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PENGUKURAN DAN PERBAIKAN KINERJA RANTAI PASOK DENGAN MENGGUNAKAN SCOR MODEL DAN FMEA DI PERUM BULOG DIVRE JATIM

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SUPPLY CHAIN PERFORMANCE MEASUREMENT AND IMPROVEMENT USING SCOR MODEL AND FMEA AT PERUM BULOG DIVRE JATIM

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PENGUKURAN DAN PERBAIKAN KINERJA RANTAI PASOK DENGAN MENGGUNAKAN *SCOR MODEL* DAN *FMEA* DI PERUM BULOG DIVRE JATIM

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ABSTRAK

Perum BULOG Divre Jatim merupakan perusahaan milik negara yang bergerak di bidang logistik makanan yang memerlukan pengukuran kinerja rantai pasok untuk mengukur capaian serta mengevaluasi performansi kinerjanya. Penelitian ini bertujuan untuk merancang model pengukuran kinerja rantai pasok, mengukur kinerja rantai pasok dan mengusulkan perbaikan untuk meningkatkan kinerja rantai pasok dari Perum BULOG. Penelitian ini menggunakan *SCOR* model sebagai referensi umtuk pembuatan model pengukuran kinerja yang terintegrasi dengan *Analytical Hierarchy Process* untuk menentukan bobot tiap atribut. *Failure mode and effect analysis* dan *Root cause analysis* digunakan untuk mengidentifikasi bentuk kegagalan yang mungkin berdampak pada penurunan performansi kinerja rantai pasok dan merumuskan strategi perbaikan untuk meningkatkan performansi rantai pasok Perum BULOG Divre Jatim. Penelitian ini menghasilkan sebelas indikator yang telah diidentifikasi dan dapat digunakan untuk mengukur kinerja Perum BULOG dimana kesebelas indikator ini telah memenuhi tujuan perusahaan yaitu tepat jumlah, tepat kualitas, tepat sasaran, tepat harga, tepat waktu dan tepat administrasi. Berdasarkan hasil dari pengukuran kinerja menunjukkan bahwa Perum BULOG mencapai nilai 75.45% dimana jika dilihat dari *traffic light system* termasuk dalam kategori kuning atau perlu diperbaiki. Proses identifikasi kegagalan menunjukkan ada dua kegagalan yang sangat kritis dan harus segera dilakukan proses mitigasi, yaitu kualitas beras yang menurun dan keterlambatan pengiriman. Beberapa rekomendasi perbaikan diberikan kepada perusahaan agar dapat meningkatkan kinerja rantai pasok Perum BULOG Divre Jatim.

Kata Kunci—FMEA, Kinerja Rantai Pasok, Perum BULOG Divre Jatim, SCOR model

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SUPPLY CHAIN PERFORMANCE MEASUREMENT AND IMPROVEMENT USING SCOR MODEL AND FMEA AT PERUM BULOG DIVRE JATIM

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ABSTRACT

Perum BULOG Divre Jatim is a state-owned company engaged in the food logistics that needs supply chain performance measurement as an evaluation of its performance. This study aims to develop new supply chain performance measurement model, measure the supply chain performance and generate improvement recommendation to improve the supply chain performance of Perum BULOG divre Jatim. This research use SCOR model as reference to develop the supply chain performance model and to measure the supply chain performance which is integrated with Analytical Hierarchy Process (AHP) to define the weight for each indicator. Failure mode and effect analysis and root cause analysis are used to identify and generate the improvement recommendation for a better supply chain performance. The result of this research shows that there are eleven indicators that have been identified and will be used to measure the supply chain performance of Perum BULOG Divre Jatim which the eleven indicators fulfill the objectives of Perum BULOG which are right quantity, right quality, right target, on-time, right price and complete administration. Based on the supply chain performance measurement conducted by using the eleven indicators that have been identified, Perum BULOG Divre Jatim scored 75.45% which is categorized in yellow category or need to be improve according to the traffic light system. The failure identification results two critical failure that need to be mitigated, namely the decreased of rice quality and delays in orders delivery, and to mitigate the failure and improve Perum BULOG supply chain performance there are several improvement suggestions that proposed to Perum BULOG Divre Jatim.

***Keywords*—**FMEA, Perum BULOG Divre Jatim, RCA, SCOR model, Supply Chain Performance

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CHAPTER I
INTRODUCTION

This chapter is consist of research background, problem formulation, research objectives, research benefits, research scope and research outline of supply chain performance measurement and improvement using SCOR performance model and FMEA at Perum BULOG divisi regional Jawa Timur.

1.1 Background

The tight competition in the industrial sector become a major challenge for the company to run its business activities. Every company is required to be creative in competitive strategies implementation to produce any good or service that has better quality, cheaper and faster than the competitors. To fulfill those three aspects the company requires the participation of all stakeholders that involved supplier, the company, distribution and customers to work together. The necessity to coordinate several business partners, such as supplier and third party logistic, internal company, business process and diverse customers across the supply chain give rise to the field of supply chain management (SCM) (Turban, et al., 2012).

Supply chain management is a unified process and a production activity that started with obtaining raw material from the supplier, value-adding processes that transform raw materials into finished goods, storing the inventories until the delivery process of the finished goods to retailer and consumer (Pujawan, 2010). Supply chain which well managed can produce an on time and cheap product with good quality. According to (Pujawan, 2010) there are three kinds of value streams that need to be managed well which are material, information and financial.

There are several important aspects in supply chain management such as performance measurement and continuous improvement. To create an effective performance measurement, management required to conduct a measurement which able to evaluate overall supply chain performance. Supply chain performance measurement is needed to conduct monitoring and controlling, to determine the position of an organization towards it competitors and it purposes, and to determine

the improvement that should be conducted for creating excellence in the competition. In designing the performance measurement system, supply chain management encourage an integration between supply chain functions and process based approach. According to Chan & Li (2003) a performance measurement system based on process approach not only aligned with the functions of supply chain management but also contributes significantly for continuous improvement. Supply chain performance measurement models developed in recent years such as Supply Chain Operation Reference, Global Supply Chain Forum and Efficient Customer Response (Estampe, et al., 2010), another frequently used model to perform supply chain performance measurement is statistical process control and balanced score card.

A performance measurement system constitutes a cycle that includes four major phases of activity, shown in figure 1.1. The performance measurement cycle starts and ends with an organization's activities and operations, as it continually moves through the following phases: measure, report, learn and improve. Measure, an organization operating performance measurement systems use indicators, metrics that are tracked regularly, to assess their activities and supporting operations. Report, to compile performance measurement data into a format that is easy to analyze. Learn, using the reporting tools to review and interpret performance data in order to make well-informed decisions and identify opportunities for improvement and corrections. And the last is improve, the organization implements its decisions to improve its activities and operations. From there, the performance measurement cycle begins again (Wolk, et al., 2009).

Figure 1. 1 Performance Measurement Cycle *(Wolk, et al., 2009)*

In developing the performance measurement model, supply chain management encourage an integration between supply chain functions and process based approach. According to Chan & Li (2003) a performance measurement system based on process approach not only aligned with the functions of supply chain management but also contributes significantly for continuous improvement. There are several models of supply chain performance measurement that has been introduced by Beamon (1999), Gunasekaran (2001), Kaplan-Norton (1990s) and Supply Chain Council (1996).

The Supply Chain Operations Reference (SCOR®) model is a tool for representing, analyzing and configuring supply chain which is popular among the companies. SCOR model is a process based performance measurement system. It is a consensus model which was developed and continues to evolve with the direct input of the industry leaders who manage global supply chains and use it to analyze and improve the performance of the organizations. SCOR model has release eleventh version of SCOR model, which indicate that SCOR model might still develop and continues to evolve its model. SCOR model features an intentionally broad scope and definitions that can be adapted to the specific supply chain requirements of any industry or application. SCOR model helps refine strategy, define structure, manage processes and measure performance by providing a framework that links business process, metrics, best practices, and technology into a unified structure. The SCOR model supports supply chain improvement by aiding the capture of an "as-is" current state from which the desired "to-be" future state can be derived. By adopting SCOR model an organization will receive several benefits such as rapid assessment of supply chain performance, clear identification of performance gaps, efficient supply chain network redesign and optimization.

Adopting the performance measurement cycle, the output of performance measurement will be analyzed and to be taken into consideration for improvement activity to improve the supply chain performance of a company. There are several methods to improve the supply chain performance, one of those method is failure mode and effect analysis. Failure mode and effect analysis (FMEA) can be used to perform analysis of the potential causes of the failure that affect supply chain performance of Perum BULOG Divre Jatim. FMEA is a systematic analysis of

potential failure modes aimed at preventing failures, FMEA is intended to be a preventive action process carried out before implementing new or changes in products or processes. Ideally, FMEAs are conducted in the product design or process development stages, although conducting FMEA in existing products and processes may also yield benefit.

Perum Bulog divre Jatim is a state-owned company engaged in the food logistics. The company business scope includes business logistics or warehousing, survey and eradication of pests, plastics bag supplier, distributor, and food commodity trader and retailer. As a company which is obligated to perform government task, BULOG maintains basic grain price, price stabilization, food stocks, and distribution of subsidized rice for poor people. The supply chain of Perum BULOG starts with subsidized rice procurement from supplier which are *satgas pengadaan* and MKP or Perum BULOG's business partner, the subsidized rice that ordered then stored in the BULOG's warehouse and then distributed to the distribution point, from the distribution point subsidized rice then distribute to each poor family. As a part of the growing company, a performance measurement system for Perum BULOG divre Jatim proves particularly important. A supply chain performance measurement is needed to monitor and control the process happen within Perum BULOG starts from raw material procurement process to the very last of goods distribution.

Based on initial observation and interview conducted with PERUM BULOG chief section of distribution, Perum Bulog conducts the supply chain performance measurement without using a certain performance measurement model or framework. Another problem that happen in Perum BULOG is the performance indicator used to measure the supply chain performance do not represent the supply chain objective of Perum BULOG which are on-time, right in quantity, right in quality, right in document, right in price and right on target. For example at the distribution department and procurement department of Perum BULOG. In distribution department performance measurement is being measured only from the percentage of realization distribution of subsidized rice and the amount of payment arrears which only represent the right in price and right in quantity of the supply chain objective. Procurement department is measured by the

amount of procurement within specific time period which represent the right in quantity supply chain objectives, which leave on time, right in quality, right on price and right on document unmeasured. According to the lifecycle of performance measurement, a performance measurement process is followed with the improvement activity to improve the process or factor which is considered critical, in this case is critical for supply chain in Perum BULOG. That is why an improvement process to improve supply chain performance is needed. The improvement process can be arranged by using FMEA. FMEA's provide the user with a tool that can assist in providing reliable, safe and customer pleasing products or process since FMEA help the engineer identify the potential failures that may occur. Therefore, this research will develop new supply chain performance measurement model based on SCOR model for Perum BULOG divre Jatim and propose improvement recommendation based on FMEA to Perum BULOG divre Jatim to increase its supply chain performance.

1.2 Problem Statement

The problem statement of this research is to develop new supply chain performance measurement model using SCOR performance model, measure the supply chain performance of Perum BULOG and propose an improvement recommendation to improve supply chain performance of Perum BULOG.

1.3 Objectives of the Research

Purposes that willing to be achieved in conducting this research are mentioned at the following:

1. to develop new supply chain performance measurement model for Perum BULOG divre Jatim
2. to measure supply chain performance of Perum BULOG divre Jatim
3. to propose improvement recommendation for Perum BULOG divre Jatim based on FMEA analysis and RCA

1.4 Contribution of the Research

Benefits which able to be achieved by conducting this research are mentioned at the following:

1. Provide Perum BULOG divre Jatim a model to measure the supply chain performance using SCOR model.
2. Provide information to Perum BULOG regarding it supply chain performance.
3. Provide an improvement recommendation to improve the supply chain performance of Perum BULOG based on FMEA analysis and RCA.

1.5 Scope of Research and Assumptions

Research scope determines the limitations and assumptions applied in this research.

1.5.1 Assumption

The assumption used in this research is no changes in company policies and company strategies that affect the supply chain structure of Perum BULOG.

1.5.2 Limitation

The limitations used in this research are mentioned at the following:

1. The research is conducted based on information and limitation released by Perum Bulog divre Jatim.
2. The research only focus in the supply chain process of the company.
3. The object that being observed in this research is the supply chain of subsidized rice in Surabaya.
4. The output of this research is to give some recommendation to improve the supply chain performance of Perum BULOG without considering the cost analysis as the constraint.

