Journal of Multidisciplinary Academic Business Studies (JoMABS)
ISSN 3032-3169, Vol 2, No 3, 2025, 457-477 https://doi.org/10.35912/jomabs.v2i3.3055

Solutions for the concrete readymix supply shortage on projects in the New Capital (IKN) of Indonesia

Pandit Purnajuara, Mursyid Hasan Basri
Institut Teknologi Bandung, Indonesia[1-3]
purnajuara@gmail.com

Article History
Received on 30 May 2025
1st Revision on 3 June 2025
Accepted on 10 June 2025

Abstract

Purpose: The conceptual framework of the research should be able to represent all of the ideal aspects of Readymix Concrete Supply Chain, as it consists of the aspects of Environment, Product, Method, Supply Chain, Time, and Finance. Based on This Research address the main probable cause through Kepner-Tregoe Analysis. Kepner-Tregoe analysis is utilized to assess the whole situation including the caveats for not to analyse in regards to later problem-solving process. After the root cause of the problem is determined, this research also uses the SWOT analysis to gain information in regards to the internal and external factor that may affect the company welfare as it also carries out as considerations to generate alternative solutions.

Research methodology: This research required Subject Matter Experts' responds based on the Pairwise Comparison in order to achieve the aimed goal of the current problem, as the solution must consider all the solutions criteria. There are five solutions criteria and three alternative solutions proposed by the Subject Matter Experts. The Solutions Criteria are consists of Cost, Flexibility & Adaptability, Schedule, Product Quality, and Supply Chain Reliability, as the three alternative solutions are proposed to solve the concurrent issue. Alternative decision is ranked through Analytical Hierarchy Process to analyze which decision should be feasible for PT XYZ.

Results: The result was to build a new batching plant as the first priority ranking with score of 50,3 % with the considerations of five solutions criteria which are Cost, Flexibility & Adaptability, Schedule, Product Quality, and Supply Chain Reliability. To implement the decisions, it is mandatory to complete the preparation process, risk mitigation, budget planning, and site/location mapping before the executing the plan.

Keywords: *Readymix Concrete Supply, Kepner-Tregoe Problem Analysis, SWOT Analysis, Analytical Hierarchy Process*

How to cite: Purnajuara, P., & Basri, M. H. (2025). Solutions for the concrete readymix supply shortage on projects in the New Capital (IKN) of Indonesia. *Journal of Multidisciplinary Academic Business Studies*, 2(3), 457-477.

1. Introduction

Ibu Kota Nusantara (IKN) is the official name of the new capital city of Indonesia, which will replace Jakarta. Officially, IKN will be a unique provincial-level regional government unit as its territory will be the capital city of the Republic of Indonesia. Administratively, the IKN area is located in two existing regencies, namely North Penajam Paser Regency and Kutai Kartanegara Regency as shown in the relocation of the Capital City (IKN) is carried out as one of the strategies to realize Indonesia's 2045 economic target with more inclusive and equitable economic growth through accelerating the development of Eastern Indonesia. Moving the National Capital City from Java Island to Kalimantan

Island is one of the efforts to encourage regional equity so as to reduce the gap between the Eastern Region of Indonesia and the Western Region of Indonesia, especially between the Java Region and outside the Java Region. (The Ministry of National Development Planning, 2022)

In addition, the development of IKN is designed to become a sustainable city in the world, a symbol of national identity and a driving force for the Indonesian economy in the future. For this reason, the development of IKN must at least include the following five norms (1) an effective and efficient government; (2) livable city; (3) smart infrastructure and connectivity; (4) priority sectors for the future; and (5) collaboration of three cities, namely Samarinda, Balikpapan, and IKN[1]. In order to meet this target, the Government prepared a development plan in a master plan for the development of the national capital.

In order to support these strategic projects, adequate support of building materials is needed. Especially in support of readymix concrete material as the main and major base material in construction, the contractor must be able to provide the need for this material for the smooth running of the project. Readymix is a term for concrete that is ready for use without the need for further processing in the field. Ready-mixed concrete is increasingly being used for structural components of buildings in Indonesian construction projects. This is mainly due to its more controllable quality and relatively high productivity compared to traditional concrete batching and mixing practices (Pottonen, 2023).

Readymix concrete material is the main material to support production work in the field. There are at least six on going projects in IKN that required Concrete Material (Readymix Concrete being one of them) Supply for each of its completion. Currently, PT XYZ are responsible to supply by estimation around 119.045 m^3In terms of Concrete Supply. Hence, the reliability of supply in adequate amount is severely required.

The projects have only relied on two local batching plant vendors namely PT. SAB and PT. RB. These vendors also serve IKN projects that are being carried out by other contractors, so that production supply capacity cannot be maximized. Besides that, the natural materials that form ready-mix concrete such as sand, split, cement will also be increasingly difficult to obtain. Apart from the large demand, some materials also have to be imported from outside Kalimantan, such as from Palu, Sulawesi. So that it also makes the existing costs more expensive and requires planning in the procurement process to adjust the existing target schedule.

In order to fulfil the target in Ongoing projects and ensure the sustainability of the company's business development, a decision making is required to determine the best solutions to solve the shortage of concrete readymix supply. This research highlights the following questions for further investigation and further recommendation for concrete readymix supply shortage on PT. ABC projects in IKN.

1. What is the root cause of the concrete readymix supply shortage issue on PT. XYZ projects in IKN?
2. What are the proposed alternatives solutions to solve the concrete readymix supply shortage issue on PT. XYZ projects in IKN?
3. What is the best solution to solve the concrete readymix supply shortage issue on PT. XYZ projects in IKN?

This study aims to provide options and solutions for supply of readymix concrete to meet the following objectives:

1. To identify the root cause of the concrete readymix supply shortage on PT. XYZ projects in IKN.
2. To propose alternatives solutions to solve the concrete readymix supply shortage on PT. XYZ projects in IKN.
3. To select the best solution to solve the concrete readymix supply shortage on PT. XYZ projects in IKN.

2. Literature review

2.1 Theoretical Foundation

2.1.1 Kepner-Tregoe Problem Analysis

Kepner-Tregoe (KT) (Kepner & Tregoe, 1997) Problem Analysis is a structured problem-solving method developed by Charles H. Kepner and Benjamin B. Tregoe. These two social scientists conducting research on breakdowns in decision making at the Strategic Air Command at the late 1950s. Kepner-Tregoe has developed four basic Rational Processes for using and sharing information about organizational concerns. It is a systematic approach for analyzing and resolving complex problems. The four basic Rational Processes are as follows (Kepner & Tregoe, 1997).

