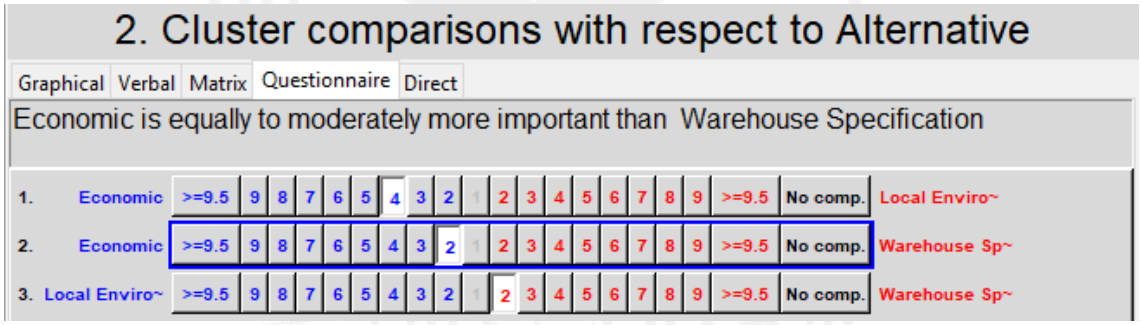

Figure 4.8 Pairwise Comparison with respect to Alternative cluster

Based on the Table 4.8 above, it can be seen that Economic is the most dependence. Economic in moderately more important than local environment and warehouse attraction. When select warehouse in pandemic economic should most important criteria to consider. Figure 4.9 shows the consistency result with respect to location A node in economic cluster.

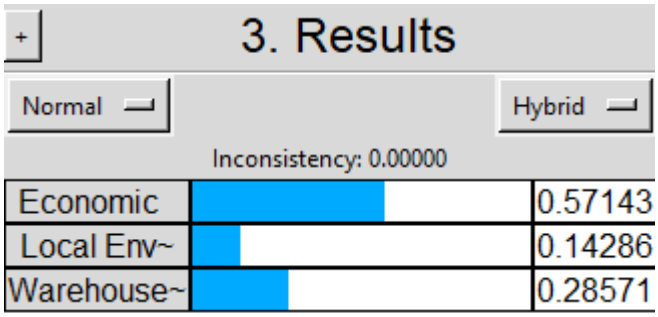

Figure 4.9 Consistency with respect Alternative Cluster

The result above of Inconsistency is 0. That result is below < 0.1, means that the calculation is already consistent. Figure 4.10 shows the pairwise comparison with respect to Location A in Economic cluster.

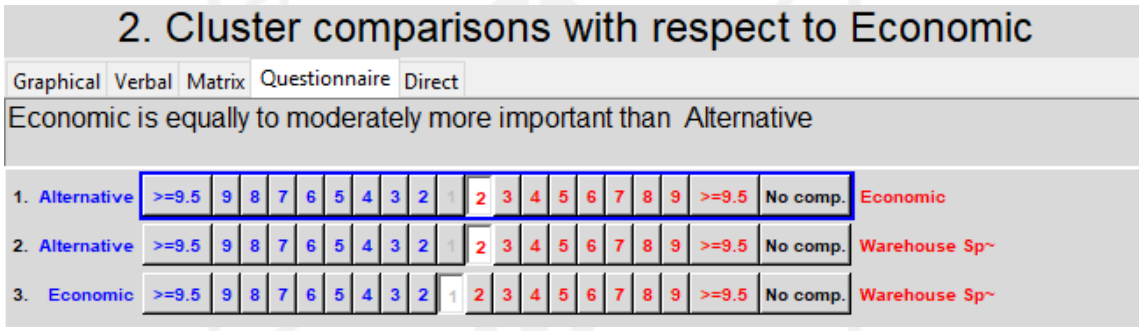

Figure 4.10 Pairwise Comparison with respect to Economic cluster

Based on the table above, economic and warehouse specification is the most dependence. Figure 4.11 shows the consistency result with respect to location A node in warehouse attraction cluster.

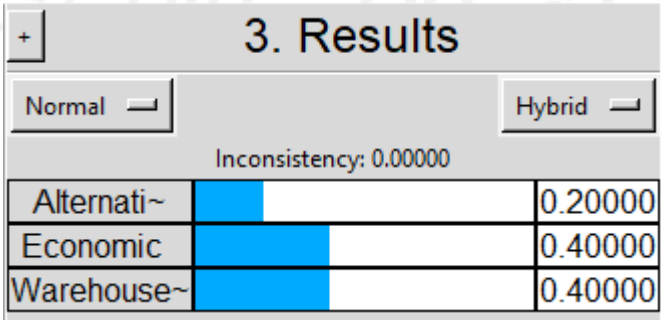

Figure 4.11 Consistency with respect to Economic cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. Figure 4.12 shows the pairwise comparison with

respect to Location B in Economic cluster.

Figure 4.12 Pairwise comparison with respect Local Environment cluster

From the table above, economic criteria are the most important and dependence. Followed with warehouse specification. Figure 4.13 shows the consistency result with respect to location B node in economic criteria.

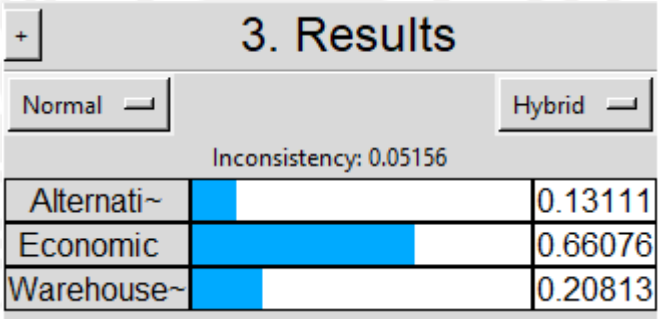

Figure 4.13 Consistency with respect to Local Environment cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. Figure 4.14 shows the pairwise comparison with respect to location B node in warehouse attraction.

Figure 4.14 Pairwise comparison with respect Warehouse Specification cluster

From the table above, economic criteria is still the more important than local environment. Figure 4.15 shows the consistency result with respect to Location B in Economic criteria. Figure 4.15 shows the consistency result with respect to Location B in warehouse attraction cluster.

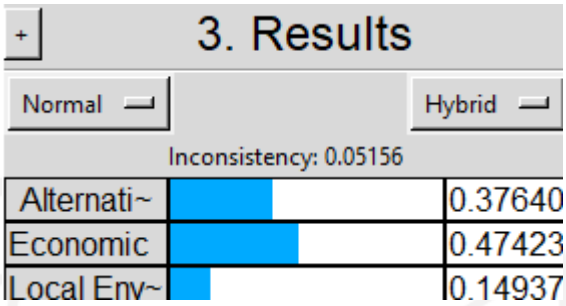

Figure 4.15 Consistency with respect Warehouse Specification cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. Figure 4.16 shows the pairwise comparison with respect to Location A in Economic cluster.