1.6 Structure of Research Report

The outline of this research report can be shown as follow:

CHAPTER I BACKGROUND

This chapter explains about the background of conducting the research, the problem statement, objectives of the research, research contribution, scope of research and assumption, and structure of research report.

CHAPTER II LITERATURE REVIEW

This chapter describes the literature review conducted by the researcher to support the research. Literature reviews that explained in this chapter are supply chain, supply chain management, supply chain performance measurement, Supply Chain Operation Reference (SCOR), Analytical Hierarchy Process (AHP), and Failure Mode and Effect Analysis (FMEA).

CHAPTER III RESEARCH DESIGN AND METHODOLOGY

This chapter discuss the design of methodology used in conducting the research. The research design and methodology is especially useful as a guidance in conducting research, so the research goes systematically. Supply chain performance measurement and improvement using SCOR model and system FMEA at Perum BULOG divre Jatim starts with literature study and field study and then develop supply chain performance measurement model for Perum BULOG based on model after that the supply chain performance measurement of Perum BULOG divre Jatim is conducted and the last stage is propose improvement recommendation based on failure mode and effect analysis for Perum BULOG to improve its supply chain performance.

CHAPTER IV DATA COLLECTION AND PROCESSING

This chapter contains a collected data and information that will become the input of this research and will be further processed and analyzed in the next chapter. The data that being collected such as Perum BULOG supply chain process, the supply chain objective, the existing key performance indicator of procurement, warehouse and distribution department, the pair-wise comparison score between two indicators by using questionnaire and etc. After the data being collected the data tabulation that will be conducted such as supply chain process illustration, brainstorming and benchmarking with experts to determine the indicators that used to measure supply chain performance of Perum BULOG, expert-choice software to determine weight of each indicator and measure the supply chain performance of Perum BULOG.

CHAPTER V SUPPLY CHAIN PERFORMANCE RESULT AND ANALYSIS

This chapter consist of supply chain performance measurement of Perum BULOG Divre Jatim that explains about the performance indicator that being measured, the actual performance measurement, and scoring system while the supply chain performance evaluation sub-chapter is consist of Perum BULOG Divre Jatim supply chain performance analysis

CHAPTER VI FAILURE MODE ASSESSMENT AND ANALYSIS

This chapter is consist of failure mode and effect analysis and improvement strategies. The failure mode and effect analysis describe the failure mode and effect identification, failure mode and effect assessment and analysis. While the improvement strategies section is consist of the strategy to mitigate the failure and to improve the performance of Perum BULOG Divre Jatim.

CHAPTER VII CONCLUSION AND RECOMMENDATION

This chapter is consist of conclusion of the research that will answer the objectives of the research which are develop supply chain performance measurement model for Perum BULOG divre Jatim based on SCOR model, measure the supply chain performance of Perum BULOG and build an improvement model for Perum BULOG divre Jatim. The suggestion part of this research will consist of recommendation for further research upon this subject area.

CHAPTER II
LITERATURE REVIEW

In this chapter will explain about the literature review regarding supply chain management, supply chain performance measurement, supply chain operation reference, analytical hierarchy process and failure mode and effect analysis that will be applied to improve the supply chain of Perum Bulog divre Jatim.

2.1 Supply Chain and Supply Chain Management

A supply chain consist of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers, and even customer themselves. A supply chain is dynamic and involves the constant flow of information, product, as well as pricing and availability information, to the customer (Chopra & Meindl, 2007). In supply chain management book (Pujawan, 2010), supply chain is described as network companies' that work together to create and deliver product to end customer. The companies involve such as supplier, manufacturer, distributor, retail store, and logistic. Another explanation regarding the definition of supply chain is explained by Lambert, Stock and Ellram, a supply chain is the alignment of firms that bring products or services to the market.

Figure 2. 1 Basic Supply Chain *(Hong, 2015)*

Basically there are three kinds of value stream that should be managed in supply chain, which are: material, financial, and information. Figure 2.2 shows the conceptual illustration of supply chain. Material flow is a flows of goods that flowing from upstream to downstream, for example is the raw material delivered by the supplier to the plant which subsequently processed into finished goods then shipped to a warehouse, and distributed to the retailer and customer. Financial flow consist of invoice, payment term and payment. Invoice and payment terms sent by supplier to the plant for raw material that has been requested while payment is the answer of the invoice and payments terms sent by supplier. The last one is the information flow which occurs from upstream to downstream and vice versa. Information flow delivers information from supplier to the manufacturer in the form of capacity, delivery status, and quotation and delivers information regarding demand, forecast demand, and request for quotation from retailer or customer to the manufacturer.

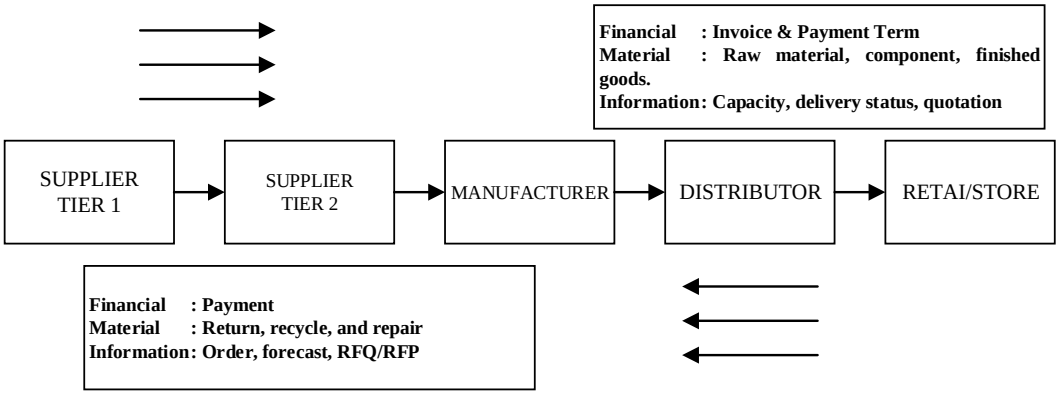

Figure 2. 2 Conceptual Illustration of Supply Chain *(Pujawan, 2010)*

The objective of every supply chain should be to maximize the overall value generated (Chopra & Meindl, 2007). The value a supply chain generates is the difference between what the final product is worth to the customer and the costs the supply chain incurs in filling the customer's request. The value will be strongly correlated with supply chain profitability or supply chain surplus which is the difference between the revenue generated from the customer and the overall cost across the supply chain to be shared in all supply chain stages, the higher the supply chain profitability the more successful is the supply chain. There is a close

connection between the design and management of supply chain flows (product, information, and funds) and the success of a supply chain. A successful supply chain management requires many decision relating to the flow of information, product and funds. Each decision should be made to raise the supply chain surplus, these decisions fall into three categories or phases, depending on the frequency of each decision and the time frame during which a decision phase has an impact or made apply, which are *supply chain design, supply chain planning and supply chain operation*.

Supply chain design, during this phase a company decides how to structure the supply chain for the next several years. It decides what the chain's configuration will be, how resources will be allocated, and what processes each stage will perform. A firm must ensure that the supply chain configuration supports its strategic objectives and increase supply chain profitability. Supply chain design decisions are typically made for the long term and are very expensive to alter on short notice.

Supply chain planning, the goal of supply chain planning is to maximize the supply chain surplus that can be generated over the planning horizon given the constraints established during the strategic or design phase. Companies start the planning phase with a forecast for the coming year of demand in different markets. Planning includes making decisions regarding which markets will be supplied from which locations, the inventory policies to be followed. Planning establishes parameters within which a supply chain will function over a specified period of time. Given a shorter time frame and better forecasts than the design phase, companies in the planning phase try to incorporate any flexibility built into the supply chain the design phase and exploit it to optimize performance. And as a result of planning phase, companies define a set of operating policies that govern short-term operations.

Supply chain operation, the time horizon during this phase is weekly or daily, and during this phase companies make decisions regarding individual customer orders. At the operational level, supply chain configuration is considered fixed, and planning policies are already defined. The goal of supply chain operations is to handle incoming customer order in the best possible condition. In

this phase, firms allocate inventory or production to individual orders, set a date for an order to be fulfilled, set delivery schedule, and etc. The design, planning and operation of a supply chain have a strong impact on overall profitability and success. It is fair to state that large part of the success of firms can be attributed to their effective supply chain design, planning, and operation.

Should be remembered that a supply chain is a sequence of processes and flows that take place within and between different stages and combine to fill a customer need for a product. There are two ways to view the processes performed in a supply chain.

1. Cycle view: The cycle view of supply chain divides process into cycles, each performed at their interface between two successive stages of a supply chain. Each cycle starts with an order placed by one stage of the supply chain and ends when the order is received from the supplier stage.

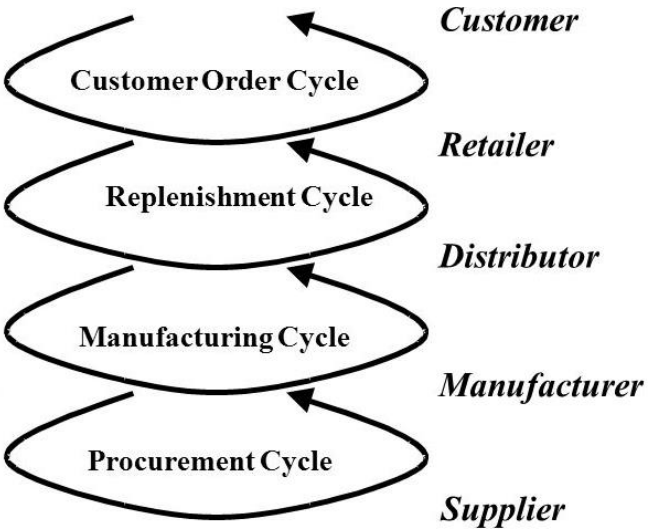

Figure 2. 3 Supply Chain Process Cycle *(Hong, 2015)*

2. Push or Pull view: The push or pull view of a supply chain characterizes processes based on their timing relative to that of a customer order. Pull processes are performed in response to a customer order, whereas push processes are performed in anticipation of customer orders.

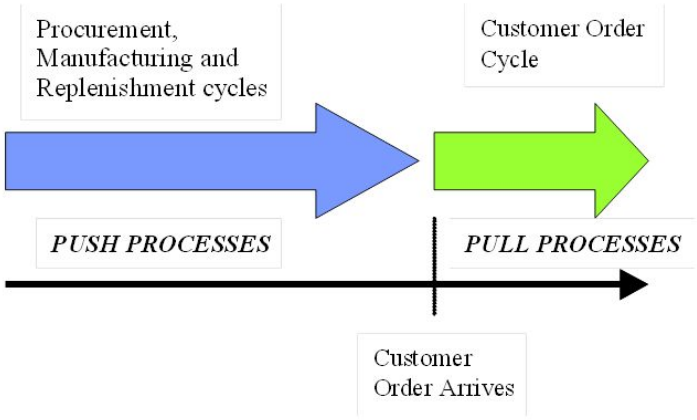

Figure 2. 4 Push or Pull View of the Supply Chain *(Chopra & Meindl, 2007)*

The terms of supply chain management was first introduced by Keith Oliver, a consultant at Booz Allen Hamilton, in an interview with Financial Times in 1982. If a supply chain is the physical network of companies that involved in supplying raw material, manufacturing, and distributing finished goods to the end customer then supply chain management is a method or an integrative approach to manage the product or material flow, information and financial in an integrated way that involving upstream to downstream stakeholders which consist of supplier, plant, network distributor, and logistic service (Pujawan, 2010). There are several definitions regarding supply chain management (SCM), such as definition from Michael Hugos (2003) Supply Chain Management is the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served.

2.2 Supply Chain Performance Measurement

There are several important aspects in supply chain management such as performance measurement and continuous improvement. To create an effective performance measurement, management required to conduct a measurement which able to evaluate overall supply chain performance. Supply chain performance measurement is needed to conduct monitoring and controlling, to determine the position of an organization towards it competitors and it purposes, and to determine the improvement that should be conducted for creating excellence in the

competition. In designing the performance measurement system, supply chain management encourage an integration between supply chain functions and process based approach. According to Chan & Li (2003) a performance measurement system based on process approach not only aligned with the functions of supply chain management but also contributes significantly for continuous improvement. Supply chain performance measurement models has been introduced by Beamon (1999), Gunasekaran (2001), Supply chain council and Kaplan-Norton (1996). Given in table 2.1 is the summary of several supply chain performance measurement model usually used by company or organization (Estampe, et al., 2010).