1. Situational Aprraisal
   The Situational Appraisal step in KT problem solving aims to provide a comprehensive understanding of the problem's current state and its underlying causes. By conducting a systematic analysis of the situation, individuals or teams can gain insights into the factors contributing to the problem and lay the foundation for developing effective alternative solutions.
2. Problem Analysis
   In this step, the problem is further analyzed to identify its root causes. Various analytical techniques, such as Cause and Effect Analysis, are used to determine the underlying factors contributing to the problem.
3. Decision Analysis
4. Once the root causes are identified, decision analysis is performed to evaluate different alternatives and select the most appropriate solution. This step involves assessing the potential impact of each alternative, considering the risks and benefits associated with them, and making an informed decision.
5. Potential Problem (Opportunity) Analysis
   After implementing the chosen solution, it is crucial to anticipate any potential problems or side effects that may arise. This step involves evaluating the potential risks and developing contingency plans to mitigate them.

In this study we will analyze the case focus on using the problem and decision analysis. By analyzing the problems with this process we will be able to identify situations and find the core of the problem so that we can provide insight to find the right solution. Kepner Tregoe describes the analytical method in several stages as follows (Kepner & Tregoe, 1997).

1. State the Problem
   In this step we must identify the problem statement or the name of the problem. It is important to name the problem precisely because all the work to follow. After that we can describe, analyze, and explain a problem. In this study the name of the problem is on the object of concrete readymix.
   One of the methods to specify the object problem is to use 5H-1H method. There are six basic questions to specify the problem.
   a. What : the identity of the deviation/problem we are trying to explain
   b. Where : the location of the deviation/problem
   c. When : the timing of the deviation/problem
   d. Who : the stakeholder that related to the deviation/problem
   e. Why : the reason that make the deviation/problem significant impact to us
   f. How : the magnitude of the deviation
2. Specify the Problem
   At this stage we try to answer the previous 5W-1H question method with the is and is not methods. As seen in Table 1 which refers to Kepner and Tregoe (1997), we try to explain what the problem IS and what the problem IS NOT for each aspect of the problem.

Table 1 KT Problem Analysis – Spesify the Problem

Is	Is Not

What	**Identify**	What is The Problem?	What is **Not** The Problem?
Where	**Locate**	Where is The Problem Found?	Where is The Problem **Not** Found?
When	**Timing**	When Does The Problem Occur?	When Does The Problem **Not** Occur?
		When was it first observed?	When was it last observed?
Extent	**Magnitude**	How Far does the problem extent?	How localized is the problem?
		How many units are affected?	How many units are not affected?
		How much of any one unit is affected?	How much of any one unit is **Not** affected?

Source : Kepner and Tregoe (1997)

3. Develop possible causes from knowledge and experience or distinctions and changes.

At this stage we must identify the causes of each question that we have elaborated into what is the problem at the previous stage. In addition, we must also try to see gaps or differences from the results of the analysis of what is a problem and what is not a problem. The description can be seen in Table 2 KT Problem Analysis worksheet with the addition of two columns on the right wich refers to Kepner & Tregoe (1997).

Table 2 KT Problem Analysis - Develop Possible Cause

		Is	**Is Not**	**Distinction**	**Cause**
What	**Identify**	What is The Problem?	What is **Not** The Problem?	What is the distinction between the is and the *is not*	What is a possible cause?
Where	**Locate**	Where is The Problem Found?	Where is The Problem **Not** Found?	What is the distinctive about the different locations?	What is a possible cause?
When	**Timing**	When Does The Problem Occur?	When Does The Problem **Not** Occur?	What is the distinctive about the different in timing?	What is a possible cause?
		When was it first observed?	When was it last observed?	What is the distinctions between these observation?	What is a possible cause?
Extent	**Magnitude**	How Far does the problem extent?	How localized is the problem?	What is the distinction?	What is a possible cause?
		How many units are affected?	How many units are not affected?	What is the distinction?	What is a possible cause?
		How much of any one unit is affected?	How much of any one unit is **Not** affected?	What is the distinction?	What is a possible cause?

Source : Kepner & Tregoe (1997)

2.2 SWOT Analysis

SWOT analysis is an effective framework for analyzing the Strengths, Weaknesses, Opportunities, and Threats of an organization (or a project) that helps to address the effectiveness of a project planning and implementation. Strengths would define any internal asset that will help to meet demands and to fight for threats. Weaknesses describe internal deficits that hinder the organization in meeting its demands. Opportunities describe any external circumstances or trends that favor the demand for an organization's specific competence. Threats define any external circumstance or trend that will unfavorably influence demand for an organization's competence (Sabbaghi & Vaidyanathan, 2004).

Table 5 shows the key question that can guide the analysis and the typical answer. These four factors can be analyzed with a matrix like in the worksheet. From the results of the analysis, positive and negative responds should be obtained in terms of Internal Factors and External Factors.

Table 3 SWOT Key Questions and Typical Answers

		Key Questions:	**Typical answers**
Internal	**S**trengths	What are our advantages? What do we do well?, How are we doing competitively? What are our resources? Are there any internal assets (know-how, motivation, technology, finance, business links) which will help to meet demands and to fight off threats?	Well-trained man-power , well established knowledge base, good contact to target group, technology, etc.
	Weaknesses	What could be improved? What is done badly? What should be avoided? Are there any Internal deficits hindering the organization in meeting demands?	Lack of motivation, lack of transport facilities, problems in distribution of services or products, low reputation (the lack of a particular strength)
External	**O**pportunities	What are the good tasks? What are the interesting trends? What changes do we expect to see in the market over the next few years? Are are any external circumstances or trends that favors the demand for an organization's specific competence?	Changes in technology and market that favor your products or services, changes in government policy related to your industry, changes in social patterns, population profiles, lifestyle, etc., local, national, & international events increasing purchasing power.
	Threats	What is our competition doing? What are the obstacles? What future changes will affect our organization? Is changing technology threatening our position? Do we have management support? Sufficient resources? Are we using the right tools, software, and platform? Are there any external circumstances or trends which will unfavorably influence demand for an organization's competence?	Establishment of strong competitors, lack of cash at household level, governmental regulations that limit free distribution of our product.

2.2.1 Analytic Hierarchy Process

One of the most useful methods for selecting project that is becoming more and more important is AHP. This method was developed by Dr. Thomas Saaty in 1980 as a tool to help with solving technical and managerial problems. It aims to measure the relative priority for a given set of alternatives on a ratio scale, based on the judgment of the decision maker, and emphasizes the importance of the intuitive judgment of the decision maker as well as the consistency of the comparison of alternatives in the decision-making process. The AHP method is especially suitable for fields where the risk of intuition, rationality, and irrationality with respect to and movement can be found (Palcic & Lalic, 2009).

AHP algorithm is basically composed of two steps : (1) Determine the relative weights of the decision criteria, (2) Determine the relative rankings (priority) of alternatives. Both qualitative and quantitative information can be compared using informed judgements to derive weights and priorities. In detail the steps are as follows.

Make a structure hierarchy of Criteria and Decision Alternative

In the first step, we must define the problem and make a tree of criteria and alternative which possible to choose. Determine the criteria can be chosen by what we want to achieve for our goal. And after that we must identify the alternative decision as seen on **Figure II.3**.