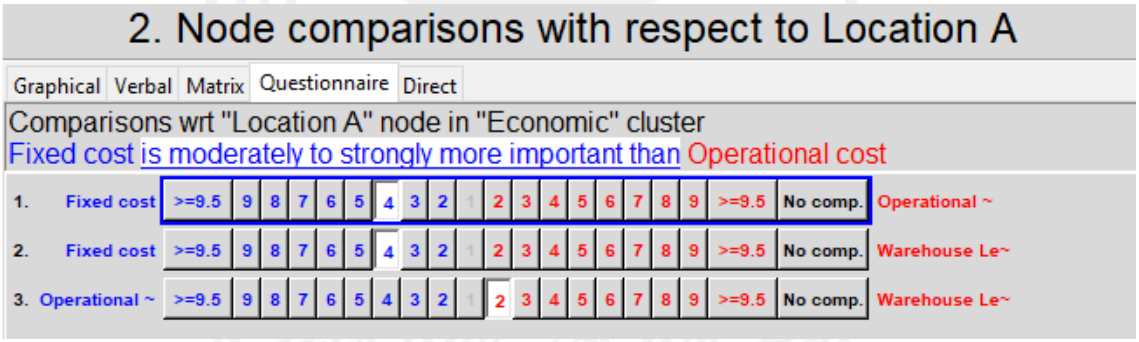

Figure 4.16 Pairwise comparison with respect to Location A node in Economic cluster

From the figure above, in location A fixed cost are more important than operational cost and warehouse lending. Operational cost less important than warehouse lending. Figure 4.19 shows the consistency result with respect to Location A node in Economic cluster.

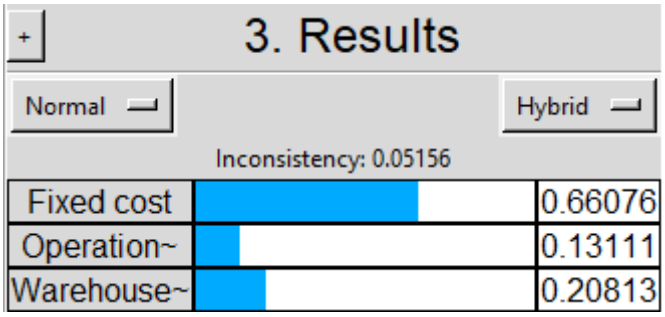

Figure 4.17 Consistency with respect to Location A node in Economic cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. Figure 4.18 shows the pairwise comparison with respect to Location A in Local Environment Cluster.

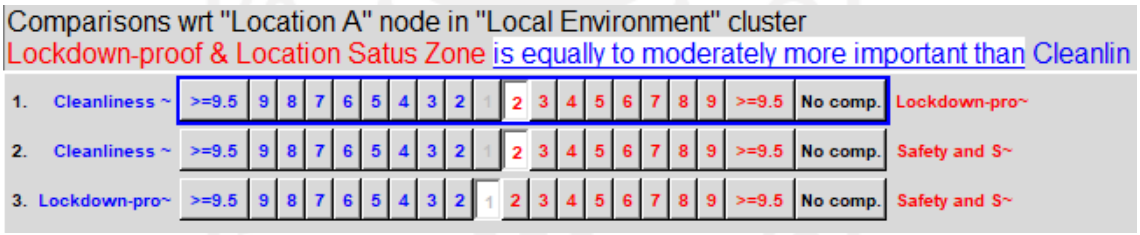

Figure 4.18 Pairwise comparison with respect to Location A node in Local Environment cluster

From the figure above, shown lockdown-proof and safe zone status are the same as important as safety and security. Cleanliness in third place of dependence. Figure 4.19 below shows the consistency result with respect to Location A in Local Environment Cluster.

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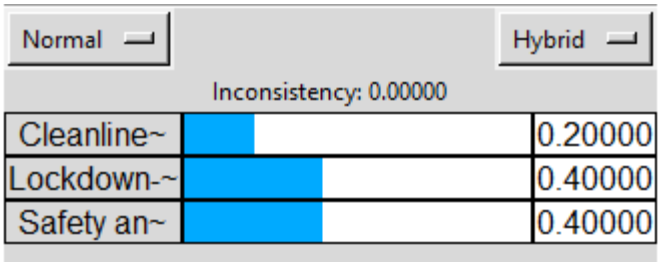

Figure 4.19 Consistency with respect to Location A node in Local Environment cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. Figure 4.20 below shows the pairwise comparison with respect to Location A node in Warehouse Specification Cluster.

Figure 4.20 Pairwise Comparison with respect to Location A node in Warehouse Specification cluster

From the figure above, location is the most important and dependence followed by capacity and physical condition. Figure 4.21 below show the consistency result with respect to Location A node in Warehouse Specification Cluster.

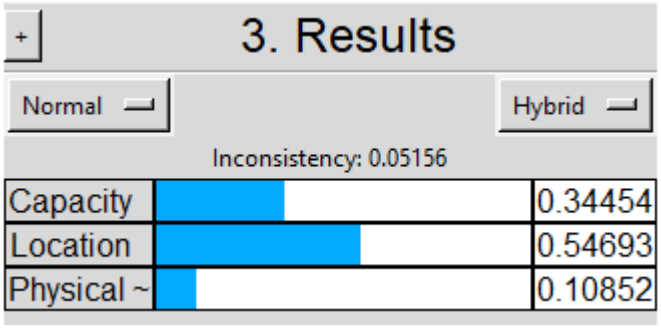

Figure 4.21 Consistency result with respect to Location A node in Warehouse Specification cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. Figure 4.22 shows pairwise comparison with respect to Location B node in Economic Cluster.

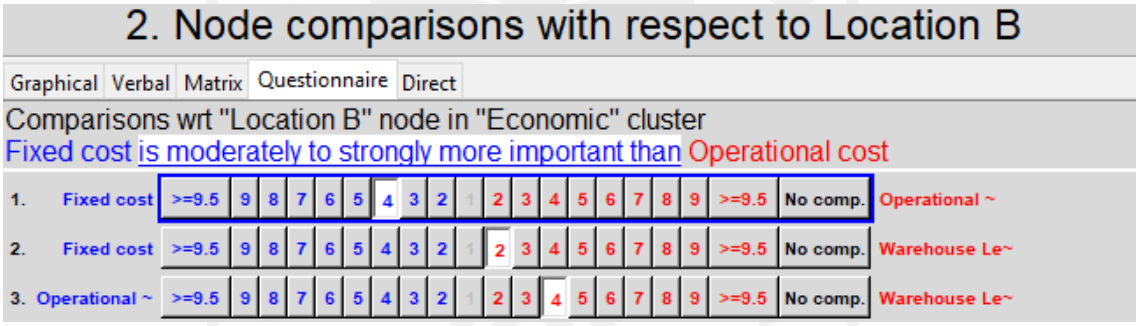

Figure 4.22 Pairwise comparison with respect to Location B node in Economic cluster

From the figure above, warehouse lending in warehouse location B is the most dependence, followed by fixed cost and operational cost. Figure 4.23 below show the consistency with respect to Location B node in Economic Cluster.