Table 2. 1 Supply Chain Performance Measurement Model

Model	Introduced by	Type of Analysis used	Established Indicators
Beamon	Beamon (1999)	• Following business process and financial perspective • Measures the three basic elements: resources, output, and flexibility.	• Indicators that capture the critical aspect of interaction among important supply chain and strategic goals.
Gunasekaran	Gunasekaran (2001)	• Following cost and non-cost perspective; strategic, tactical or operation focus.	• Metrics that truly capture the essence of organizational performance • Metrics that reflect a balance between financial and non-financial that related to strategic, tactical and operational levels of decision making and control.
Balanced Score Card	Kaplan and Norton (1990s)	• Seeks balanced measures to buttress company strategies • Proposes 4 analytical perspectives: customers, finance, internal process and learning-growth • Incorporates human dimension in performance measurement	• Indicators chosen depending on the company objectives • Measurement must be balanced to accommodate demands emanating from all internal corporate functions and from external environment.
SCOR	Supply Chain Council (1996)	• Analyzes 5 dimensions: reliability, responsiveness, agility, cost and asset management.	• Indicators defined explained using calculation modes • Association of indicators with each process

Model	Introduced by	Type of Analysis used	Established Indicators
			• Enables internal and external comparison of measurement

2.3 Supply Chain Operation References (SCOR) version 11.0

The Supply Chain Operations Reference model (SCOR®) is the product of Supply Chain Council, Inc. which is a global non-profit consortium whose methodology, diagnostic and benchmarking tools help organizations make dramatic and rapid improvements in supply chain processes. Supply Chain Council (SCC) established SCOR process reference model for evaluating and comparing supply chain activities and performance (Supply Chain Council, 2012). The SCOR-model capture SCC's consensus view of supply chain management. It provides a unique framework that links business process, metrics, best practices and technology into a unified structure to support communication among supply chain partners and to improve effectiveness of supply chain management and related supply chain improvement activities. Supply Chain Operation Reference can be applied to all industrial and service sector companies, at tactical and operational level for an implementation of decision relating to the company's strategic planning. Its indicators definitions are explained using calculation modes and giving association of indicators for each process (Estampe, et al., 2010).

2.3.1 Scope of SCOR

The SCOR model is a supply chain performance evaluation model. It has been developed to describe the business activities associated with all phases of satisfying a customer's demand, it also provides a consistent supply chain management framework. The SCCOR model can help all participant of supply chain, including manufacturer, supplier, downstream retailer, and customer to improve the efficiency of supply chain management by communicating effectively via the reference model (Hwang, et al., 2008). The model itself contains several sections and is organized around the six primaries management processes of plan, make, source, deliver, return and enable, shown in figure 2.5. By describing supply chain using the process building blocks, the model can be used to describe supply chains that are very simple or very complex by using a standard set of definitions defined by SCOR. The model has been able to successfully describe and provide a

basis for supply chain improvement for global projects as well as site-specific projects.

Figure 2. 5 Six Primaries Management Process of SCOR *(Supply Chain Council, 2012)*

The model is designed to support supply chain analysis at multiple levels. Supply Chain Council has focused on the top three process levels, which are industry neutral. SCOR does not attempt to prescribe how a particular organization should conduct its business or tailor its system information flow.

2.3.2 SCOR Structure

SCOR is a reference model. The purpose of a process reference model, or business process framework is to describe the process architecture in a way that makes sense to key business partners. Architecture here means the way processes interact, how they perform, how they are configured and the requirement or skill needed on staff when operating the process (Supply Chain Council, 2012). The reference model is especially useful for describing value chains that cut across multiple departments and organizations, providing a common language for managing such processes. A reference model also can be a powerful management tool. Once a complex management process is captured in standard process reference model form, it can be measured, managed and controlled. It can also be tuned and re-tuned to achieve specific purpose or attain a competitive advantage.

The SCOR reference model has four major sections which are:

- Performance: Standard metric to describe process performance and define strategic goals.
- Processes: Standard descriptions of management processes and process relationships

- Practices: Management practices that produce significant better process performance
- People: Standard definitions for skills required to perform supply chain processes.

2.3.3 SCOR Performance Model

The performance section of SCOR consists of two types of elements: Performance attribute and Metrics. A performance attribute is a grouping of metrics used to express a strategy. An attribute itself cannot be measured, it is used to set strategic direction. SCOR identifies five cores supply chain performance attributes, shown in table 2.2. Reliability, responsiveness and agility are considered customer-focused. Cost and asset management efficiency are considered internal-focused. All SCOR metrics are grouped within one of the performance attributes.

Table 2. 2 SCOR Performance Attributes *(Supply Chain Council, 2012)*

Performance Attribute	Definition
Reliability	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: On-time, the right quantity, and the right quality.
Responsiveness	The speed at which tasks are performed. The speed at which a supply chain provides products to the customer. Examples: cycle-time metrics.
Agility	The ability to respond to external influences, the ability to respond to marketplace changes to gain or maintain competitive advantage. SCOR agility metrics include flexibility and adaptability.
Costs	The cost of operating the supply chain processes. This includes labor costs, material costs, management, and transportation costs.
Asset Management Efficiency	The ability to efficiently utilize assets. Asset management strategies in a supply chain include inventory reduction and in-sourcing vs outsourcing.

Each performance attribute has one or more level-1 or strategic metrics. These level-1 metrics are the calculations by which an organization can measure how successful it is in achieving its desired positioning within the competitive market space. Given in table 2.3 is ten strategic metrics or level-1 metrics defined by SCOR.

Table 2. 3 The SCOR Level-1 Metrics *(Supply Chain Council, 2012)*

Performance Attribute	Level-1 Strategic Metric
Reliability	• Perfect Order Fulfillment (RL. 1.1)
Responsiveness	• Order Fulfillment Cycle Time (RS. 1.1)

Performance Attribute	Level-1 Strategic Metric
Agility	• Upside Supply Chain Flexibility (AG. 1.1) • Upside Supply Chain Adaptability (AG. 1.2) • Downside Supply chain adaptability (AG. 1.3) • Overall Value at Risk (AG. 1.4)
Cost	• Total Cost to Serve (CO.1.001)
Asset Management Efficiency	• Cash-to-Cash Cycle Time (AM. 1.1) • Return on Supply Chain Fixed Asset (AM. 1.2) • Return on Working Capital (AM. 1.3)

A metric is a standard for measurement of a process. SCOR metrics are diagnostic metrics and organized in hierarchical structure. SCOR recognizes three levels of predefined metrics:

- Level 1 metrics are diagnostics for the overall health of the supply chain. These metrics are also known as strategic metrics and key performance indicators (KPIs). Benchmarking level 1 metrics help establish realistic targets that support strategic objectives.
- Level 2 metrics serve as diagnostic for the level 1 metrics. The diagnostic relationship helps to identify the root cause or causes of performance gap for a level 1 metric.
- Level 3 metrics serve as diagnostic for level 2 metrics.

SCOR metric level-2 serve as diagnostic for level-1 metrics, it means that by looking at the performances of the level-2 metrics the company can explain performance gaps or improvements for level-1 metrics. This type of analysis of the performance of a supply chain is referred to as metric decomposition or root causing. Similarly level-3 metrics serve as diagnostics for level-2 metrics. Supply Chain Council recommends supply chain scorecards to contain at least one metric for each performance attribute to ensure balanced decision making and governance.

Keep in mind that a metric is a standard for measurement of a process. Known that metric is consist of three levels mean that each metric level has its own calculation method to measure its indicator. Given an example of calculation of level-1 perfect order fulfillment of reliability performance indicator:

- Perfect order fulfillment: is the percentage of orders meeting delivery performance with complete and accurate documentation and no delivery damage. Which is the standard set by SCOR to define a perfect order

fulfillment. The standard set by SCOR is available for all metrics from level-1 to level-3.

$$\% \text{ Perfect Order Fulfillment} = \frac{Total\ Perfect\ Orders}{Total\ Number\ of\ Orders}\ x\ 100\%$$

The perfect order fulfillment calculation is based on the performance of each level 2 component of the order line to be calculated such as % of Orders Delivered in Full which is calculated by

$$\% \text{ of Orders Delivered in Full} = \frac{Total\ Number\ or\ orders\ delivered\ in\ full}{Total\ Number\ of\ Orders\ delivered}\ x\ 100\%$$

2.3.4 SCOR Process Model

SCOR identifies the unique processes a supply chain requires to support the objective of fulfilling customer orders. By definition, a process is a unique activity performed to meet predefined outcomes. SCOR processes are organized by aggregation and decomposition relationship. From level 3 to 2 to 1 is aggregation and from level 1 to 2 to 3 is decomposition. SCOR processes help standardize the description of the supply chain architecture and the implementation of the architecture. SCOR provides standards down to level where process descriptions are applicable across a range of industries. The detail of three levels of process given in table 2.4.

Table 2. 4 SCOR Hierarchical Process details *(Supply Chain Council, 2012)*

	Level		Examples	Comments
	#	Description		
Within scope of SCOR	1 	Process Types (Scope)	Plan, Source, Make, Deliver, Return and Enable	Level-1 defines scope and content of a supply chain. At level-1 the basis-of-competition performance targets for a supply chain are set.
	2 	Process Categories (Configuration)	Make-to-Stock, Make-to-Order, Engineer-to-Order Defective Products, MRO Products, Excess Products	Level-2 defines the operations strategy. At level-2 the process capabilities for a supply chain are set. (Make-to-Stock, Make-to-Order)
	3 	Process Elements (Steps)	• Schedule Deliveries • Receive Product • Verify Product • Transfer Product • Authorize Payment	Level-3 defines the configuration of individual processes. At level-3 the ability to execute is set. At level-3 the focus is on the right: • Processes • Inputs and Outputs • Process performance • Practices • Technology capabilities • Skills of staff
Not in scope	4 	Activities (Implementation)	Industry-, company-, location- and/or technology specific steps	Level-4 describes the activities performed within the supply chain. Companies implement industry-, company-, and/or location-specific processes and practices to achieve required performance

Based on SCOR version 11.0, SCOR is based on six level-1 of management process which are:

- Plan: The Plan processes describe the planning activities associated with operating a supply chain.
- Source: The source processes describe the ordering and receipt of goods and services.
- Make: The make processes describe the activities associated with the conversion of materials or creation of the content for services.
- Deliver: The deliver process describe the activities associated with the conversion of materials or creation of the content for services.
- Return: The return process describe the activities associated with the reverse flow of goods back from the customer.
- Enable: The enable processes describe the associated with the management of the supply chain.

For each level-1 process three or more differentiating level-2 process categorizations exist. Each level-2 process contains level-3 process elements. These hierarchical relationships provide classification of processes. Process hierarchy example of level-1 and level 2 plan is given in table 2.5.

Table 2. 5 Level-1 and 2 of Plan Process

Process Level-1	Process Level-2
Plan	sP1 Plan Supply Chain
	sP2 Plan Source
	sP3 Plan Make
	sP4 Plan Deliver
	sP5 Plan Return

2.4 Analytical Hierarchy Process (AHP)

Some process in a supply chain are more critical than others (Palma-Mendoza, et al., 2014). Thus in order to differentiate the degree of importance among several supply chain processes, multi criteria decision making analysis such as AHP or analytical hierarchy processes is recommended to be used as a decision support tool for process selection (Palma-Mendoza, et al., 2014). According to Saaty & Vargas (2012) AHP assumes that decision problems can be structured by translating goals into measurable criteria, which, in turn, can be related to alternative decisions. As results, AHP provides a priority number at each level of the hierarchy then priorities of the alternatives are weighted against those of the criteria so that the eventual importance of the alternatives related to the goal are quantified.

AHP decomposes a complex problem into a multi-level hierarchical structure of objectives, decision criteria and an alternatives. In this case the overall objective is a selection target of supply chain performance measurement, the decision criterial will be the performance attributes and the alternative will be level-1 metrics of SCOR model. The objectives, criteria and alternatives will be presented in a form of structural or hierarchy. Once the structure of the criteria is constructed, the AHP analysis for the identification of the target for performance measurement will follow this following steps:

1. Pair-wise comparison: pair wise comparison aims at determining the relative importance of the elements in each level of the hierarchy. The decision maker, which later will be given a questionnaire to score the level of priority among the indicators, expresses his or her preference for each pair of indicator.