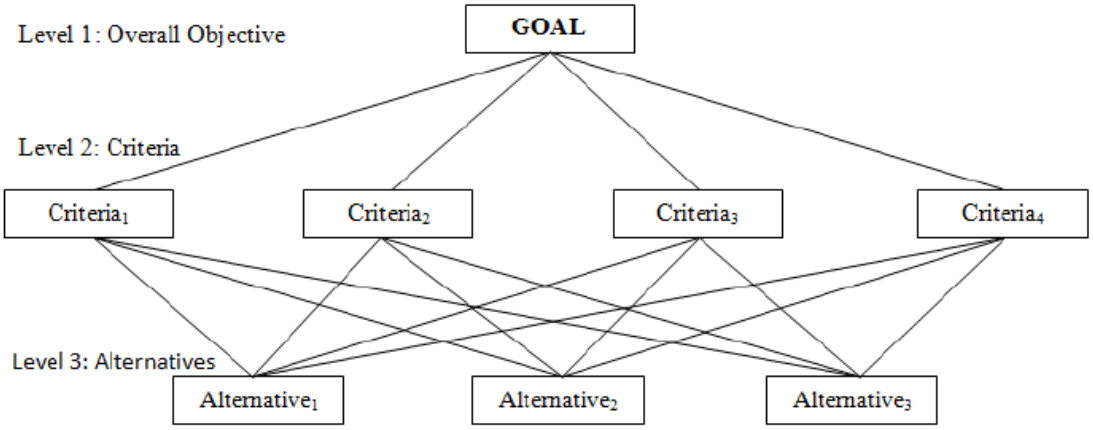

Figure 1. Illustration of AHP Structure Hierarchy

Check the Consistency
An important consideration in terms of the quality of the ultimate decision relates to the consistency of judgments that the decision maker demonstrated during the series of pairwise comparisons. To handle the consistency question, the AHP provides a method for measuring the degree of consistency among the pairwise judgments provided by the decision maker. The ratio is designed in such a way that values of the ratio exceeding 0.10 are indicative of inconsistent judgments. Although the exact mathematical computation of the consistency ratio is beyond the scope of this text, an approximation of the ratio can be obtained.

Here are the step to estimate Consistency Ratio :

1. Multiply each value in the first column of the pairwise comparison matrix by the relative priority of the first item considered. Same procedures for other items.
2. Divide the elements of the vector of weighted sums obtained in Step 1 by the corresponding priority value.
3. Compute the average of the values computed in step 2. This average is denoted as λ_{max}
4. Compute the consistency index (CI), Where n is the number of items being compared. The formula is :

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

5. Compute the consistency ratio (CR) = (CI/RI), Where RI is the random index, which is the consistency index of a randomly generated pairwise comparison matrix.
6. Development the Priority Ranking
   The overall priority for each decision alternative is obtained by summing the product of the criterion priority times the priority of the decision alternative with respect to that criterion. Ranking these priority values, we will have AHP ranking of the decision alternatives.

2.3 Conceptual Framework

Conceptual Framework are tools that meant to guide empirical research as it offers critical structure and direction (Hussain, 2024) as Ravitch and Riggan (2016) implied “an argument about why the topic one wishes to study matters, and why the means proposed to study it are appropriate and rigorous”.

Conceptual Framework should be able to define the concurrent problem and to seek the answer towards the questions based on the problem (Luft, Jeong, Idsardi, & Gardner, 2022).

Several factors contribute to the general Supply Chain Process of PT XYZ. Aspect of environment, time, economic situation, capital power, and pricing should play significant part on PT XYZ Readymix Concrete process. These factors shall be elaborated as follows:

1. Environment Aspects

As concrete workability is a major part for Readymix Concrete Structure, it should be able to sufficient enough to be poured without void and create a solid bonding between materials. Concrete normally settle and starting to hardens in relatively short amount of time which arround 90 minutes (Mahgoub, Hussein, & Mousa, 2024). Hence, speed and distance should play significant part in terms of concrete delivery. Legal procedure, and permits should also played significant role, in terms of production as it should adhere to regulations specifically in the production site.

2. Product

Product Quality and Quantity should be supervised in detail, as it is the major part of a concrete structure (Nurokhman, Suharyanto, & Rochmawati, 2021). Product Quality and Quantity should adhere to construction specifications as is also related to the aspect of Quality, Safety, Health, and Environment.

3. Method

Donald, David, M Bixby, and John (2020) initially implied that Supply Chain Management is a multifirm relationship management. Effective tools of communication and technology allow the subjects of supply chain to perform communication and create value among each other. Structure of production should add value towards a productivity, as reducing the amount of production time, process cost, and identifiying issue should improve the production process (Quesada, Gazo, & Sanchez, 2012).

4. Supply Chain

Performance of Supply Chain defined as the Operational Exellence to deliver leading customer experience (Simchi-Levi, Kaminsky, & Simchi-Levi, 2004). Responsiveness to the changes, service/technical support is major part of Supplier Performance (Steward, Wu, & Hartley, 2010).

5. Time

Time management is process of controlling and recording the time make by the projects. Bad time and scheduling adds cost over run, disputes, or even abandonment of the projects (Westland, 2006). Hence, time management in terms of delivery schedule and time is an important aspect.

6. Finance

Implementing adequate Financial Control could prevent Fraud, as it is able to ensure Supply Chain Stability and rellience. A fluctuative of material price, and ability souricng may also affects the supply chain process (Stemmler, 2002). Hence strong equity power and good economic condition would be the major aspects for Suppy Chain Rellience.

Based on the all-previous aspects that has been mentioned, it can be compiled into a conceptual framework to constitute a complete and solid principal of Readmix Concrete Supply Conceptual Framework. Here is the general illustration of factors that play part on Readymix Concrete Supply ats seen on Figure 1.

3. Research methodology

This chapter will discuss research methodology consisting of research design, data collection methods, and data analysis methods. Research design will discuss the framework of research methods. On the data collection method will be discussed about how does the selected sources and methods are appropriate to the contextual problem by specifying what kind of data will be collected. The data that has been obtained will be discussed related to the method or how to analyze the data on subchapter of data analysis method.

3.1 Research Design

Kepner-Tregoe analysis is applied since the beginning stage refering to Chapter I, which was to determine is the problem. The problem may occure as the implications of the concurring root cause which should be determined prior to the alternative solutions implementation. The main rootcause then

should be verified with brainstorming to generate idea and additional information and verifiy the assumption. To determine the solution, SWOT analysis and brainstoriming process are required based on the category mentioned based on Kepner-Tregoe Analysis to determaine the company situation and what shall be the applicable solution for the concurrent situation. Advancing to decision making step, the research shall use Analytical Hierarchy Process to quantify the priority order of Decision to solve the main problem. The decision shall be assessed comprehensively through proper risk analysis, budget analysis, spot/location analysis.

3.2 Data Collection Method

The researcher uses some data collection methods to support the research. In this study, in general, quantitative data collection will be carried out from reports that have been running. Likewise, a qualitative analysis will be carried out on related stakeholders as well as the point of view of experts in each section to carry out a qualitative analysis based on observation and brainstorming.