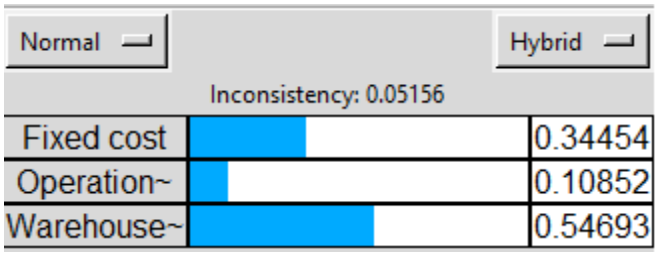

Figure 4.23 Consistency with respect to Location B node in Economic cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. Figure 4.24 shows pairwise comparison with respect to Location B node in Local Environment Cluster.

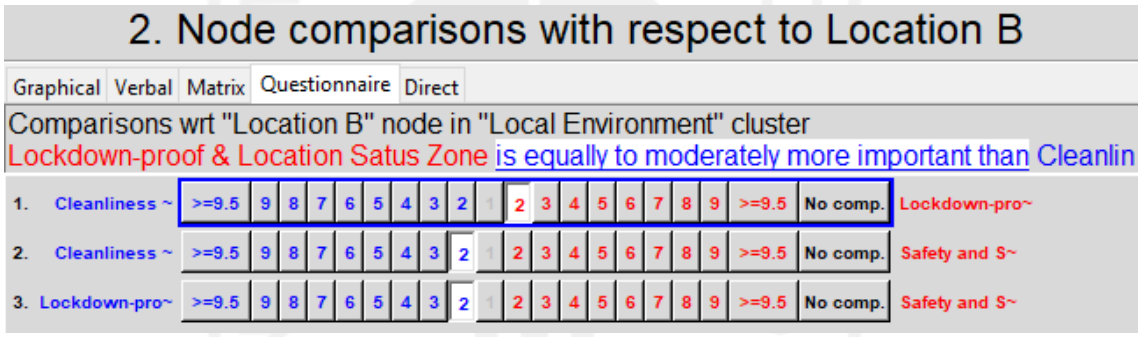

Figure 4.24 Pairwise comparison with respect to Location B node in Local Environment cluster

From the figure above, lockdown proof and zone status are the most important, dependence, followed by cleanliness and safety and security. From table 4.25 shows consistency with respect to Location B node in Local Environment Cluster.

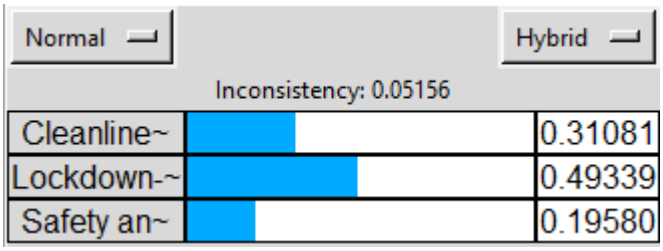

Figure 4.25 Consistency with respect to Location B node in Local Environment cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. From table 4.26, shows the pairwise comparison with respect to Location B node in Warehouse Specification Cluster.

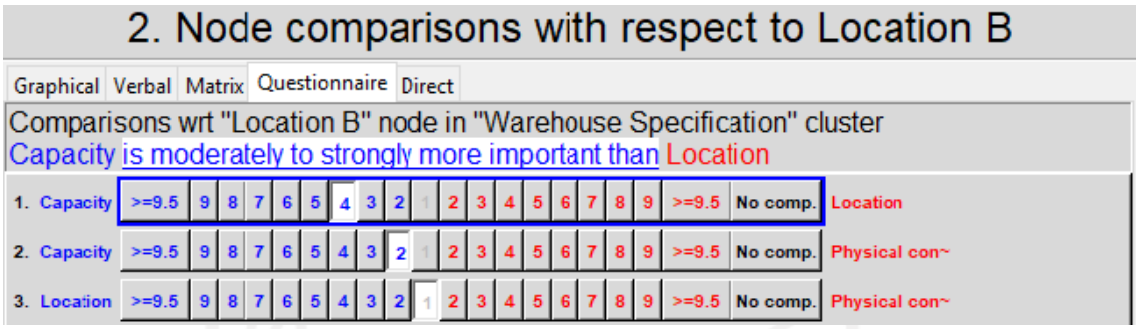

Figure 4.26 Pairwise comparison with respect to Location B node in Warehouse Specification cluster

From the figure above, location b warehouse attraction node shown that capacity in location B is the most dependence, followed by physical condition and location. From table 4.27 below, shows the consistency with respect to Location B node in Warehouse Specification Cluster.

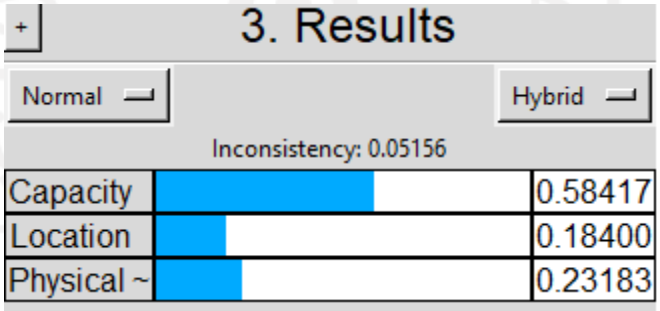

Figure 4.27 Consistency with respect to Location B node in Warehouse Specification cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. From the table 4.28, shows pairwise comparison with respect to Location C node to Economic Cluster.