Table 2. 6 Fundamental pair-wise comparison score or scale (Saaty, 1987)

Intensity of importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgement strongly favor one activity over another
5	Strong importance	Experience and judgement strongly favor one activity over another
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme Importance	The evidence favoring one activity over another is of the highest possible order affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed

From the questionnaire the score or scale for each decision criteria or in this case is the performance attribute and the alternatives or level-1 of SCOR metrics model are represented in the form of recapitulation form, shown in table 2.7.

Table 2. 7 Questionnaire Recapitulation Form of Pair-wise comparison

Performance Attribute	Respondent			Performance Attribute
	1	2	3	
Reliability	7	7	8	Responsiveness
Reliability	5	5	5	Agility
Reliability	7	6	7	Cost
Reliability	3	5	3	Asset Management

2. Weight calculation: in this case the weight calculation process will be conducted by using expert choice software with the input is from the score given by the respondent through the questionnaire of pair-wise comparison.
3. Consistency check: A consistency ratio is calculated to check for consistency in making the pair-wise comparisons. According to (Mendoza, 2014) if the consistency ratio is less than 10%, then the pair-wise comparison matrix can be considered as having an acceptable consistency, otherwise the judgements need to be checked.
4. Hierarchical synthesis: The calculated priority vectors at different levels are integrated to allow overall evaluation of the alternatives (supply chain process)

5. Determine priority for all alternatives: The alternative (supply chain process) with the highest overall priority weight is chosen.

In the end AHP analysis will provide a priority numerical order for the supply chain processes under consideration. One of the criticisms to the AHP is the process of selecting the set of criteria and the way AHP is structured. However and advantage of combining the SCOR model with the AHP is that the SCOR model provides a standard and accepted structure of supply chain metrics as a criterion for the selection (Mendoza, 2014).

2.5 Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effect Analysis is a methodology for analyzing potential reliability problem or unwanted events early in the development cycle where it is easier to take actions to overcome the problem, thereby enhancing reliability through design. Implementation of FMEA is accustomed to identify potential failure forms, determine the impacts of the failure, and also the agent that affected. Failure mode and effect analysis is a planning tool on developing the process, products or services and it has been developed in the deployment of products or services troubleshooting and counteractive action.

There are several benefits that can be achieved by applying FMEA which are: FMEA helps to substantially reduce cost by identifying process improvement in the development process when it relatively easy and inexpensive change can be made, improves process quality and reliability, produce a more robust process and reduces or eliminates the trend for after-the-fact corrective action and late changes crises, significantly reduce potential costly liability when product or process do not perform as promised, and provide new ideas for improvements in similar process.

The standard of FMEA evaluation is based on three values which are severity, occurrence and detection. The value for each factor (severity, occurrence, and detection) is rank from 1to 10 (Parsana & Patel, 2014). The explanation of severity, occurrence and detection is given as follows:

- Severity is a numerical subjective estimate how severe the customer or end customer will perceive the effect of a failure.

Table 2. 8 Severity Rating Scale

Value	Severity	Criteria
10	Hazardous without warning	Failure could injure the customer or and employee without warning
9	Hazardous with warning	Failure could injure the customer or and employee with warning
8	Very High	Failure would render the unit inoperable or unfit for use
7	High	Failure causes a high degree of customer dissatisfaction
6	Moderate	Failure result in a subsystem or partial malfunction of the product
5	Low	Failure creates performance loss to cause customer complain because of dissatisfaction
4	Very Low	Failures can be noticed by most of the customer
3	Minor	Failure would create minor nuisance to the customer
2	Very Minor	Failure may not be readily apparent to the customer but would have minor effects on the customer product
1	None	Failure would not be noticeable and would not affect the customer

- Occurrence or likelihood is a numerical subjective estimate of the likelihood that the cause of a failure mode will occur in the process of FMEA case.

Table 2. 9 Occurrence Rating Scale

Value	Occurrence	Criteria
10	Very high	Inevitable Failures
9	Very High	Inevitable Failures
8	High	Repeated failures
7	High	Repeated failures
6	Moderate	Occasional Failures
5	Moderate	Occasional Failures
4	Low	Few Failures
3	Low	Few Failures
2	Low	Few Failures
1	Remote	Failure Unlikely

- Detection is termed with effectiveness. It is a numerical subjective estimate the effectiveness of the controls to prevent or detect the cause or failure mode before the failure affect the customer.

Table 2. 10 Detection Rating Scale

Value	Detection	Criteria
1	Extremely Likely	Controls will almost certainly detect
2	Very high likelihood	Very high probability of detection
3	High likelihood	High probability of detection
4	Moderately high likelihood	Controls are moderately effective
5	Medium likelihood	Controls have an even chance of working
6	Moderately low likelihood	Controls may miss the problem
7	Low likelihood	Controls are likely to miss the problem
8	Very low likelihood	Controls have a poor chance of detection
9	Very low likelihood	Unproven, unreliable, or poor chance for detection
10	Extremely unlikely	Controls will not detect anything

The multiplication of severity, occurrence and detection results Risk Priority Number or RPN. RPN is an indicator used when assessing risk or failure effect to identify the critical failure modes associated with the process that being analyzed. The RPN values range from 1 to 1000 which the higher the number of RPN indicates the critical value (higher is worst).

$$RPN = Severity\ x\ Occurence\ x\ Detection$$

Nowadays, using FMEA as an analytical method is very common. The reason of choosing FMEA is due to its capacity to provide a simple method for analyzing crucial steps to anticipate what might fail with the process or services. This research implements FMEA's framework to identify the failure mode and effect that cause the decrease of supply chain performance measurement in Perum BULOG Divre Jatim.

2.6 Root Cause Analysis (RCA)

Root cause analysis is a method or series of actions taken to determine why a particular failure or problem exists and to establish a means of correcting the causes. In root cause analysis, a problem can be defined as a situation where the performance of a process does not meet the expectations or goals (Hall, 2010). Simply stated, Root cause analysis is a tool designed to help identify not only what and how an event occurred but also why it happened. Understanding why an event occurred is the key to developing effective recommendations. Usually root cause

analysis got mixed with the accurate description of what happened and how it happened. However, if the analysis stop there, it is not probed deeply enough to understand the reasons for the problem.

Identifying root cause is the key to preventing similar recurrences (Tomic & Brkic, 2011). An added benefit of an effective root cause analysis is that the root cause identified across the population of occurrences can be used to target major opportunities for improvement. Trending of root causes allow development of systematic improvements and assessment of the impact of corrective programs. Effective root cause analysis process serves the purpose to find the root causes of unwanted event and facilitating effective corrective actions to prevent recurrence. The strength of root cause analysis method is that it investigates real failures that have occurred and clearly shows the relationship between symptoms and causes (Waters,2008).

CHAPTER III
RESEARCH DESIGN AND METHODOLOGY

In this chapter will explain about the research design and methodology used in this research study. The research design and methodology proposed consist of six stages which are literature review, field observation, supply chain performance measurement framework, supply chain performance measurement, failure mode and effect analysis, and the last is conclusion and suggestion.

3.1 Research Methodology Flowchart

There is sequential step required to be followed in conduct this research from literature review study to conclusion and suggestion for further research. The research design and methodology is given in figure 3.1-3.2.

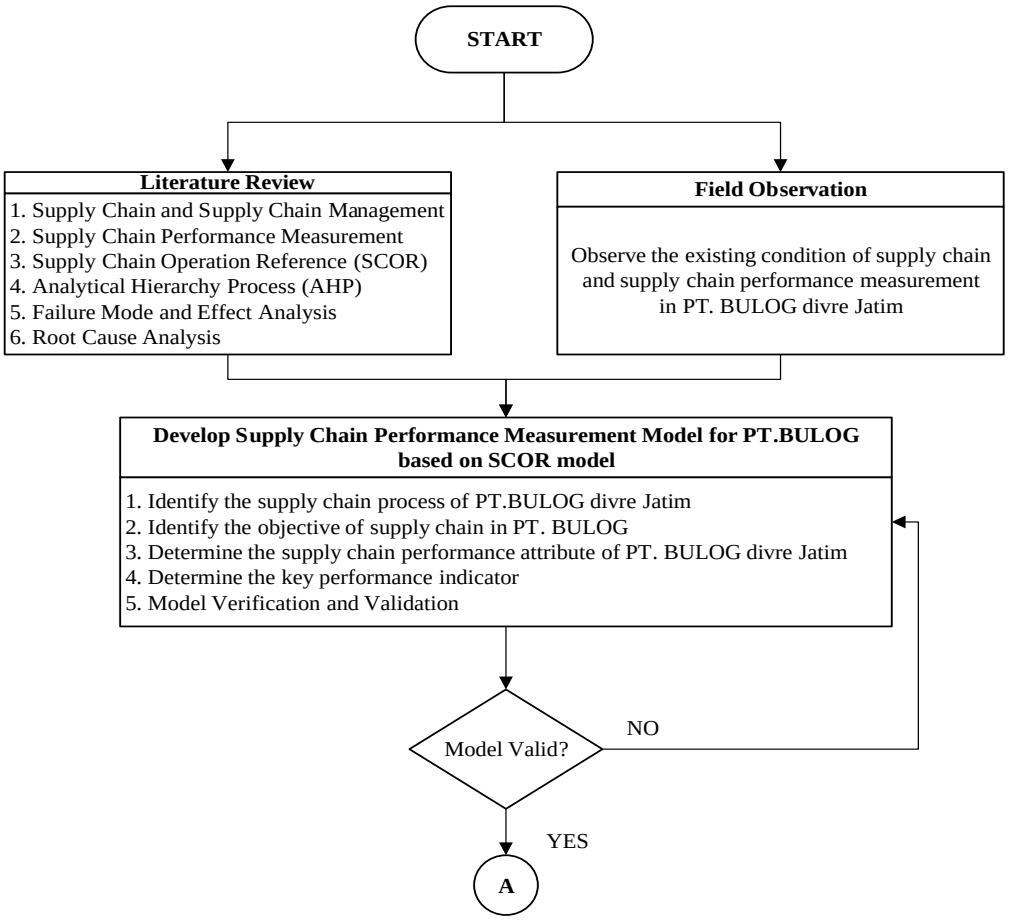

Figure 3. 1 Research Methodology Flowchart

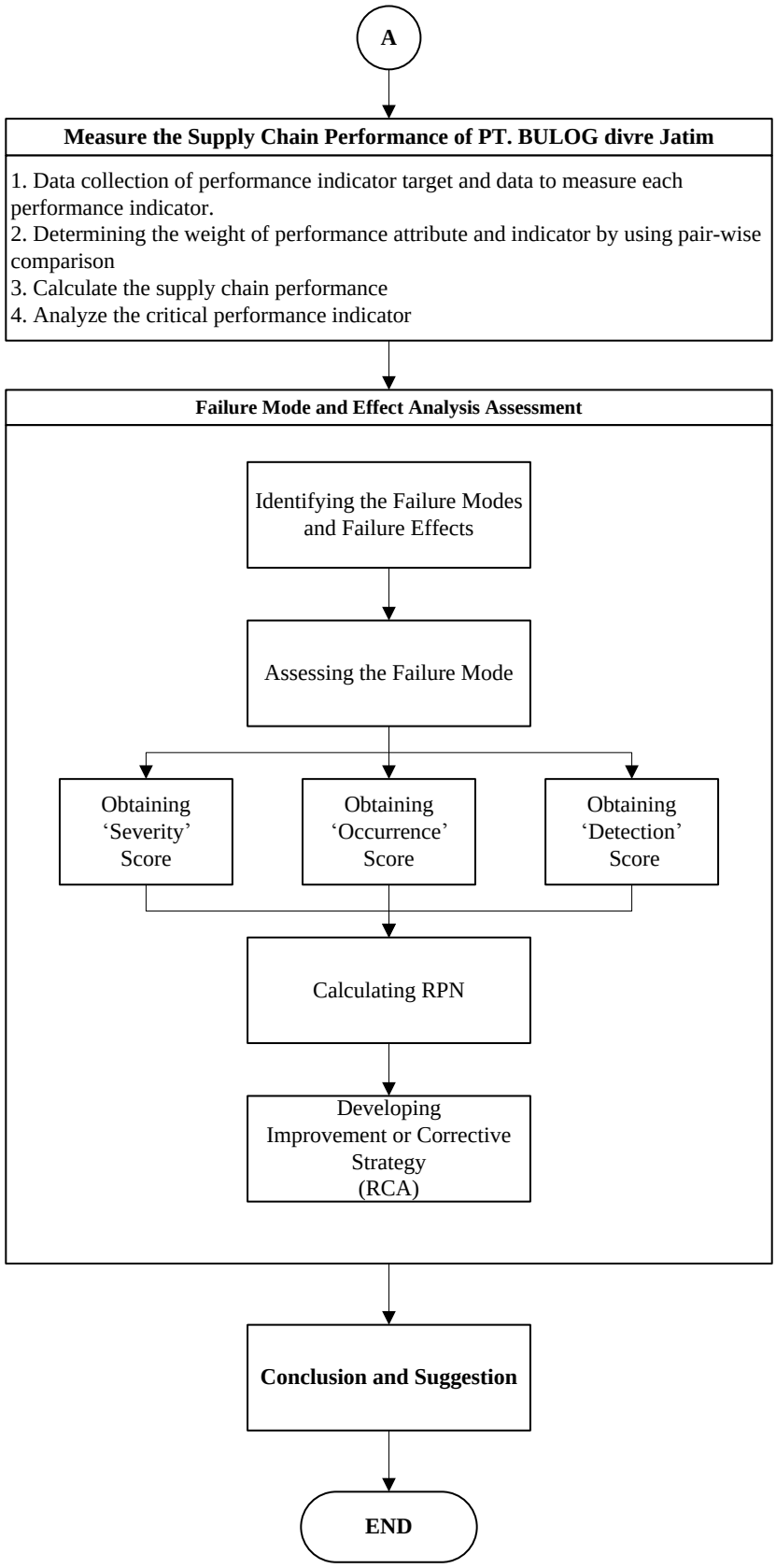

Figure 3. 2 Research Methodology Flowchart cont.