3.2.1 Data Quantitative

This quantitative data will help to analyze the initial identification of problems that exist in the initial readymix production process in the projects being studied. This data is obtained from the primary report production data using readymix concrete material compared to the daily procurement plan targeted by the sample project. The data is sourced from the project's internal data which is reported in the project's weekly report. In the step to define the root cause, we also needed to identify the 5W1H questions to describe the core of the problem we face. To support that, we have to get the related data to answer each question so that can guide us to find the root cause. Also, when we try to analyze using AHP to choose the best solution, we need to get the data of project progress and cost contained in each solution option for consideration. All that data we can get by using the observation and report over a period of time.

3.2.2 Data Qualitative

We also need qualitative data to analyze the research process, such as the define root causes and determine solutions stages. This qualitative data is able to add information so that it becomes a deeper consideration in answering and making decision solutions. This qualitative data was obtained through a process of brainstorming and direct discussion with relevant stakeholders. Qualitative data is also needed in the solution determination stage with the AHP process. At this stage, considerations and views from experts in the field (Subject Matter Expert) are needed related to the problems faced in this research. The summary of the data collection method is as shown in **Table III.1**.

3.3 Data Analysis Method

In this research, data analysis methods will be carried out in the form of methods for quantitative data and methods for qualitative data.

1. Quantitative method analysis data

Quantitative method analysis data is intended as a systematic approach to examine numerical data to extract meaningful insights, identify patterns, and make informed decisions. In this study the approach used is descriptive statistical analysis. Descriptive statistics consists of methods for organizing, displaying, and describing data by using tables, graphs, and summary measures. **(Mann & Lane, 1995)**

2. Qualitative Data Analysis Method

Qualitative analysis aims to helps us understand the underlying meanings, interpretations, and experiences of individuals or groups. In this study the approach used is framework analysis. Framework analysis involves developing a thematic framework or matrix to organize and analyze data. Researchers use this matrix to systematically compare and contrast data across different cases or themes.

4. Results and discussions

4.1 Possible Cause Analysis

Upon determining the root cause, this research directly involve Three Subject Matter Experts (SME) as correspondent, as it should provides important information in regards to the required information and problem resolutions (Khanam, 2023)**.** The selected SME's are the persons who directly in charge in the

working site as project owner and some of the others serves as person in charge of Readymix Concrete Production at this current Batching Plant.

Table 1 List of Qualified Subject Matter Expert

SUBJECT	EXPERTISE/OCCUPATION/ROLE
SUBJECT MATTER EXPERT 1	Site Operations Manager of PT ABC
SUBJECT MATTER EXPERT 2	Site Contract Administration Manager of PT ABC
SUBJECT MATTER EXPERT 3	Site Procurement, Logistic, Equipment Manager of PT ABC

Various questions are being asked to the correspondent (see appendix A) correlated with the needed information and qualitative data to support this research. After the interview process is completed, the research continued to the advanced steps which consist of these approaches:

1. Kepner-Tregoe Analysis

Kepner-Tregoe Analysis (KT Analysis) is used since the beginning of the research. Upon determining the problem, KT Analysis determine the distinction of the situation, what seems to be different than the ideal situation.In chapter I we obtain an issue which is Shortage of Readymix Concrete Supply which is possibly caused by several reason.

Proceeds to the next step, particular reasons are implied depends on the analyst's judgement and standpoint (Kristamuljana, 1998). Thus, these are the possible reasons based on the result of the conducted interview and analysis:

a. Production Machine/Unit Insufficiency;
b. Low Batching Plant Productivity;
c. High Difficulties on Materials Hauling;
d. Difficulties on Raw Material Supply;
e. Insufficient Amount of Manforce/Labour;

2. Root Cause Analysis

To define the root cause, brainstorming is also used to determine the main probable cause. The idea of using the brainstorming is to verify the assumed most probable cause is to confirm the issue that likely cause the concurrent issue (Kurnia et al., 2020).

To provide systematical thinking in order to find the main problem cause on occurring problem, root cause analysis is necessarily needed before proceeding to remedial action planning and excecuting (Groot, 2021).

4.2 Determining Problem Resolutions

The next step after the root cause determining process completed, the research proceed to the steps of defining problem resolutions, which includes several methods, such as:

1. SWOT Analysis

To obtain the optimal resolution on the problem, SWOT analysis method utilized to gather all the general situations and assess the four main point of current conditions, including Strengths, Weaknesses, Opportunities, and Threats in advance, prior to the solutions process, as strengths and

weaknesses mainly as the result of company's own performance, Opportunities and Threats might derived from external factors (Gurl, 2017).

According to the **Table 1** PT XYZ possess several key factors as its strengths and opportunities as the major point to start on problem resolutions, while also suffers from its weakness and imposed to upcoming threats as potential obstacles upon resolving the current situation/problem. Subject Matter Expert (**SME**) Opinions and Recommendations
As Subject Matter Expert (SME)s Opinions and Recommendations are also posing significant roles on this research, another list of targeted Subject Matter Experts also provides some alternative solutions towards the problem. Previously, SMEs are listed to define the main problem cause by the problem. Proceeding to the next step which several SMEs selected as audiences to gather necessary informations. Qualified SMEs are shown in **Table 5**. However, these are several alternative solutions based on the interview and brainstorming with the involved corespondences as seen in **Table 5**:

Table 2 List of Subject Matter Expert #2

EXPERTISE/OCCUPATION/ROLE	Expertise/Job Description
Vice President – *Konstruksi dan Instalasi* of PT XYZ	Responsible for Maintaining the Supply Chain Reliability and Process of PT XYZ
Project Manager of PT ABC	Responsible for whole project operations of PT ABC
Project Manager of PT XYZ	Responsible for whole productions of concrete readymix supply
Site Contract Administration Manage of PT XYZ	Responsible for Budget Controlling
Site Engineering and Standardization Manager PT XYZ	Responsible for design and quality controlling
Project Manager of PT XYZ	Responsible for whole productions of concrete readymix supply
Site Procurement, Logistics, and Equipment Manager of PT ABC	Responsible for project work, equipment, and materials procurement, logistics management, and warehouse management.

The result of the interview provided several alternative solutions towards the probable main causes, as the alternative solutions also consider the SWOT analysis shown in **Table IV.6**, as previously mentioned that the SWOT analysis represents company general situations. Based on the conducted interview alongwith the qualified SME as listed on **Table IV.5**, the provided solutions are narrowed into three best alternative solutions, as the solutions might feasible and applicable as those should be able to address the main probable cause. Hence, there are the three Alternative Solutions provided by the Qualified **SME:**

1. Purchase new production machine and expanding current batching plant
2. Outsource Readymix Concrete Supply from External Vendors with long term strategic partnership
3. Build new Batching Plant with new production equipment and bigger production volume

Table 3 Root Cause Problem with Alternative Solutions

Main Problem	Alternative Solutions

Shortage on Readymix Concrete Material Supply caused by Low Batching Plant Productiviy and Difficulties on Delivery Process.	1. Purchase new production machine and expanding current batching plant 2. Outsource Readymix Concrete Supply from External Vendors with long term strategic partnership 3. Build new Batching Plant with new production equipment and bigger production volume

To support the decision-making process, the alternative solutions also consider the aspect of cost to implement, as outsource ready concrete supply might include the production cost which should be the responsibility for the potential strategic partner. Thus, the estimated implementation cost is on **Table IV.7**.