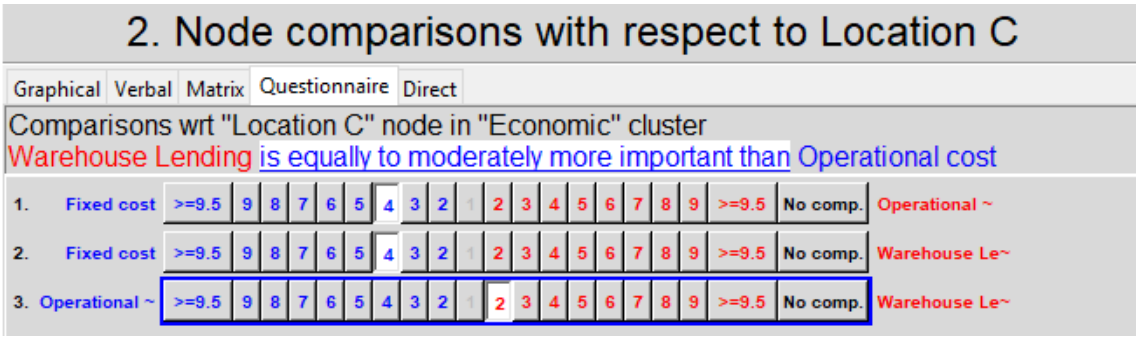

Figure 4.28 Pairwise Comparison with respect to Location C node to Economic cluster.

From the figure above, fixed cost in location C is the most dependence. From the table 4.29 below, show the consistency with respect to location C in Economic Cluster

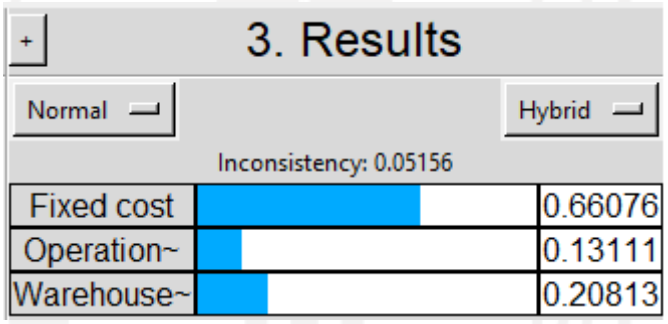

Figure 4.29 Consistency with respect to Location C node in Economic cluster

The result above of Inconsistency is 0.05156. That result is below <0.1, means that the calculation is already consistent. From the table 4.300, shows pairwise comparison with respect to Location C node to Local Environment Cluster.

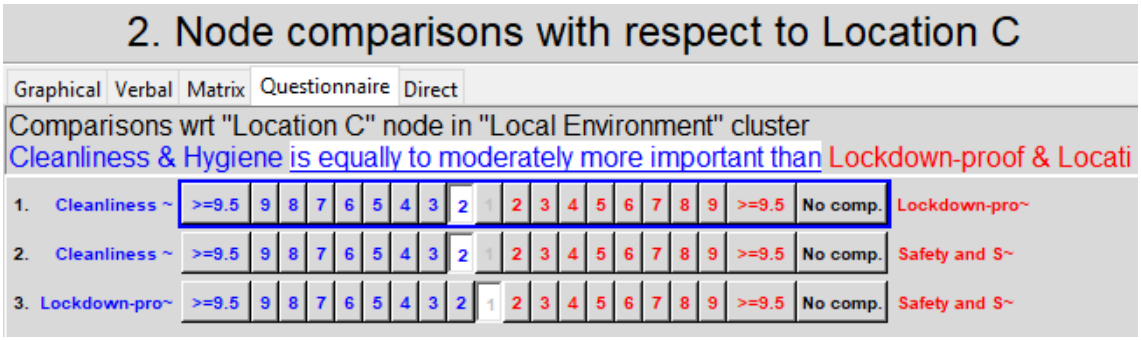

Figure 4.30 Pairwise comparison with respect to Location C node to Local Environment cluster

From the figure above, in location C cleanliness are the most dependence. From table 4.31 shows the consistency with respect to Location C node in Local Environment cluster.

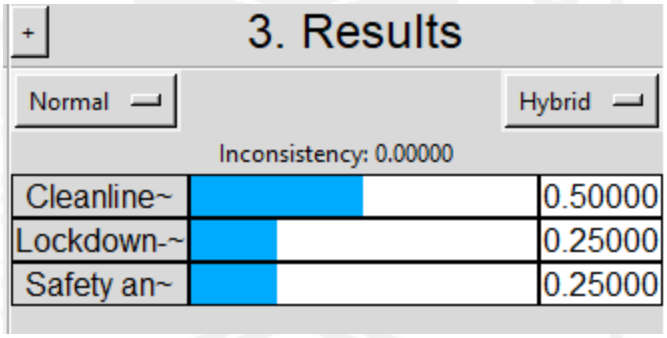

Figure 4.31 Consistency with respect to Location C node in Local Environment cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. The table 4.31 shows, pairwise comparison with respect to Location C node in Warehouse Specification cluster.

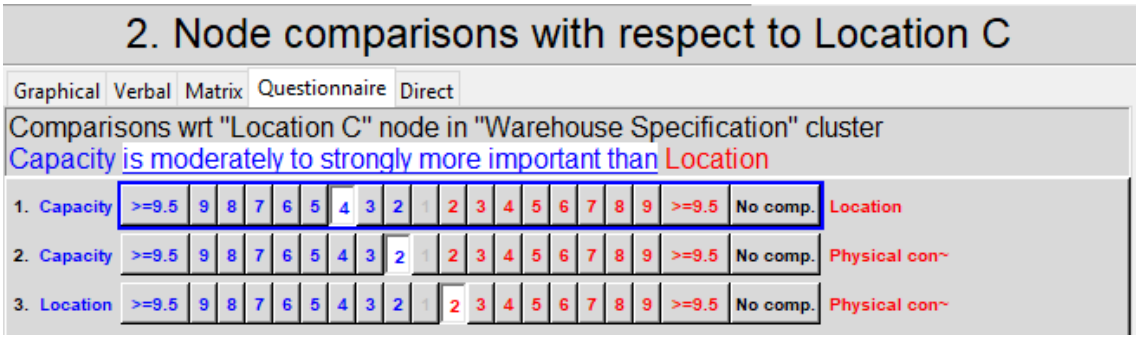

Figure 4.32 Pairwise comparison with respect to Location C node in Warehouse Specification cluster

From the figure above, Capacity in location C is the most dependence. Followed by Physical Condition and location. The table 4.33 below shows, consistency with respect to Location C node in Warehouse Specification cluster.

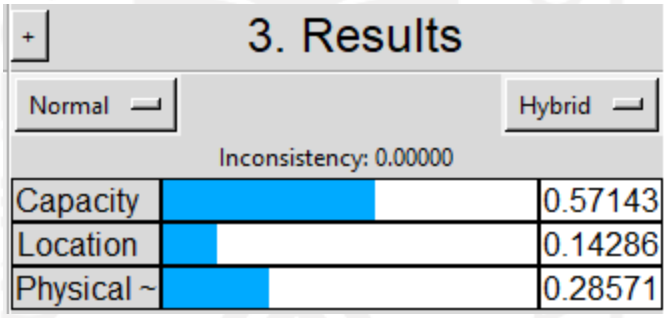

Figure 4.33 Consistency with respect to Location C node in Warehouse Specification cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. The table 4.34 shows, pairwise comparison with respect to Fixed Cost node in Alternative cluster.