The research methodology consist of six stages that need to be done in order to conduct this research. The research starts by conducting literature study and field study followed with formulation of supply chain performance measurement framework based on SCOR model, supply chain performance measurement, improvement model building and analysis, and the last is conclusion and suggestion. The detail for each stage in the research methodology is given in the following:

3.2 Literature Review

The literature study is a study phase to find any references that will support the researcher conduct the research. In the literature study the researcher collect several references regarding supply chain, supply chain management, supply chain performance measurement, supply chain operation reference or SCOR and failure mode and effect analysis that will help the researcher decide which concept and theory that support the research to solve the problem and achieve the research goals.

3.3 Field Observation

The field observation is the stage of observing the existing condition of the company. This stage aims to observe and study the flow of supply chain processes in Perum BULOG divre Jatim that begin from goods entry until goods are delivered to the customer. In addition, during the field observation the researcher able to determine or know the indicators used by Perum BULOG to measure the success of supply chain performance and how to calculate it.

3.4 Develop Supply Chain Performance Measurement Model

Supply chain performance measurement framework focus on the formulation of supply chain performance measurement indicators. Supply chain performance measurement model stage starts with identifying the supply chain process in Perum BULOG divre Jatim. The information regarding the supply chain process of Perum BULOG was obtained by interviewing several representatives of Perum BULOG. The simple illustration of supply chain process in Perum BULOG given in figure 3.3.

After identifying the supply chain process next is identifying the supply chain objective(s). Information regarding supply chain objectives are obtained from interview and literature review. From the interview was obtained the information about 6Ts which are *Tepat Sasaran, Tepat Waktu, Tepat Kualitas, Tepat Jumlah, Tepat Harga dan Tepat Administrasi*. According to Mr. Pras, Perum BULOG representative, the supply chain objective are summarized in the 6Ts. Apart from the interview, the researcher also found supply chain objectives for subsidized rice is right on target to reduce poverty in Indonesia which is a fundamental policy of long-term plan proposed by President Jokowi and Vice President Jusuf Kalla.

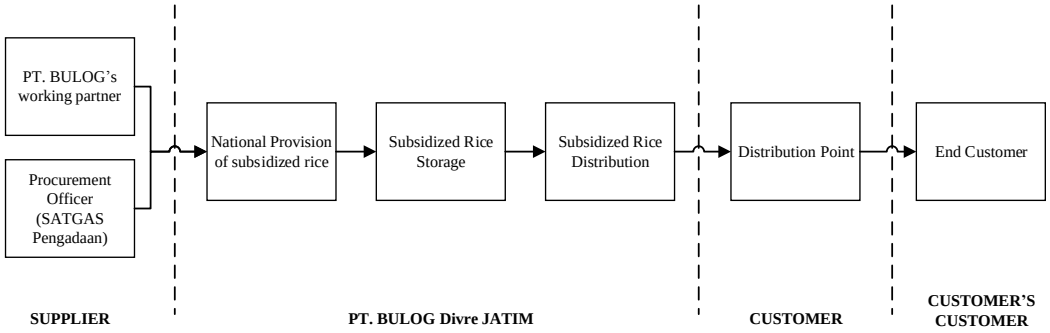

Figure 3. 3 illustration of PERUM BULOG divre Jatim Supply Chain

The next step after identifying the supply chain objective will be determining the supply chain performance attribute. According to SCOR (Supply Chain Council, 2012) there are five performance attributes which are reliability, responsiveness, agility, cost and asset management. The performance attribute obtained from interview, literature review, discuss with expert, and observe the existing condition of Perum BULOG divre Jatim. The output of this step will be the most suitable performance attribute that represent Perum BULOG's objective and condition.

After the supply chain performance attribute is determined, the next step will be identifying performance indicator that will represent Perum BULOG's objectives. The supply chain performance indicators will be obtained from benchmarking the existing performance indicator with the indicator or metric from SCOR model. The formulation of performance indicator is conducted not only by benchmarking but also interview and brainstorming with the expert. The

performance indicator will be defined into metric level-1 and level-2 of SCOR model.

After the performance attributes and performance indicators have been determined, the next step is supply chain performance measurement model verification and validation. Verification and validation are aimed to see whether the performance measurement model represents the supply chain objectives or not. If the model is verified and validate, performance measurement process can be conducted, otherwise then performance attribute and indicator have to be revised.

3.5 Supply Chain Performance Measurement

Supply chain performance measurement is the process undertaken to measure the supply chain performance of Perum BULOG by using model that has been developed in the preceding process. Performance measurement stage is conducted after the model of performance measurement verified and validated.

The first step of supply chain performance measurement will be data collection. The data collection based on indicators which have been determined in develop supply chain performance model. According to SCOR models, each indicator has its own method to measure an indicator and what kind of data that are needed. For example is the level-2 of SCOR performance metric which is % of orders delivered in full. Because the measurement is done by dividing the total number or orders delivered in full with the total number of overall orders delivered then data that must be collected are subsidized rice data that has been delivered which the amount is equal with the order amount and the total number of orders delivered within a specific period of time. The data will be obtained from the existing data own by Perum BULOG, interview, and questionnaire.

$$\%\ \text{of Orders Delivered in Full} = \frac{Total\ Number\ or\ orders\ delivered\ in\ full}{Total\ Number\ of\ Orders\ delivered}\ x\ 100\%$$

The next step is weighting indicator by using a questionnaire. A questionnaire will be distributed to several respondents who are directly involved

in the supply chain process to scale the weight of each performance attribute based on fundamental pair-wise comparison score or scale.

Table 3. 1 Example of Weight Recapitulation Questionnaire

Performance Attribute	Respondent			Performance Attribute
	1	2	3	
Reliability	7	7	8	Responsiveness
Reliability	5	5	5	Agility
Reliability	7	6	7	Cost
Reliability	3	5	3	Asset Management

After questionnaire distribution then the questionnaire are recapitulated in the form of weight recap form, table 3.1, in which the recapitulation form or table will be the input of *Expert Choice Software* to determine the weight for each attribute. The attribute considered right, acceptable and can be used if it has less than equal to 10% of consistency ratio.

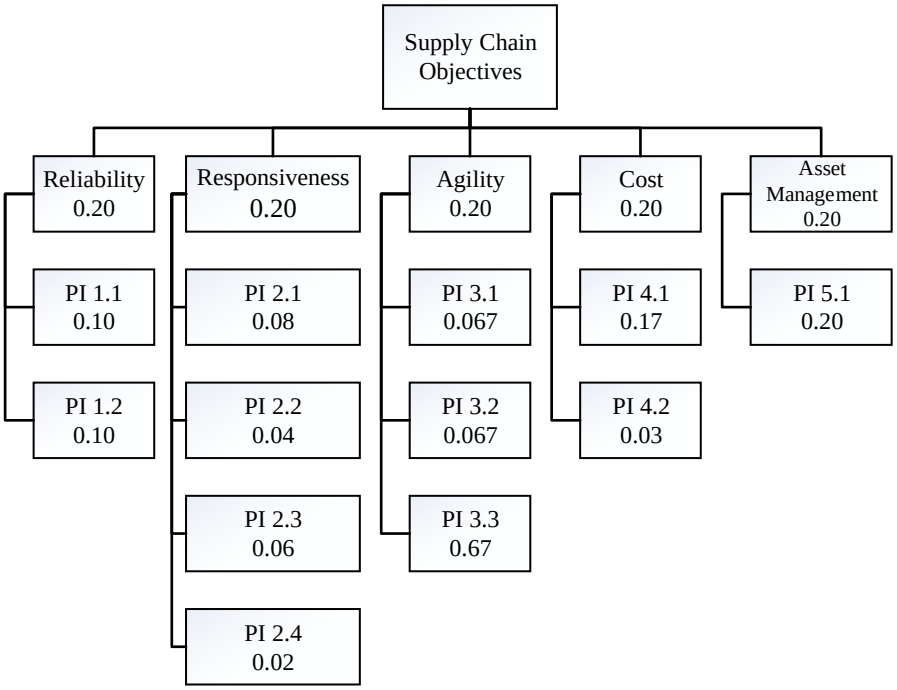

Figure 3. 4 Illustration of weight hierarchical

After each performance indicator is being weight, the next step will be measuring the supply chain performance and analyze the critical performance indicator that contribute to make the performance of supply chain decrease and improve it. The measurement is conducted by using the calculation method based

on SCOR model and multiplied with the weight that has been determined to obtain final score of supply chain performance. From the measurement result then analysis to find the critical indicator is conducted. Based on the analysis the next will be improvement process for the critical indicator. The improvement model scenario will be explained in the next sub-chapter.

3.6 Failure Mode and Effect Analysis

Failure Mode and Effect Analysis stage contains a failure identification based on the process that represented by the supply chain performance measurement indicators. The first step is identifying the failure modes and failure effects of each indicators. At this step, the collection of data in the failure mode was conducted by interviewing Perum BULOG Representatives, especially those who works in Raskin program, direct observation and reviewing the historical data. Failure in question is failure that can affect the supply chain performance of Perum BULOG Divre Jatim. The result of this step is the identification of failure modes and failure effects that may occur in each supply chain performance indicators.

The second step within failure mode and effect analysis stage is assessing the failure by using FMEA method. In this step, the process of data formulation is performed to assess the failure and find out the value of RPN or risk priority number. Assessing the failure begins by handing out questionnaire and discussing with Bulog representatives to obtain the value of severity, occurrence and detection for each failure mode. The rating value for severity, occurrence and detection have been determined in sub-chapter 2.5. The third step is multiplying the value of severity, occurrence, and detection to produce the RPN value. RPN value is used to determine the priority level of the failure modes. There will be an analysis and evaluation process before developing the improvement strategies. The result of the failure assessment is evaluated and analyzed to determine the priority rating that require mitigation. In determining the failure rating, then the failure is mapped by sorting the failure mode that has the highest RPN number to the smallest. Where the failure that included in the high risk category has a great influence in achieving Perum BULOG Divre Jatim goals. After determining the failure rating, next step is to determine the priority to mitigate the failure. The priority is the failure that has

the highest RPN value, where the determination of high, medium and low category is the result of brainstorming with Perum BULOG Divre Jatim. The failure that has the highest RPN value will be prioritized.

The last step of failure mode and effect analysis is developing the improvement or corrective strategies to mitigate or reduce the failure. In this step, root cause analysis will be used as a tool to assist in determining the best strategies to mitigate the failure and improve supply chain performance by analyzing the root cause of failure mode that has highest RPN Value. The failure mode will be breakdown by using 5-whys to obtain the root cause of the failure and produce an improvement or corrective strategies to omit the failure.

3.7 Conclusion and Suggestion

The last stage of this research methodology is the conclusion and suggestion stage. Conclusion and suggestion stage consist of conclusion that will answer the purpose of this research and suggestion that is given by the researcher for future research regarding this topic.