Table IV.4 Estimated Cost for Solutions Implementation

No.	Alternative Solutions	Estimated Cost
1	Purchase new production machine and expanding current batching plant	**± Rp 310.000.000.000**
2	Outsource Readymix Concrete Supply from External Vendors with long term strategic partnership	**± 20.000.000.000,-***
3	Build new Batching Plant with new production equipment and bigger production volume	**± Rp 429.000.000.000,-**

Based on **Table IV.7**, it can be observed that there are three key solutions to address the primary probable cause. Each of these solutions has its own advantages and disadvantages as shown in Table IV.8 as it requires further justification to quantify the decision-making process to establish the most effective and efficient solutions. One thing that should be considered, whilst outsourcing readymix concrete may appear lower in terms of issue resolving price, the material orders might be higher than the actual cost as there should be margins or profit for the 3rd party vendor, so that part must be considered in advance.

In Addition, Alternative solutions are measured by five key aspects that would complement the decision-making process, there are five key factors that have to be taken into considerations to choose the fittest decision on concurring problem, each criteria represent each own description and criteria. The five key criterias and its descriptions are shown in **Table IV.9**

Table IV.5 Five Key Criteria on Alternative Solutions

CRITERIA	DESCRIPTION
Cost	Cost required for solution implementation, including project cost, maintentance cost, operational cost, and procurement cost
Flexibility & Adaptability	The ability to adapt to the required amount of production, change of specification required, and fluctuation in market price
Schedule	Estimated Time for Solution Implementation and Project Completion

CRITERIA	DESCRIPTION
Product Quality	Product Quality according to required specifications based on the standard of the construction process; this played significant aspect of product acceptability and construction safety when the construction process is finished
Supply Chain Reliability	The consistent ability of a Supply Chain to deliver products according to demanded quantities, matched quality levels, and resistant on disturbances and disruption

All the aspects from Table IV.5 are required to considers the Product Quality Aspect as it the most prominent aspect amongst all the five criteria, as Product Quality directly correlated with Product Acceptability and Safety Aspects of the finished construction according to the required construction specifications and requirement.

4.3 Decision Making Process

Advancing to the Decision Making, in this research used Analytical Hierarchy Process (**AHP**). As Saaty and Vargas (2012) implied, prior to decision making process is to considers what factors to include on the process. Which consist on identifying the issues, determining the probable causes and also the main probable cause, alternative solutions. Few steps are needed to determine the correlations between one and the other aspect.

1. Construction of Hierarchy Structure

The three mentioned alternative solutions based on **Table IV.6** should be complemented by criterias based on **Table IV.9** are the fundamental aspects on determining the possible solutions which directly considers the five key aspects. The Hierarchy Structure are drawn as **Figure IV.4**.

2. Pairwise Comparison of **Analytical Hierarchy Process**

Saaty and Vargas (2012) implied that Pairwise Comparison is meant to quanitify preferences between criteria and alternative solutions. SME are required to answer and choose between criterias and its correlated alternative solutions as it also called as Fundamental Scale. The numbers are meant to quanitify the significacies or preference of the criteria. With the explanation the higher the number which is nine (9) towards the desired criteria, the higher the preference towards the desired criteria, as it applied vice versa towards the undesired criteria. The detail explanation about the number signification on quantifying the preference in Pairwise Comparison is shown on **Figure IV.5**. The Example of Pairwise Comparisons Table is as shown on **Figure IV.6** and **Figure IV.7**.

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above nonzero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining *n* numerical values to span the matrix

The generic responds collected from on the interview alongwith the qualified correspondents listed on **Table IV.10** as the detailed responds are attached on the **Appendix** Section for each of Pairwise Comparison Tables. The detailed responds that are able to be processed are presented in a table which each criteria represents the average value of correspondences criteria solutions.

The pairwise comparison of Alternative Solutions for each criteria solution are listed on **Table IV.11**. The Table would then be processed along with the criteria solutions from **Table IV.10** and analysis can start to finish with AHP Method to determine the decision to solve for the main probable cause.

Table IV. 6 Pairwise Comparison of Criteria Solutions for Problem Cause

CRITERIA	AVERAGE SCORE	CRITERIA	AVERAGE SCORE
Cost	0,54	Schedule	1,86
Cost	2,29	Flexibility & Adaptability	0,44
Cost	0,15	Product Quality	6,57
Cost	0,58	Supply Chain Reliability	1,71
Schedule	2,71	Flexibility & Adaptability	0,37
Schedule	0,18	Product Quality	5,71
Schedule	2,57	Supply Chain Reliability	0,39

Flexibility & Adaptability	0,16	Product Quality	6,14
Flexibility & Adaptability	1,86	Supply Chain Reliability	0,54
Product Quality	6,14	Supply Chain Reliability	0,16

Analysis for Decision Making Process based on Pairwise Comparison
The conducted analysis is to determine the Main Goal (As Drawn on **Figure IV. 5**). As the level 2 – Criteria might be the the main criteria to be taken as consideration for each alternative solutions as the level-3 of the matrix hierarchy. Herewith the analytical hyerarchy process computation as the advancing step after the responds are collected:

1) Upon the pairwise comparison of criteria solution, the data should be summed to get the total score for each criteria solution. The summed quanitified respond of each Subject Matter Experts is on **Table IV.12**.

Table IV. 7 Total Column of Each Criteria Solutions

CRITERIA	Cost	Schedule	Flexibility & Adaptability	Product Quality	Supply Chain Reliability
Cost	1	0,54	2,29	0,15	0,58
Schedule	1,86	1	2,71	0,18	2,57
Flexibility & Adaptability	0,44	0,37	1	0,16	1,86
Product Quality	6,57	5,71	6,14	1	6,14
Supply Chain Reliability	1,71	0,39	0,54	0,16	1
Column Total	11,58	8,01	12,68	1,65	12,15

2) Each row are divided by the Column total, to determine the average of each row. The average of each row should be used as further calculation in matrix calculation. The result of each row divided by the Column Total is on Table IV.13

Table IV. 8 Row Average for Each Criteria Solution

CRITERIA	Cost	Schedule	Flexibility & Adaptability	Product Quality	Supply Chain Reliability	Row Average
Cost	0,09	0,07	0,18	0,09	0,05	0,09
Schedule	0,16	0,12	0,21	0,11	0,21	0,16
Flexibility & Adaptability	0,04	0,05	0,08	0,10	0,15	0,08
Product Quality	0,57	0,71	0,48	0,61	0,51	0,58
Supply Chain Reliability	0,15	0,05	0,04	0,10	0,08	0,08
Column Total	1	1	1	1	1	1