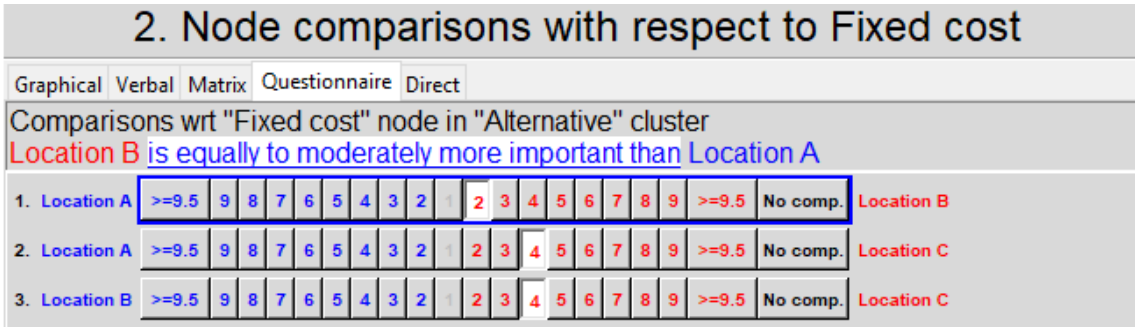

Figure 4.34 Pairwise comparison with respect to Fixed Cost node in Alternative cluster

From the figure above, warehouse B is the most expensive according to data above. Followed with location A and B. From table 4.35 shows, consistency with respect to Fixed Cost node in Alternative cluster.

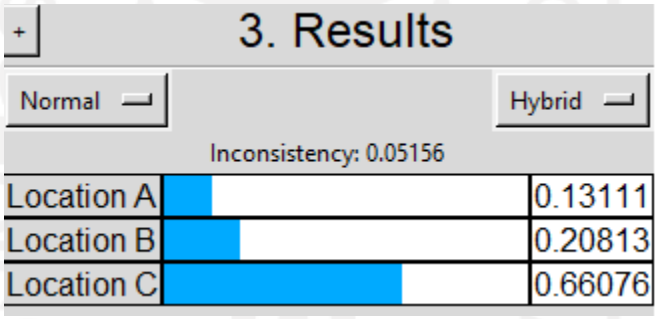

Figure 4.35 with respect to Fixed Cost node in Alternative cluster

The result above of Inconsistency is 0.5156. That result is below <0.1, means that the calculation is already consistent. From the table 4.36 shows, pairwise comparison with respect to Operational Cost node in Alternative Cluster.

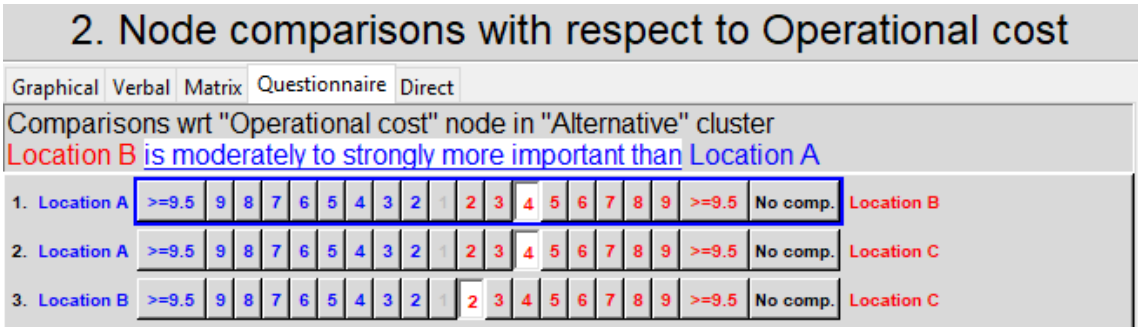

Figure 4.36 Pairwise comparison with respect to Operational Cost node in Alternative Cluster

From the figure above, location B in moderately more important than location, location A moderately more important than location C, and location B strongly more important than location C. The order is, location B, location A, location C. From table 4.37 show, the consistency with respect to Operational Cost node in Alternative Cluster.

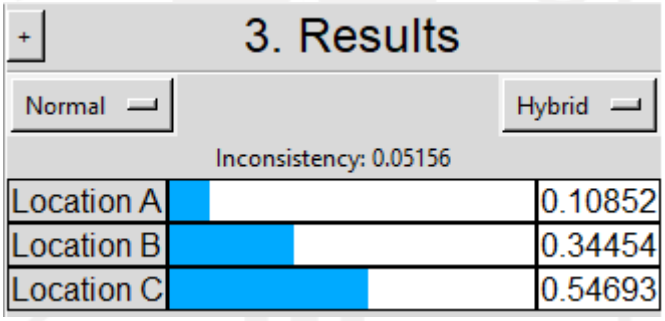

Figure 4.37 Consistency with respect to Operational Cost node in Alternative Cluster

The result above of Inconsistency is 0.5156. That result is below <0.1, means that the calculation is already consistent. From table below 4.38 show, pairwise comparison with respect to Warehouse Lending node in Alternative cluster.

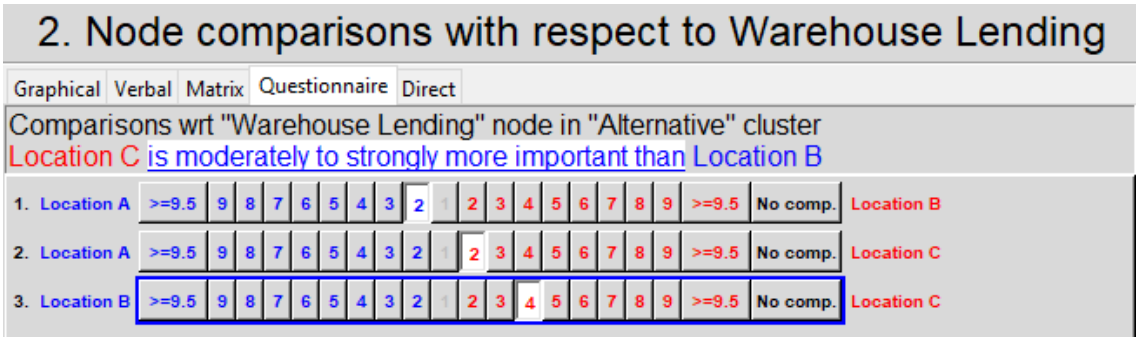

Figure 4.38 Pairwise comparison with respect to Warehouse Lending node in Alternative cluster

From the figure above, warehouse B is the hardest lending according to data above. Followed by warehouse A then B. Table 4.39 shows the consistency with respect to Warehouse Lending node in Alternative cluster.