CHAPTER IV
DATA COLLECTION AND PROCESSING

This chapter explains the general description of Perum BULOG Divre Jatim, identification of performance indicator that suitable for Perum BULOG divre Jatim, weighting for each performance indicator and the validation and verification of performance indicator.

4.1 Company Description

Process of collecting data is conducted by reviewing historical data of Perum BULOG Divre Jatim, interviewing with several managers, and performing direct survey at Perum BULOG Divre Jatim and RTS-PM.

4.1.1 Perum BULOG Divre Jatim Profile

Perum Bulog divre Jatim is a state-owned company engaged in the food logistics. It has the task of organizing the food logistic especially subsidized rice or *Raskin*, which is a program from the government to help poor family. Besides that, Perum BULOG Divre Jatim also involves in business logistics or warehousing, survey and eradication of pests, supplying plastic bag, distributor, and food commodity trades and retail.

As a company which is obligated to perform government task, BULOG maintains basic grain price, price stabilization, food stocks, and distribution of subsidized rice for poor people. Perum BULOG Divre Jatim is contributing to the food industry to support the objectives of Perum BULOG to participate in building the national economy.

Perum BULOG Divre Jatim has twenty two (22) Rice Grain Processing Unit or *Unit Pengolahan Gabah Beras* and Warehouse located throughout the east java region. In Surabaya there are three UPGB and warehouses that dedicated to fulfill the demand of subsidized rice in Surabaya and other cities near Surabaya such as Sidoarjo, Jombang, Mojokerto, and Gresik, which are:

1. UPGB Buduran Subdivre Surabaya Utara
2. UPGB Tunggorono Subdivre Surabaya Selatan

3. UPGB Gunung Gedangan Subdivre Surabaya Selatan

Subsidized Rice for Surabaya region is provided by UPGB and Warehouse Buduran Subdivre Surabaya Utara. Based on the data provided by Perum BULOG Divre Jatim, there are 65,991 RTS-PM or *Rumah Tangga Sasaran-Penerima Manfaat* that will receive 15 kilos of subsidized rice each month for a year. The subsidized rice will be distributed by Perum BULOG to the distribution point, where the Raskin officer will deliver the rice to the final customer. For Surabaya region, there are one hundred sixty one distribution points all across the city. All RTS-PM families that have been registered in RTS database and also have *Kartu Raskin* can redeem the subsidized rice by paying Rp 1,600 for each kilo to the *raskin* officer.

4.1.2 Vision and Mission of Perum BULOG Divre Jatim

The vision and mission of Perum BULOG Divre Jatim are:

a. Vision:

   'Becoming a winning company in achieving food sovereignty'

b. Mission:

   1. Providing excellent service to the society and other stakeholders to meet basic needs food
   2. Achieving sustainable business growth
   3. Applying good corporate governance

4.1.3 Organization Structure of Perum BULOG Divre Jatim

Perum BULOG Divre Jatim is part of Perum BULOG Indonesia that operated in East Java region. Perum BULOG Divre Jatim is directed by Head of Regional Division. Perum BULOG Divre Jatim has three divisions within it, which are: Public services division, planning and business development, and financial and administration division. Raskin program is carried out under the authority of public services division.

In public service division, there are four sub divisions which are: procurement, market price analyst, inventory and transportation, quality maintenance, and distribution. The procurement sub-division is cooperating with

procurement officer, *Mitra Kerja Perusahaan* to acquire the number of rice that needed within specific period of time. For distribution, Perum BULOG Divre Jatim cooperates with PT. Jasa Prima Logistik to deliver the subsidized rice to the distribution points that have been determined.

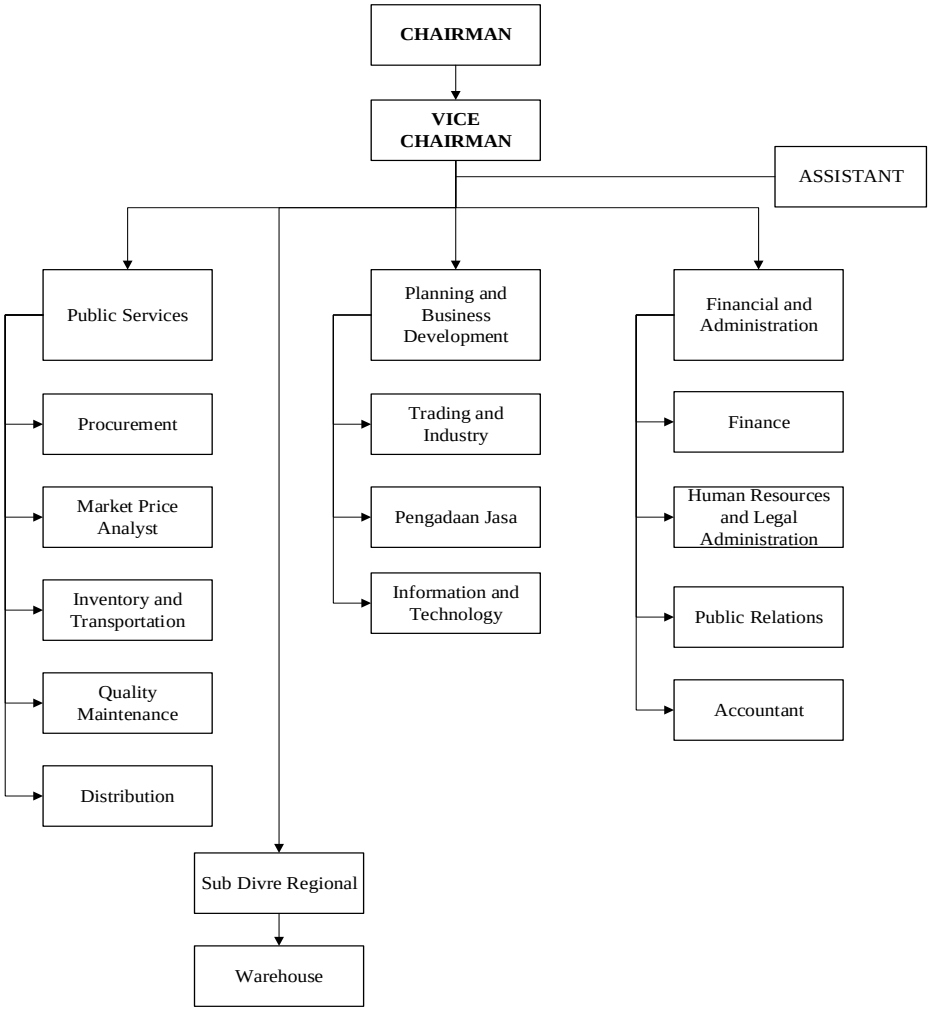

Figure 4. 1 Organization Structure of Perum BULOG Divre Jatim

4.1.4 Supply Chain Network in Perum BULOG Divre Jatim

Perum BULOG public duties in procurement and distribution of subsidized rice are the mandate of coordinating minister for the people's welfare No. 54 of 2014 on *Pedoman Umum Raskin 2015*, which is a manifestation of government intervention in reducing the household expenditure by providing subsidized rice to fulfill the needs. The first task in Raskin program is to implement purchasing policies rice in the country with the provisions of Government

Purchasing Price or Harga Pembelian Pemerintah (HPP). This activity is manifested in the form of rice procurement of domestic grain and rice by Perum BULOG. The second task is to stock and maintain the rice before being distributed while the third task is to distribute the subsidized rice to the distribution point which later will be distributed to the RTS-PM by Raskin officer.

Before performing the supply chain activities, each regional division will set the procurement target of grain or rice. Head of Regional Division is responsible in preparing the target acquisition per division operations or subdivre for procurement and distribution. The target is developed based on the SPA or *Surat Perintah Alokasi* which is issued from Perum BULOG Nasional.

In general, the supply chain of Perum BULOG starts with subsidized rice procurement from supplier which are *satgas pengadaan* and MKP or Perum BULOG's business partner, the subsidized rice that ordered then stored in the BULOG's warehouse and then distributed to the distribution point, from the distribution point subsidized rice then distribute to each poor family. As a part of the growing company, a performance measurement system for Perum BULOG divre Jatim proves particularly important. A supply chain performance measurement is needed to monitor and control the process happen within Perum BULOG starts from raw material procurement process to the very last of goods distribution.

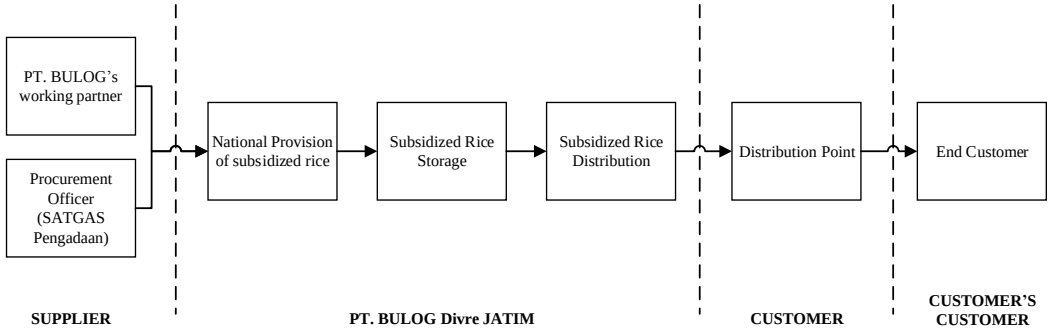

Figure 4. 2 Brief Description of Perum BULOG Divre Jatim Supply Chain

4.1.5 Process of Subsidized Rice Procurement

Procurement activity for subsidized rice in BULOG starts by preparing the procurement target. The target is set by the Head of East Java Regional Division of Perum BULOG based on SPA or Surat Perintah Alokasi released by National BULOG Division. The procurement target per division becomes the basis to provide procurement funds and provision of purchase agreement or work order procurement of subsidized rice. The target acquisition could be revised depends on the dynamic conditions that occurred. There are two alternatives to conduct procurement activity in Perum BULOG Divre Jatim, first the procurement can be conducted through MKP/GAPOKTAN which is Perum BULOG working partner and second is conducted through SATGAS ADA DN or Satuan Petugas Pengadaan Dalam Negeri.

Sourcing process through SATGAS ADA DN has several stages that need to be done. Several stakeholders such as National Perum BULOG, Bulog Divre Jatim, Satgas ADA DN, quality surveyor, warehouse and bank get involved in this process. The procurement process starts by creating SATGAS ADA DN team and submitting procurement plans for approval from Head of Perum BULOG Divre Jatim. SATGAS ADA DN makes a statement or integrity pact stated that rice submitted to Perum BULOG will fulfill the quality requirement set by Perum BULOG. The integrity pact is completed before SATGAS ADA DN conducted any procurement activities and it valid for one year. Based on the procurement plan submitted by SATGAS ADA DN and has been approved, the head of Perum BULOG Divre Jatim will release SPK or Surat Perintah Kerja for SATGAS ADA DN, DO or delivery order and SPTB or Surat Perintah Terima Barang for warehouse, and SPPK or Surat Perintah Pemeriksaan Kualitas for quality surveyor.