Hence, based on the **Table IV. 13** the eigen vector found is as seen on **Table IV. 14**. As the table represent the matrix or vector of solution criteria which would be needed to determine the decision in the later

Table IV. 9 Priority Vector of Criteria Solution

SOLUTION CRITERIA	PRIORITY VECTOR
Cost	0,09
Schedule	0,16
Flexibility & Adaptability	0,08
Product Quality	0,58
Supply Chain Reliability	0,08

3) In order to determine the matrix of alternative solutions, similar method is applied, which each solution criteria are required to be quantified through pairwise comparison. Each solution criteria which previously mentioned are now paired with the alternative solution as illustraed on **Figure IV.6** and **Figure IV.7**. The detailed process of analysis is available on Appendix section. **Table IV.15** is the compilation of each priority vector of alternative solutions of each criteria solution.

Table IV. 10 Priority Vector of Alternative Solutions based on Each Criteria Solution

Alternative Solutions	Cost	Schedule	Flexibility & Adaptability	Product Quality	Supply Chain Reliability
Purchase New Equipment	0,23	0,15	0,33	0,31	0,28
Strategic Partnership with Suppliers	0,69	0,60	0,07	0,08	0,08
Build New Batching Plant	0,08	0,25	0,60	0,61	0,64

4) In order to define the priority ranking based on the Priority Vector of Solution Criteria and Alternative solution of each solution criteria, the weighted sum are applied to quantify the priority ranking. Prior to the calculation step, the quantifaction of each Criteria Solution and Alternative Solution is seen in **Figure IV.9.**

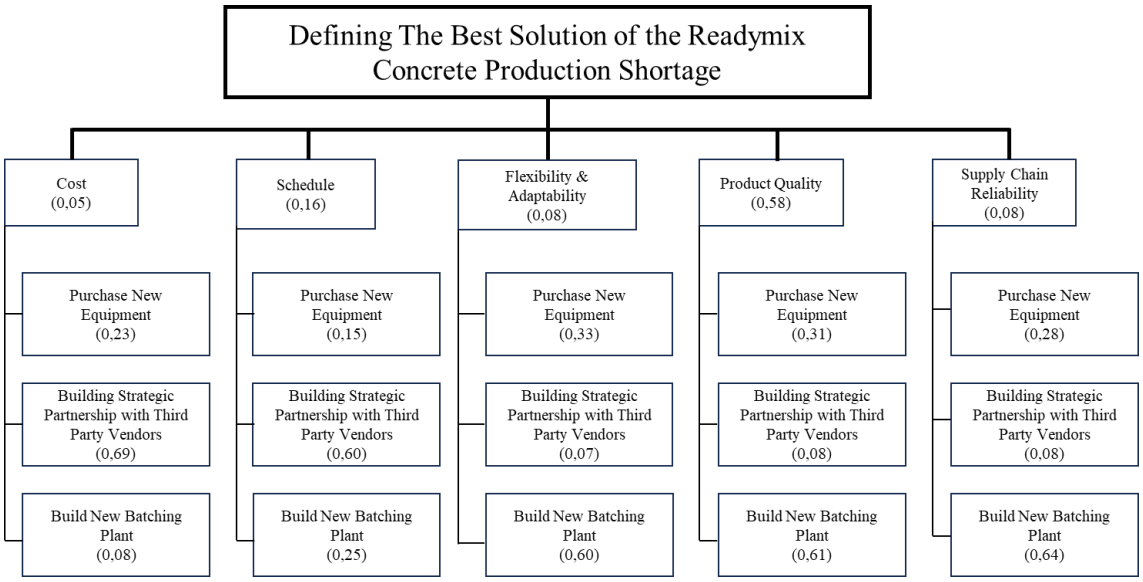

Figure 8 Weight of Solution Criteria and Each Alternative Solution

Criteria Solution with the aspect of Product Quality played a very significant portion for decision making, as it mandatory for every production. The implication of failure in achieving required the quality structure would cause a significant profit loss, or even worse, cause a mortality. Those implications can cause domino effect towards the whole company welfare. Product Quality also is the mandatory requirement for a structure to be accepted as it should be paid after the project/ progress is completed and meet the required quality. However, all the aspects of Criteria Solution are important, as Schedule and Supply Chain Reliability are also the second and third highest weighted priority, as schedule might impacted on the duration based on the duration of procurement contract, which any latency in delivery and completion would cause an immediate punishment such as Fine or the worst is contract termination. Moreover, as Cost and Flexibility & Adaptability follows on the Fourth and Fifth Priority.

5) Advanced to the decision-making process, **AHP** utilize matrix computation to quantify which would be the most effective decision regarding the weight of criteria solution (level-1) and the weight of alternative solution (Level-2). Here is the calculation process to determine the decision:

Alternative Ranking = Priority Vector (Level -1) x Priority Vector (Level-2)

$$\text{Alternative Ranking} = \begin{pmatrix} 0{,}23 & 0{,}15 & 0{,}33 & 0{,}31 & 0{,}28 \\ 0{,}69 & 0{,}60 & 0{,}07 & 0{,}08 & 0{,}08 \\ 0{,}08 & 0{,}25 & 0{,}60 & 0{,}61 & 0{,}64 \end{pmatrix} \mathbf{x} \begin{pmatrix} 0{,}09 \\ 0{,}16 \\ 0{,}08 \\ 0{,}58 \\ 0{,}08 \end{pmatrix}$$

$$\text{Alternative Ranking} = \begin{pmatrix} 0{,}274 \\ 0{,}223 \\ 0{,}503 \end{pmatrix}$$

As the calculation finished, it is defined that the third alternative solution of "Build New Batching Plant" stands as the best alternative solution towards the main problem which would address the problem and also considered the five important aspects. As the table of decision ranking is as seen on **Table IV.17**

Table IV. 11 Priority Ranking of Alternative Solutions

Alternative Solution	Score	Alternative Rank
Purchase New Equipment	27,4 %	Second
Strategic Partnership with Suppliers	22,3 %	Third
Build New Batching Plant	**50,3 %**	**First**

1. As the decision been choosed, it is required to check the Constency Index, and Consistency Ratio as every Crieria Level-1 and Level-2 have to acceptable based on the Cosistency Ratio below 0,1 or 10% indicates a consistent judgement which is acceptable:
   1) Determine the weight of every aspect of solution criteria, which in this research it is listed on **Table IV.4** and the weight of every aspect is based on each criterias on **Table IV.4.** The method upon determining the Consistency Index, is to define the value of $\boldsymbol{\lambda}_{max}$ and we can immediately determine the Consistency Index (CI).
   2) Then, after obtaining the Consistency Index (CI) it is mandatory to understand that this research considers five criteria solutions which correlated on the number of **n** on defining the Random Consistency Index (RI) based on **Table IV.19**
   3)

Table IV.12 Random Consistency Index (RI)

n	1	2	3	4	5	6	7	8	9	10

RI	0.00	0.00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

Source : Padmowati (2009)

4) The alternative solutions of each criterias are also required to be verified though with different index of Random Consistency Index (RI) as similar method might be applied; All the criteria must meet the required Consistency Ratio as mentioned in advance, which is 0,1.