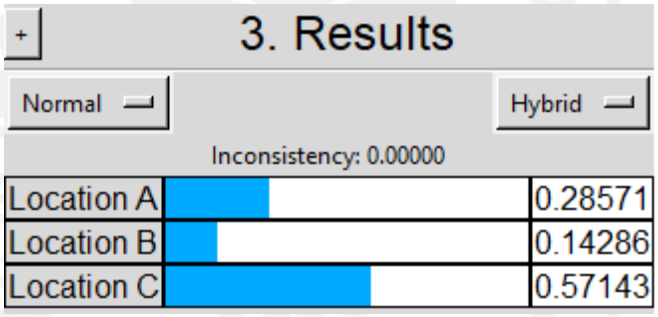

Figure 4.39 Consistency with respect to Warehouse Lending node in Alternative cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. The table 4.40 shows pairwise comparison with respect to cleanliness node in alternative cluster.

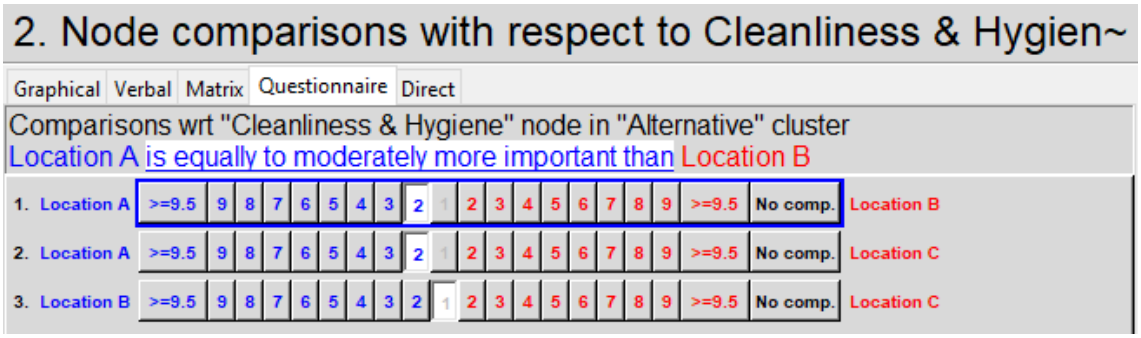

Figure 4.40 Pairwise comparison with respect to cleanliness node in alternative cluster

From the table warehouse A is the cleanest compared to the other warehouses. The order is, location B, location A, location C, respectively. Table 4.41 below, shows consistency with respect to cleanliness node in alternative cluster.

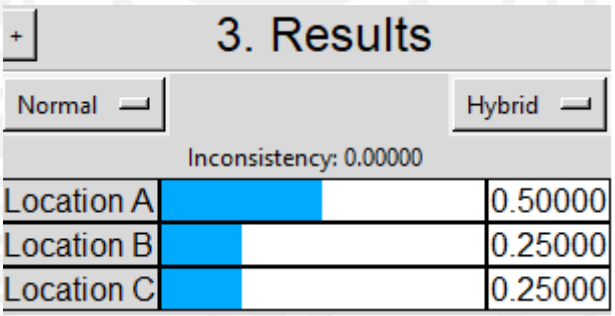

Figure 4.41 Consistency with respect to cleanliness node in alternative cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. From table 4.42, shows pairwise comparison with respect to capacity node in alternative cluster.

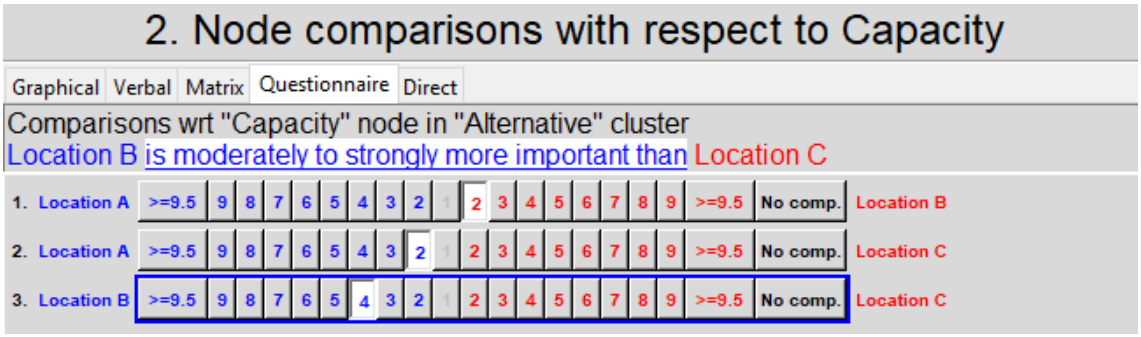

Figure 4.42 Pair wise comparison with respect to capacity node in alternative cluster

From the figure above warehouse B has the most capacity, followed by warehouse A and C. The table 4.43 below, shows consistency with respect to capacity node in alternative cluster.

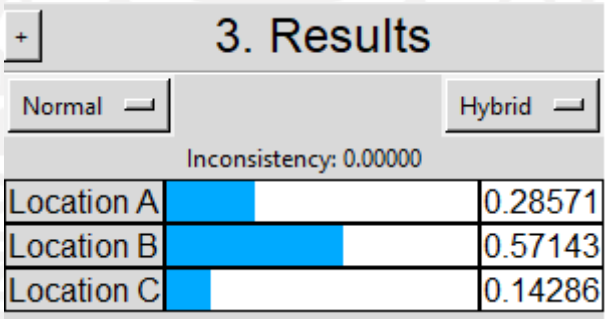

Figure 4.43 Consistency with respect to capacity node in alternative cluster

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. The table 4.44 below, shows pairwise comparison with respect to Location node in Alternative cluster.