The procurement activity can be carried after the procurement fund is given to SATGAS ADA DN. The procurement fund is originated from National BULOG alongside the SKBDN Red clause that safe in the Bank. The procurement fund can be distributed to the SATGAS ADA DN after SKBDN or Surat Keterangan Berdokumentasi Dalam Negeri being authorized and endorsed by the Bank. After obtaining the procurement fund, the SATGAS ADA DN will purchase both grain and rice that have medium quality and send it to the warehouse to be test

by quality surveyor. Based on the SPPK, quality surveyor, a third party surveyor such as Sucofindo which is appointed by Perum BULOG, checks the quality of grain or rice in a place determined by the head of Perum BULOG which includes seams and labels as well as the quality of the rice according to the standard operation procedure of Inspection procedures quality grain, rice and packaging by sampling 10% of the overall procurement batch. Based on the results of quality inspection the Head of the Warehouse can accept, reject or re-analysis of the quality of the rice submitted by SATGAS ADA DN. The rice that meets the requirements will be accepted and stored in BULOG warehouse, for Surabaya the rice is stored in Buduran. After the rice is received by the warehouse officer, the head of the warehouse will publish GD1M or Bukti Penerimaan Barang and quality inspector publish LHPK or Lembar Hasil Pemeriksaan Kualitas and both of the documents will be submitted to the SATGAS ADA DN, this process happens alongside the transfer process from quality inspection to the BULOG warehouse. GD1M and LHPS documents will be submitted to Perum BULOG Divre Jatim and used as evidence on behalf of SATGAS ADA DN. The flow diagram of rice procurement through SATGAS ADA DN is shown in figure 4.3

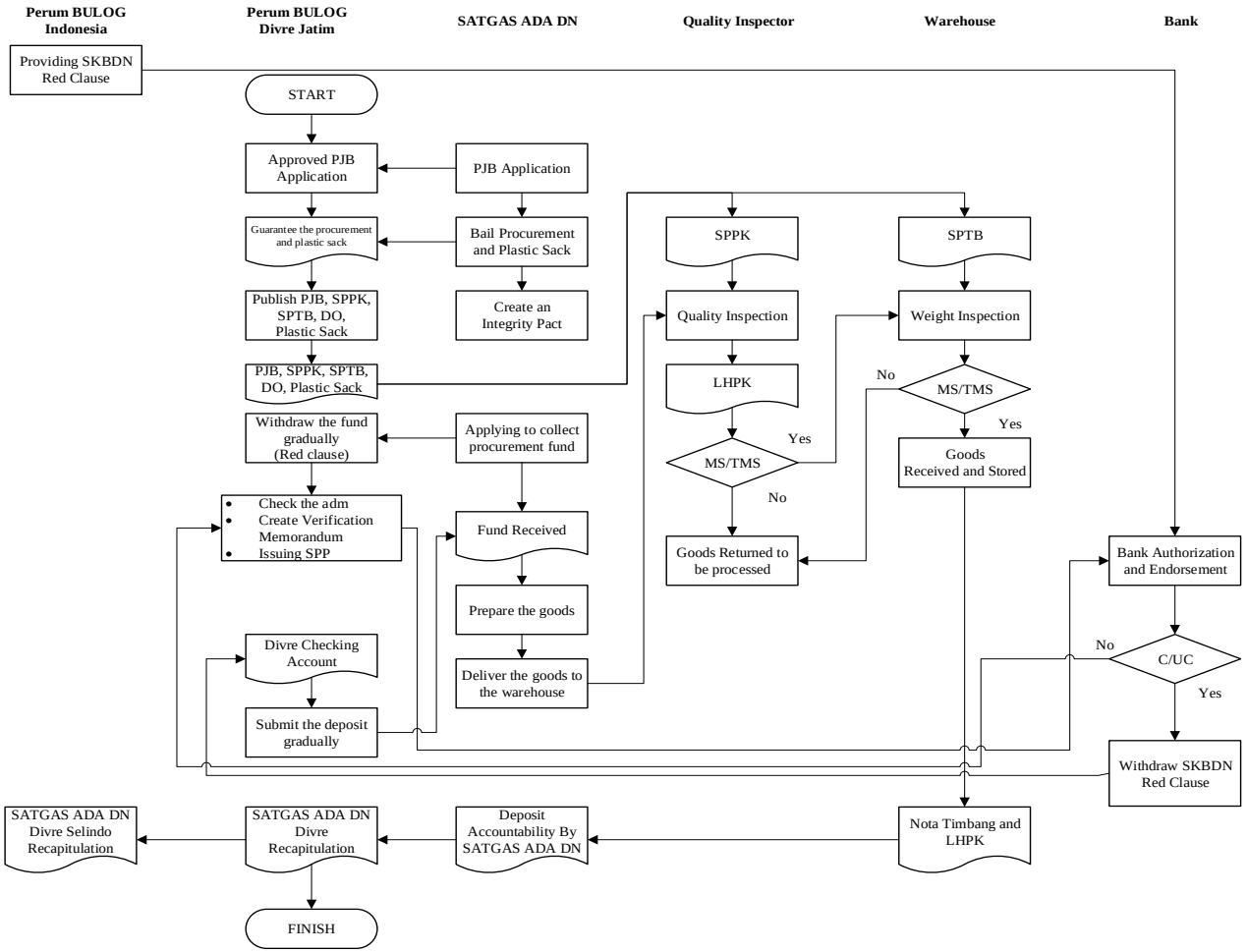

Figure 4. 3 Flow Diagram of Subsidized Rice Procurement through SATGAS ADA DN (Source: Perum BULOG Divre Jatim Procurement SOP)

The procurement process carried by MKP or BULOG's working partner is quite different compare to the one that conducted by SATGAS ADA DN. First, MKP has to submit application to carry the subsidized rice procurement to the Head of Regional Division, in this case is the Head of Perum BULOG Divre Jatim. Second, after the application submitted by MKP is approved, the Head of Perum BULOG Divre Jatim determine the quantity, time, place of procurement and compose a PJB or Perjanjian Jual Beli for procurement with MKP, release delivery order for MKP, SPTB or Surat Perintah Terima Barang for warehouse officer, and SPPK or Surat Perintah Pemeriksaan Kualitas for Quality Inspector, while the head of Perum BULOG Divre Jatim release several documents mentioned before, MKP compose an Integrity Pact which stated that MKP will provide subsidized rice that meets standard requirement sets by Perum BULOG Divre Jatim. The integrity pact should be submitted to Perum BULOG Divre Jatim before delivery order is released.

The third and last step of procurement process is delivery the rice which in accordance with PJB to the warehouse designated to do quality inspection. Based on the SPPK, Quality Inspector checks the quality of the rice by sampling 10% of the overall rice. Based on the result of quality inspection as stated in LHPK or Lembar Hasil Pemeriksaan Kualitas, then the head of the warehouse can accept, reject or asking for re-analysis of the quality of subsidized rice delivered by MKP. The rice that meet the requirements are accepted by the head of Warehouse to be stored in Warehouse Buduran Surabaya Utara. MKP could request payment for all the rice that has been received and stored in BULOG warehouse. The overall process of procurement carried out by MKP is given in figure 4.4.

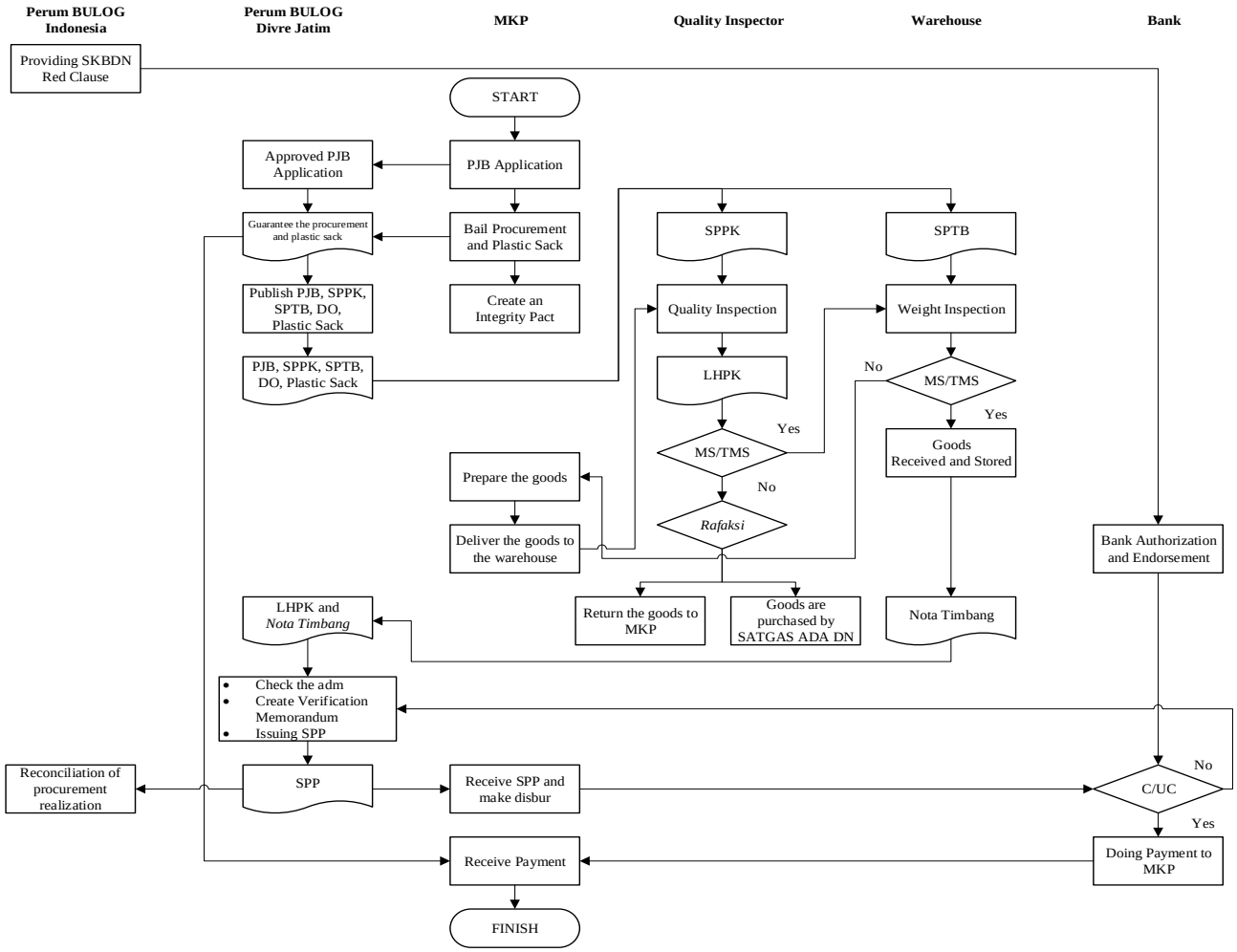

Figure 4. 4 Flow Diagram of Subsidized Rice Procurement through MKP (Source: Perum BULOG Divre Jatim Procurement SOP)

4.1.6 Maintaining and Stocking of Subsidized Rice

Maintaining and stocking processes begin after the head of warehouse receives the rice that fulfill the quality requirement sets by Perum BULOG for subsidized rice or medium rice. The rice that stored in the warehouse are maintained by the warehouse officer,BULOG warehouse has a program called Integrated Warehouse Pet Management or *Pengelolaan Hama Gudang Terpadu (PHGT).* PHGT promote warehouse cleanliness then monitoring the implementation of commodities and warehouse maintenance and preventive activities such as pest spraying and curative activities such as fumigation pest control in case of pest infestation.

Alongside the PHGT, Perum BULOG Divre Jatim also implements a stacking method in the rice storage. There are two methods, conventional and unconventional, which in conventional way the rice sacks stacked in a pallet with key system 5, 7 or 8. This method is used to make sure that the stack can stand firm and ensure the safety of warehouse worker. Figure 4.5 - 4.7 show the illustration of stacking pallet with key system (in sequence) 5, 7 and 8.

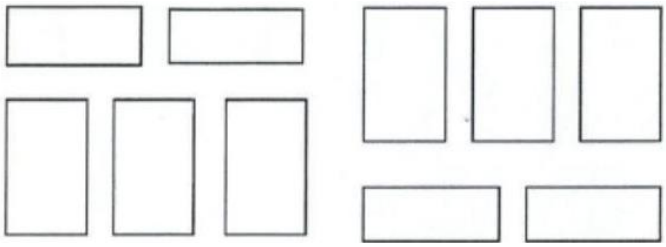

Figure 4. 5 Stacking System Key Element 5

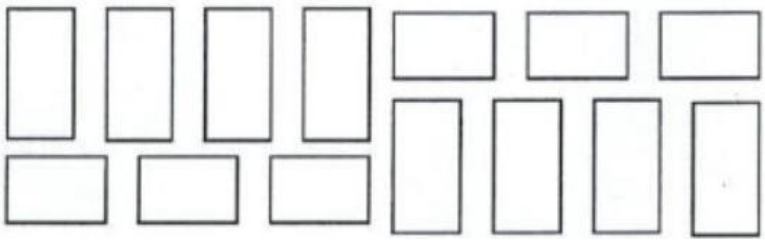

Figure 4. 6 Stacking System Key Element 7

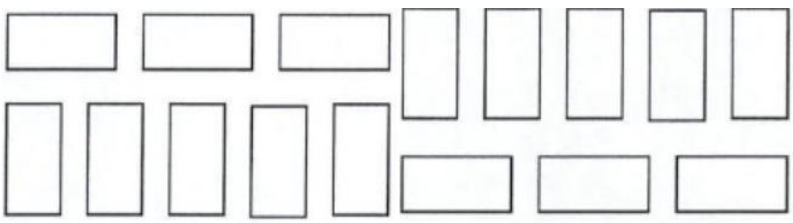

Figure 4. 7 Stacking System Key Element 8

Beside the design of stacking pallet, the quantity of each pallet also standardized in the warehouse SOP, given in table 4.1 is the standard number of rice sacks per pallet categorized based on the quantity of each rice sack.