Detailed calculation and Consistency Ratio Checking are attached on the **Appendix** section. Hence, after the calculation finished the compilations are as seen on **Table IV.19** and **Table IV.20**;

Table IV. 13 Consistency Ratio of Criteria Solutions

Criteria Solutions	Row Average	Weighted Sum	Average Value	λmax	Consistency Index (CI)	Consistency Ratio (CR)
Cost	0,09	0,51	5,36	5,36	0,09	0,081
Schedule	0,16	0,88	5,39			
Flexibility & Adaptability	0,08	0,43	5,24			
Product Quality	0,58	3,16	5,49			
Supply Chain Reliability	0,08	0,45	5,34			

As the result of decision-making process finished through **AHP Method,** to address the main root cause which is **"Shortage on Readymix Concrete Material Supply caused by Low Batching Plant Productiviy and Difficulties on Delivery Process.**" is "Build New Batching Plant" as the answer held the highest alternative rank (50,3%) as mentioned in Table IV.17, as the decision appeared to be consistent for each criteria solutions. Hence the Hierarchy Tree for Proposed Alternative Solutions for each criteria Solutions is on Figure IV.10

b. Business Implementation Plan

Implementation plan consists the process of executing the decision made which "Build New Batching Plant" which previously obtain through AHP method with concurrent circumstance. The Plan consist of risk analysis, estimating construction bill of quantities, cost and benefit analysis, production analysis, and positioning analysis of New Batching Plan. Here are the elaboration the steps to execute the "Implementation Plan", which:

1. SWOT Analysis

Comprehensive Risk Analysis is a mandatory process before proceeding to next step, as SWOT Analaysis is meant to determine the current condition of the company. The SWOT analysis which based on Table IV.4 is still applicable considering all of the aspects is a literal factor that represent whole company current welfare.

Several points could be added to adhere the current specific situation, as in addition, PT XYZ is not a candidate of a consortium of PT Karya Logistik Nusantara which pose a big role in terms of Concrete Manufacturing especially for acceleration program for **IKN** development. Moreover, current company liquidation process imposed a difficult situation.

2. Budget Analysis

Based on past sales, it is assumed that PT XYZ are capable to achieve 17,5% of total demand, as the project owner presumed to purchase readymix concrete from several vedors. Moreover, it is estimated in the next two years, demand on concrete readymix that specifically for PT XYZ 305.689 m^2.

Budget analysis consists of estimating the operations cost which is Cost of Goods Manufactured, General & Administrative Expenses, Cost of Goods Sold, and Revenue. Cost of Goods Manufactured are detailed bill of quantites of esitimated work based on the demand from the project owner as the Cost of Goods Sold have the same quantities, but the adjusted prie to generate margin or profit. On the

otherhand, General & Administrave Expenses is estimated for 1% of Cost of Goods Manufactured (COGM).

3. Spot Analysis

The last step before executing the plan, the location of new batching plant should not be too distant from the projects to eliminate any possibility of difficulty during hauling process. Not only to address the roadway difficulties, as setting time for readymix concrete are considerably long. New batching plant should withstand at least for two years – five years. Several locations are avaible in few options, which Simpang IKN is appeared to be the most effective and efficient spot to build a new batching plant. Simpang IKN, or IKN main intersection is the central to the potential projects and the occurring projects, which means it should be able to address the previously mentioned issue. The illustration of the proposed location is shown on Figure IV.11

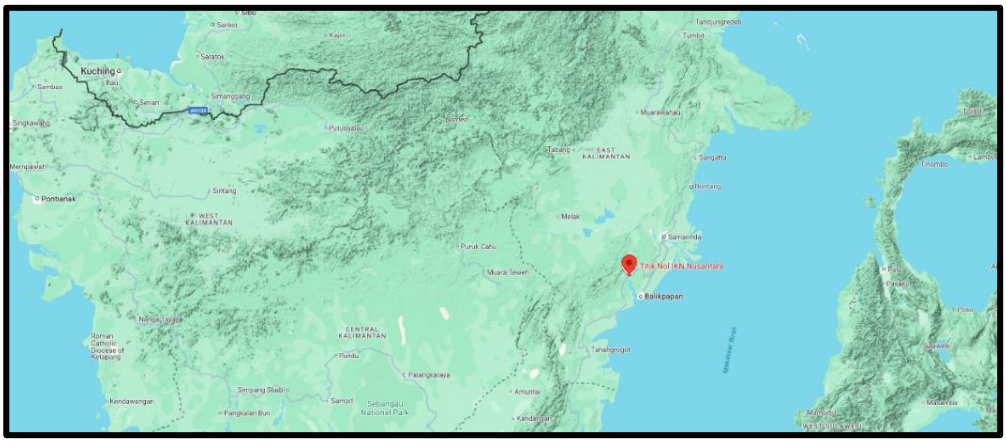

Figure IV. 1 Map of New Batching Plant

4. Risk Analysis

To analyse the possible threats and risk during the implementation process, risk analysis is severely mandatory. Risk analysis should identify all vital aspects of the company including Financial Risk, Production Risk, Supply Chain Management Risk, Human Resouce Risk, Legal Risk. The risk analysis should come with immediate mitigation as it should not be happened so the implementation process is applicable. Risk Analysis is shown at Table IV.26

Table IV. 14 Risk Analysis of Implementation Plan

No.	Risk	Main Cause	Mitigations
1	**Financial Risk** – Difficulties on achieving desired market shares	• Current Product Price is Higher compared to PT XYZ competitors	• Evalue current purchasing method, COGM, and COGM • Identify and construct a strategic partnership with third party raw material supplier
2	**Production Risk** – underachieveing production rate	• Bad Weather Condition • Bad Quality Control • Limited Workforce Available • Uncertainty of Raw Material Supply	• Increasing the effectiveness of the quality control • Reassuring the production equipment have to be in good condition • Recruit more high capability workforce • Construct a better third party vendors, especially

No.	Risk	Main Cause	Mitigations
			high achieving supplier with lowest price
3	**Supply Chain Management Risk –** Uncertainty in Price and Latency in Product and Raw Material Supply	• Limited Available Supplier • Difficulties in Access • Communication Problem	• Reassuring outline agreement towards available vendors to lock uncertainty in market price • Better Delivery Access by selecting the most efficient way • Make sure that outstanding payment is not too long
4	**Human Resource Risk –** Low Skilled Workforce	• Slow Speed in terms of increasing Workforce Skills • Low retaining rate for Current High Skilled Workforce	• Improving training speed with more efficient method • Reassuring that the incentive would adhere the needs of the Workforce
5	**Legal Risk –** Illegal Production Process	• Low Legal Awareness • Limited Time for Production Permits	• Reasurring All Required Administrative Document is ready • Create document monitoring and build better commniucation with legal division to control the process

5. Conclusion

After the situation appraisal as it to obtain information in regards to the current situation, and followed by problem solving process is completed this research and several implications may be applied as problem resolutions.