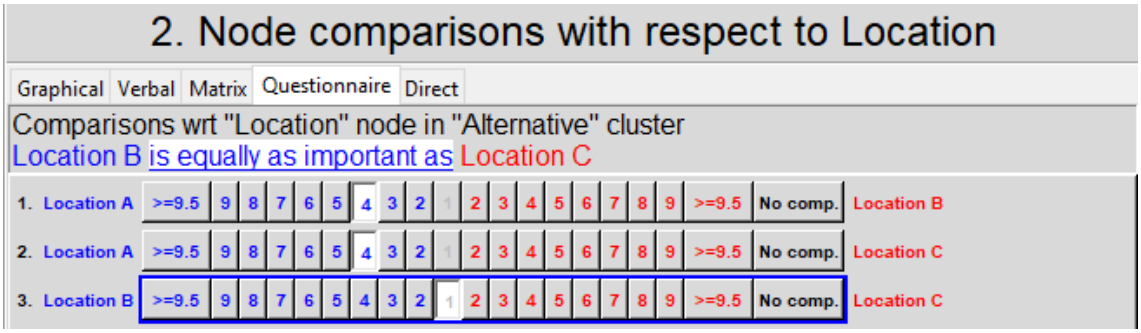

Figure 4.44 Pairwise comparison with respect to Location node in Alternative cluster

From the figure above, warehouse A has the best location compared to warehouse B and C. Table below 4.45 below, shows consistency with respect to Location node in Alternative cluster.

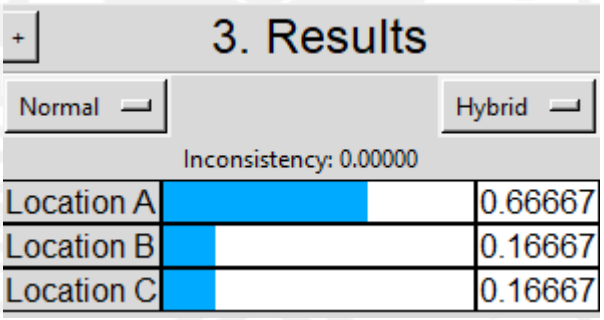

Figure 4.45 Consistency with respect to Location node in Alternative cluster.

The result above of Inconsistency is 0. That result is below <0.1, means that the calculation is already consistent. From the table 4.46 show the unweighted supermatrix.

4.5 Result Analysis

4.5.1 Unweighted Supermatrix based on the calculation using superdecision application:

The unweighted Supermatrix can be seen in Figure 4.26.

	Locatio~	Locatio~	Locatio~	Fixed c~	Operati~	Warehou~	Cleanli~	Lockdow~	Safety ~	Capacity	Location	Physica~
Locatio~	0.00000	0.00000	0.00000	0.13111	0.10853	0.28571	0.50000	0.00000	0.00000	0.28571	0.66667	0.00000
Locatio~	0.00000	0.00000	0.00000	0.20813	0.34454	0.14286	0.25000	0.00000	0.00000	0.57143	0.16667	0.00000
Locatio~	0.00000	0.00000	0.00000	0.66076	0.54693	0.57143	0.25000	0.00000	0.00000	0.14286	0.16667	0.00000
Fixed c~	0.66076	0.34454	0.66076	0.00000	0.00000	0.00000	0.00000	1.00000	0.00000	0.83333	1.00000	0.85714
Operati~	0.13111	0.10853	0.13111	0.00000	0.00000	0.00000	1.00000	0.00000	1.00000	0.16667	0.00000	0.14286
Warehou~	0.20813	0.54693	0.20813	1.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Cleanli~	0.20000	0.31081	0.50000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.20000
Lockdow~	0.40000	0.49339	0.25000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.00000	0.80000
Safety ~	0.40000	0.19580	0.25000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Capacity	0.34454	0.58417	0.57143	0.40000	0.66667	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Location	0.54693	0.18400	0.14286	0.40000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Physica~	0.10853	0.23183	0.28571	0.20000	0.33333	0.00000	1.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Figure 4.46 Unweighted Supermatrix

4.5.2 Weighted Supermatrix based on the calculation using superdecision application

The weighted Supermatrix can be seen in Figure 4.27.

	Locatio~	Locatio~	Locatio~	Fixed c~	Operati~	Warehou~	Cleanli~	Lockdow~	Safety ~	Capacity	Location	Physica~
Locatio~	0.00000	0.00000	0.00000	0.02622	0.03617	0.28571	0.02000	0.00000	0.00000	0.12643	0.25093	0.00000
Locatio~	0.00000	0.00000	0.00000	0.04163	0.11485	0.14286	0.01000	0.00000	0.00000	0.25285	0.06273	0.00000
Locatio~	0.00000	0.00000	0.00000	0.13215	0.18231	0.57143	0.01000	0.00000	0.00000	0.06321	0.06273	0.00000
Fixed c~	0.37758	0.19688	0.37758	0.00000	0.00000	0.00000	0.00000	1.00000	0.00000	0.46459	0.47423	0.65183
Operati~	0.07492	0.06201	0.07492	0.00000	0.00000	0.00000	0.16000	0.00000	1.00000	0.09292	0.00000	0.10864
Warehou~	0.11893	0.31253	0.11893	0.40000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Cleanli~	0.02857	0.04440	0.07143	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.04791
Lockdow~	0.05714	0.07048	0.03571	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.14937	0.19163
Safety ~	0.05714	0.02797	0.03571	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Capacity	0.09844	0.16691	0.16326	0.16000	0.44444	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Location	0.15627	0.05257	0.04082	0.16000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Physica~	0.03101	0.06624	0.08163	0.08000	0.22222	0.00000	0.80000	0.00000	0.00000	0.00000	0.00000	0.00000

Figure 4.47 Weighted Supermatrix

4.5.3 Limit Matrix

	Locatio~	Locatio~	Locatio~	Fixed c~	Operati~	Warehou~	Cleanli~	Lockdow~	Safety ~	Capacity	Location	Physica~
Locatio~	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727	0.07727
Locatio~	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590	0.06590
Locatio~	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334	0.13334
Fixed c~	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342	0.24342
Operati~	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991	0.04991
Warehou~	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301	0.14301
Cleanli~	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764	0.01764
Lockdow~	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472	0.03472
Safety ~	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102	0.01102
Capacity	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151	0.10151
Location	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993	0.05993
Physica~	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233	0.06233

Figure 4.48 Limit Matrix

4.6 Synthesize of Supermatrix

Name	Graphic	Ideals	Normals	Raw
Location A		0.579513	0.279457	0.077273
Location B		0.494199	0.238316	0.065897
Location C		1.000000	0.482227	0.133341

Figure 4.49 Synthesize of Supermatrix and Alternative Recapitulation

Based on the Figure 4.49 above, to make analysis begin with processing data of unweighted supermatrix that get from comparison between cluster and cluster, node and node, alternative and cluster also node. Then the data of weighted supermatrix get from processing and calculation the all element in unweighted supermatrix. Then the data of limit supermatrix obtained by increasing the weight of supermatrix, this data signed by the same value in each cluster, node.

After the processing the supermatrix, synthesize to get the final decision of the problem. The synthesize step begin from raw, normal, then ideals. The raw synthesize is supermatrix that was stable, after it the data processed into normal synthesize with divide the value of raw and the total raw. Then, the final decision signed with the value of ideals synthesize is one. This value get from the value of normal divide by the highest value of normal. In this case, the researcher get the final decision is location C.

CHAPTER V

DISCUSSION

5.1 Criteria Weighting

After getting the criteria from the first questionnaire, there are 3 important criteria with 3 sub- criteria each assessing the Warehouse location selection, next step is to weight each criterion through the second questionnaire that directly will be filled by the expert on SME retail sector. The criteria for warehouse location selection can be seen in Table 5.1.

Table 5.1 Criteria for Warehouse Location Selection

No	Criteria	Sub-criteria
1	Economy	Fixed Cost
		Operational Cost
		Warehouse Lending
2	Warehouse Specification	Capacity
		Location
		Physical condition and Facility
3	Local Environment	Cleanliness & Hygiene
		Lockdown-proof & Location status zone
		Safety and Security

5.2 ANP Weighting Analysis Method with the Help of Super Decisions

Super Decisions is software that implements the Analytic Network Process (ANP) which is useful as a decision maker due to dependency and feedback. By entering the weighting questionnaire data that has been distributed to the Super Decisions software, the Super Decisions software is able to determine the weighting for each data that has been inputted. By using the intelligent Computation command with Unweighted Supermatrix and Text, results. Unweighted Supermatrix. Unweighted Supermatrix is made based on pairwise comparisons between clusters, criteria, and alternatives by entering the priority vector (eigenvector) of the column into the matrix corresponding to the cell.

After determining the Super Weightless Matrix, the next step is to determine the Super Weighted Matrix with the Calculation command based on Supermatrix and Text in the Super Decisions software. The weighted Supermatrix element is obtained by multiplying everything in the Weighted Supermatrix by the value contained in the appropriate cluster matrix so that each column has the sum of one. After determining the Weighted Supermatrix, the next step is to determine the Limit Matrix with the Computation command with Limit Matrix and Text in the Super Decisions software. The boundary matrix is obtained by multiplying the matrix by itself several times. When the weights for each column have the same value, the Limit Matrix is obtained. The calculation result of ANP Superdecision can be seen in Figure 5.1

Name	Graphic	Ideals	Normals	Raw
Location A		0.579513	0.279457	0.077273
Location B		0.494199	0.238316	0.065897
Location C		1.000000	0.482227	0.133341

Figure 5.1 ANP Superdecision calculation result

From the result above, location C is the best location follow with location B and Location A. The order of the best location based on cluster and node and calculated using superdecision application are Location C, Location A and last Location B. The result of dependence calculation of the clusters can be seen in Figure 5.2.

Clusters	Alternative	Economic	Local Environment	Warehouse Specification
Alternative	0.000000	0.200000	0.040000	0.376397
Economic	0.571429	0.400000	0.160000	0.474230
Local Environment	0.142857	0.000000	0.000000	0.149373
Warehouse Specification	0.285714	0.400000	0.800000	0.000000

Figure 5.2 Most Dependence Cluster

From the calculation also found the result as shown in Figure 5.2 above. From the Figure 5.2 above, economic cluster/criteria are the most important and the most dependence with 0.571429, followed with warehouse specification and local environment. It can be understood because we face uncertainty because of the pandemic, making it more careful on investment on big budget spending. The priority result can be seen in Figure 5.3.

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Location A	0.27946	0.077273
No Icon	Location B	0.23832	0.065897
No Icon	Location C	0.48223	0.133341
No Icon	Fixed cost	0.55786	0.243420
No Icon	Operational cost	0.11439	0.049913
No Icon	Warehouse Lending	0.32775	0.143011
No Icon	Cleanliness & Hygiene	0.27837	0.017644
No Icon	Lockdown-proof & Location Satus Zone	0.54775	0.034718
No Icon	Safety and Security	0.17388	0.011021
No Icon	Capacity	0.45364	0.101506
No Icon	Location	0.26783	0.059929
No Icon	Physical condition and facility	0.27854	0.062326

Figure 5.3 Node Priority

From the table 5.3 above, shows the priority of the Alternative and node, fixed cost is the most important and most dependence node/sub-criteria in economic cluster with 0.55786, lockdown-proof and location status zone is the most important node in local environment cluster with 0.54775. On warehouse specification cluster, capacity is the most important node with 0.45364. Fixed costs, capacity. lockdown-proof and location status, as the chart above shows, experienced the biggest increase due to the pandemic. This is understandable because since the Covid-19 outbreak the situation has become uncertain and unpredictable.

So, people are more afraid of spending money especially those that involve spending and which have long-term effects. circumstances influence the decisions of people and businesses in their financial management but bicycle retailers may be one of the retailers or businesses that are not affected. While businesses in other sectors have experienced a large decline due to the Covid-19 pandemic, bicycle business has actually increased significantly. Demand has increased 2 to 3 times as much, but is not accompanied by stock from the producer, thus causing scarcity of goods. Therefore,

Agung Jaya bike shop is considering buying a new warehouse and looking for which warehouse is most appropriate during this pandemic.

Lockdown-proof and location status zone make sure the warehouse is still able used in business process. In This Covid-19 pandemic, many businesses have to stop the business process due to, lockdown from government. Having warehouse in lockdown proof make sure the business process. Especially warehouse with enough capacity to come up with goods scarcity. Stock up the scarcity goods with high demand will make sure to compete with another competitor.

CHAPTER VI

CONCLUSION AND RECOMMEDATION

6.1 Conclusion

Based on the research results, below are the several conclusions that could be obtained from this study:

1. Based on the result, there are 3 clusters and 9 nodes that affecting Agung Jaya Bicycle Store warehouse selection. They are, Economic Cluster, Local Environment Cluster, and Warehouse Specification Cluster. Economic cluster has 3 node which are, fixed cost, operational cost and warehouse lending. Local environment has 3 nodes also, Cleanliness and hygiene, Lockdown-proof and Status zone. Warehouse Specification also has 3 node, capacity, location and Physical condition.

2. Based on research using Analytical Network Process method with cluster and node that are found from interview and discussion with experts, it can be notified that:
   a. Best Location: Location C
   b. Most dependence cluster: Economy
   c. Most dependence node: Fixed Cost

6.2 Recommendation

The suggestion that can be provided from the results of this research, both for the company and further researches are:

1. Agung Jaya bike shop should prepare more on financial and economic sector before deciding to buying a new warehouse due to uncertainty during Covid-19

pandemic. Yes, warehouse Location C is the most ideal if the store want to buy a new warehouse

2. For next research, the researcher recommends to try and using different methodology and to compare the results of using two different methodology.

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