5.1 Conclusion

This research has finally able to address the root cause of the issue, followed by the problem resolution and the decision-making process to choose the best option. Here are the conclusion of this research, which are:

1. What is the root cause of the concrete readymix supply shortage issue on PT.XYZ projects in IKN?

Through Kepner-Tregoe Analysis and verified through brainstorming with correspondences`, there are several issues that cause the Shortage on Readymix Concrete Supply, which are:

a. Production Machine/Unit Insufficiency;
b. Low Batching Plant Productivity;
c. High Difficulties on Materials Hauling;
d. Difficulties on Raw Material Supply;
e. Insufficient Amount of Manforce/Labour;

Hence, the main root cause of the problem is **Shortage on Readymix Concrete Material Supply caused by Low Batching Plant Productiviy and Difficulties on Delivery Process.**

2. What are the proposed alternatives solutions to solve the concrete readymix supply shortage issue on PT. XYZ projects in IKN?

To solve the concurrent issue, this research involves **SME**s to address the main root cause, **SME**s offered alternative resolutions as those solutions was assumed to effective enough to address the main root cause of the problem, which are:

a. Purchase new production machine and expanding current batching plant.
b. Outsource Readymix Concrete Supply from External Vendors with long term strategic partnership.
c. Build new Batching Plant with new production equipment and bigger production volume.

3. What is the best solution to solve the concrete readymix supply shortage issue on PT. XYZ projects in IKN?

Through Analytical Hierarchy Process (AHP) By considering the five important aspects, including Cost, Schedule, Flexibility & Adaptability, and Supply Chain Reliability, the most effective solution appeared to be "Build new Batching Plant with new production equipment and bigger production volume". According to the alternative ranking, build a new batching plant pose 50,3% in terms of scoring as the highest scored compared to the other two problem solution.

5.2 Recommendation

Implementation plan to solve the main root cause should be done under strict supervision considering possible threats may affect, the implementation process including progress monitoring and evaluation and Risk Mitigations should be strictly under control as it should save the company from upcoming threats. Batching plant should be built after it is legally permitted and under safe condition, as new problem may happen and imposing the company current welfare. It is better to take other considerations before proceeding to the next step by completing another research and other considerations.

On the other hand, the research is able to be improved in many ways, such as increasing the number of the correspondent, since the current condition author is limited. The justification and decision making may appear different in other case since other situations may differ from this research subject, based on the main root cause, alternative solutions, or any other considerations.

References

Donald, J. B., David, J. C., M Bixby, C., & John, C. B. (2020). *Supply chain logistics management*: McGraw-Hill Education.

Groot, W. (2021). Root cause analysis–what do we know? *Maandblad voor accountancy en bedrijfseconomie, 95*(1/2), 87-93. doi:https://doi.org/10.5117/mab.95.60778

Gurl, E. (2017). SWOT analysis: A theoretical review.

Hussain, A. (2024). *The Tale of Technology: A Guide to Understanding Technology Business in the 21st Century*: Notion Press.

Kepner, C. H., & Tregoe, B. B. (1997). *The New Rational Manager* Princeton Research Press.

Khanam, M. (2023). *Subject Matter Expert (SME) Management Strategy for Multi-Criteria Decision Making (MCDM): A Case Study of Hierarchical Decision Model (HDM).* Paper presented at the 2023 Portland International Conference on Management of Engineering and Technology (PICMET).

Kristamuljana, S. (1998). *Landasan Teori Metode Kasus untuk Pengembangan Manajer yang Rasional.* Paper presented at the Forum Manajemen.

Kurnia, G., Johanes, H., Hidayat, D., Rozha, A., Zahvira, M., & Sukarno, I. (2020). Improving Airport On-Time Performance Using Kepner-Tregoe Problem-Solving Approaches. *Jurnal Teknologia, 3*(1), 493086.

Luft, J. A., Jeong, S., Idsardi, R., & Gardner, G. (2022). Literature reviews, theoretical frameworks, and conceptual frameworks: An introduction for new biology education researchers. *CBE—Life Sciences Education, 21*(3), rm33. doi:https://doi.org/10.1187/cbe.21-05-0134

Mahgoub, M., Hussein, M., & Mousa, A. (2024). Extended discharge time of ready-mixed concrete: Myth or necessity? *Construction and Building Materials, 437*, 136913. doi:https://doi.org/10.1016/j.conbuildmat.2024.136913

Nurokhman, N., Suharyanto, I., & Rochmawati, U. (2021). Evaluasi Mutu Beton Dari Berbagai Ready Mix Pada Gedung Parkir Yogyakarta International Airport. *CivETech, 3*(2), 55-65. doi:https://doi.org/10.47200/civetech.v3i2.1058

Padmowati, R. d. L. E. (2009). *Pengukuran index konsistensi dalam proses pengambilan keputusan menggunakan metode AHP.* Paper presented at the Seminar Nasional Informatika (SEMNASIF).

Palcic, I., & Lalic, B. (2009). Analytical Hierarchy Process as a tool for selecting and evaluating projects. *International Journal of Simulation Modelling (IJSIMM), 8*(1). doi:https://doi.org/10.2507/IJSIMM08(1)2.112

Pottonen, J. (2023). Utilization of The 8d Quality Tool in Solving The Quality Problems in John Crane Nordic Units.
Quesada, H., Gazo, R., & Sanchez, S. (2012). Critical factors affecting supply chain management: A case study in the US pallet industry. *Pathways to supply chain excellence*, 33-56.
Ravitch, S. M., & Riggan, M. (2016). *Reason & rigor: How conceptual frameworks guide research*: Sage publications.
Saaty, T. L., & Vargas, L. G. (2012). *Models, methods, concepts & applications of the analytic hierarchy process* (Vol. 175): Springer Science & Business Media.
Sabbaghi, A., & Vaidyanathan, G. (2004). SWOT analysis and theory of constraint in information technology projects. *Information systems education journal, 2*(23), 1-19.
Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2004). *Managing the supply chain: the definitive guide for the business professional*: McGraw-Hill.
Stemmler, L. (2002). *The role of finance in supply chain management.* Paper presented at the Cost management in supply chains.
Steward, M. D., Wu, Z., & Hartley, J. L. (2010). Exploring supply managers' intrapreneurial ability and relationship quality. *Journal of Business-to-Business Marketing, 17*(2), 127-148. doi:https://doi.org/10.1080/10517120903407857
Westland, J. (2006). *The project management life cycle: a complete step-by-step methodology for initiating, planning, executing & closing a project successfully*: Kogan Page Limited.