Table 4. 1 Number of Sack per pallet

No	Quantity per sack	Max No of Stacking Per Pallet
1	15	40 sacks
2	20	40 sacks
3	50	30 sacks
4	100	23 sacks

In contrast with conventional method, the unconventional method are carried by BULOG by using an airproof storage technology innovation or a CO_2 stack method. CO_2 storage method has been implemented by BULOG since 1987. According to the warehouse representative, the use of CO_2 stack is able to meet the economic threshold if the CO_2 stack is being implemented for more or less 9 months.

4.1.7 Distribution Process of Raskin Program

The distribution of subsidized rice from Perum BULOG end at the distribution point, where for Surabaya there are approximately 161 distribution points. The subsidized rice is distributed to the distribution point using third party logistic, PT. Jasa Prima Logistik, which is Perum BULOG subsidiary company. According to Perum BULOG standard operational procedure of rice distribution, there are several steps that need to be conducted in Raskin delivery. The procedure of raskin distribution begins by Perum BULOG Divre Jatim receiving SPA or *Surat Perintah Alokasi* as the basis to issue SPPB or *Surat Perintah Pengeluaran Barang* and delivery order. Before issuing both SPPB and DO, Perum BULOG Divre Jatim has to check the amount of HP-Raskin arrears, if there are no arrears then the SPPB and DO can be released alongside the BAST or *Berita Acara Serah Terima.* SPPB and DO is submitted to SATKER RASKIN and copied to the warehouse that will be used to release the rice from the warehouse. The SPPB and DO is valid for one

month and can be extended one time. If during those time the distribution has yet to be finished then the SPPB and DO should be cancelled, and for the rest of rice that has not been distributed, the latest SPPB and DO will be issued.

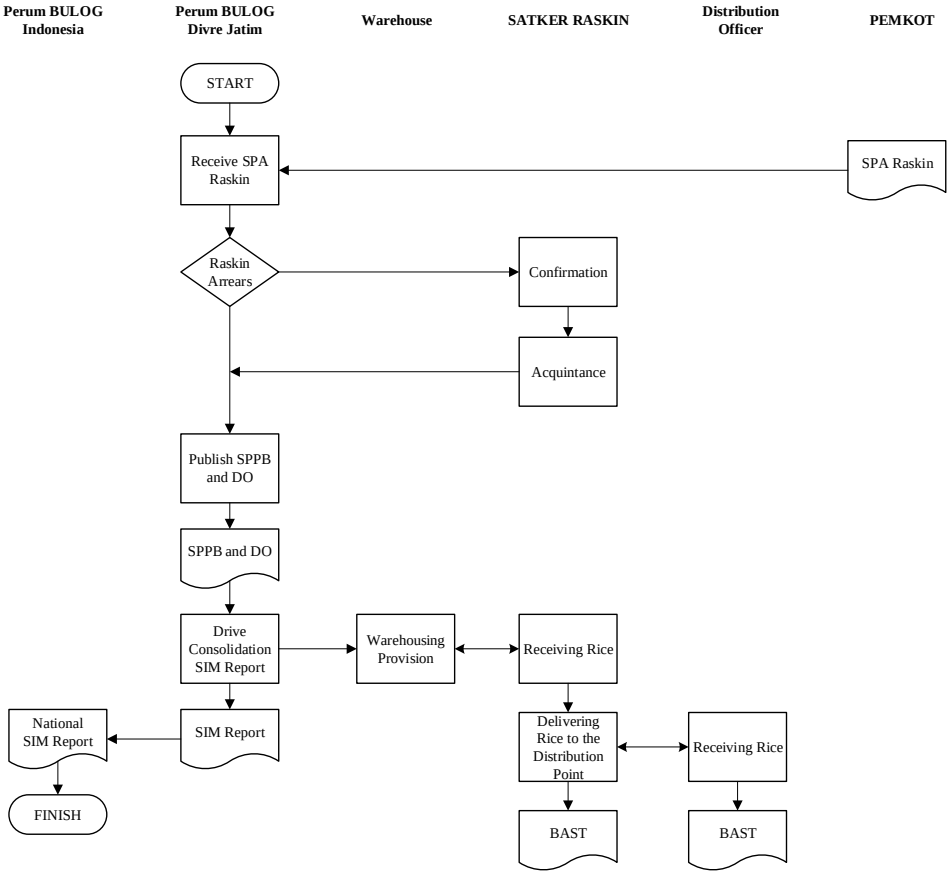

Figure 5. 1 Flow Diagram of Subsidized Rice Distribution (Source:Perum BULOG Divre Jatim Distribution SOP)

SATKER RASKIN will receive and submit SPPB and DO to the warehouse that appointed, in Surabaya it is located at Buduran. The warehouse officer will check the suitability of SPPB and DO from SATKER RASKIN and copies from Perum BULOG Divre Jatim. After being confirm, warehouse will release the rice and hand it to the SATKER RASKIN to be checks once again before being distributed to the distribution point. SATKER RASKIN will deliver the rice to the distribution point and hand it to the Raskin officer in each distribution point before being delivered to the end customer or Rumah Tangga Sasaran Penerima manfaat (RTS-PM). In the distribution point, SATKER RASKIN and Distribution Point Raskin officer will sign BAST Raskin. The BAST will be used as proof of

distribution realization which will be submitted to the Perum BULOG Divre Jatim to be recapped in SIM or *Sistem Informasi Manajemen* at regional and national levels.

4.1.8 Observed Product Determination

The process observed in this study is the supply chain of *Raskin* program which is dedicated to reduce the household expenditure of poor family, where the object that selected in this study is subsidized rice. Based on the interview result with BULOG, *Raskin* program is using rice with medium quality. The details of standard medium quality rice that will be accepted by Perum Bulog is as follows:

1. The water content contained in rice is less than or equal to 14%
2. *Butir patah* is less than or equal to 20%
3. *Beras Menir* is less than or equal to 2%
4. And *derajat susuh* is more than equal to 95%.

To ensure the quality of rice distributed according to the standard, quality checks performed before the rice stacked into the warehouse. Quality checks carried out by taking 10% sample of the total rice from one purchasement order. In addition to quality check, physical checking is also performed. Physical checking is conducted on the odor, color, chemicals, packaging of the subsidized rice. Physical and quality test are carried out by a third party which has been appointed by Perum BULOG.

4.2 Performance Indicator Identification

The initial identification of performance measurement indicators are conducted by identifying the purpose of company's supply chain. The identification process is done by interviewing Perum BULOG representatives and direct observation. Based on the observation and interview, it can be concluded that there are six objectives that Perum BULOG want to achieve, namely the delivery and procurement of goods on time, right quantity, right quality, right target, right price and complete administration. The description of each objective is explained as follow:

a. On Time Procurement and Delivery: Perum Bulog is committed to distribute rice accordance with the specified time. Not only is the distribution process, Perum Bulog also targeting the fulfillment of rice procurement in accordance with the specified time for each month.
b. Right Quantity: The right quantity objective has three main aspects that need to be accomplished, namely the procurement in accordance with the procurement target, distribution in accordance with the target of distribution and the amount that received by RTS-PM has to be 15 kg for each family per month.
c. Right Quality: the right quality purpose is defined as the quality of the rice given to RTS-PM should fulfill the standard quality set by Perum Bulog which are the water content contained in rice is less than or equal to 14%, *Butir patah* is less than or equal to 20%, *Beras Menir* is less than or equal to 2%, and *derajat susuh* is more than equal to 95%.
d. Right Target: right on target means that BULOG should distribute rice to the distribution points that have been determined. From the distribution point, the subsidized rice will be distributed to the RTS-PM who has been registered in the distribution points.
e. Right Price: means that the redeem price for subsidized rice should be in accordance with the Perdum Raskin 2015 which is Rp 1.600,00 per kg.
f. Complete administration: complete administration that need to be achieved by Perum Bulog is the administrative requirement for distribution process, MBA. MBA is the handover document during the distribution process in distribution point.

The next process is further identification of the indicators that could represent all six of the Perum BULOG Divre Jatim objectives. The initial indicator identification generates 12 indicators that will represent the objectives. The 12 indicators are grouped into three attributes which are reliability, responsiveness and asset. The initial identification is conducted by discussing several possible indicators with the expert. The figure of initial indicators that have been identified is shown in figure 4.8.

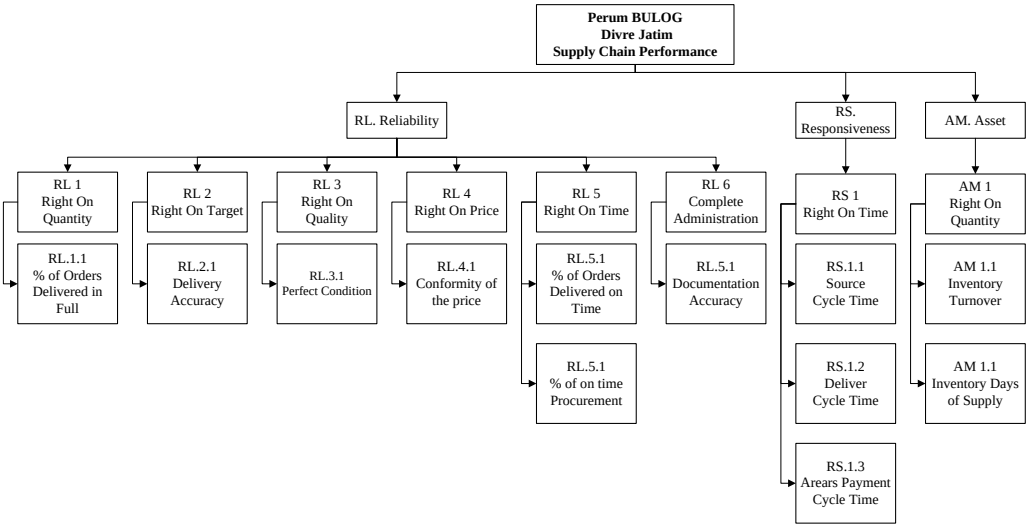

Figure 4. 8 Initial identification of Performance Indicators at Perum BULOG Divre Jatim

- **Reliability (RL)**

The reliability attribute addresses the ability to perform tasks as required. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: On-Time, the right quality, the right quantity. The reliability is a customer focused attribute (Supply Chain Council, 2012).

a. Right on Quantity (RL 1)

1. % of Orders Delivered in Full (RL 1.1)

Percentage of orders which all of the items are received by customer in the quantities committed. The number of orders that are received by the customer in the quantities committed divided by the total orders.

b. Right on Target (RL 2)

1. Delivery Accuracy (RL 2.1)

The ratio of orders delivered to the designated distribution point, the data will be collected by interviewing the representative in the distribution point and direct observation.

c. Right on Quality (RL 3)

1. Conformity of Goods Quality (RL 3.1)

The ratio of orders delivered in an undamaged state that meet the specification and accepted by the RTS-PM. The data will be collected by interviewing the representative in the distribution point and direct observation.

d. Right on Price (RL 4)

1. Conformity of the Price (RL 4.1)

The ratio of redeem price that in accordance with Perdum Raskin 2015 which is Rp 16.00 per kg for RTS-PM. The data will be collected by interviewing the representative in the distribution point and direct observation.

e. Right on Time (RL 5)

1. % of Orders Delivered on Time (RL 5.1)

The percentage of orders that are fulfilled on the customer's originally committed date. The data is obtained from distribution realization report and BAST document.

2. % of On Time Procurement (RL 5.2)

The percentage of orders that are sourced on the procurement division originally committed date. The data is obtained from procurement realization report.

f. Complete Documentation (RL 6)

1. Documentation Accuracy (RL 6.1)

Documentation accuracy is represented by the percentage of orders with on time and accurate documentation supporting the order, including shipping document or MBA in this case.

- **Responsiveness (RS)**

The responsiveness attribute describes the speed at which tasks are performed. Responsiveness addresses repeated speed of doing business. Example responsiveness metrics are cycle time metrics (Supply Chain Council, 2012).

a. Right on Time (RS 1)

1. Source Cycle Time (RS 1.1)

The average time associated with the source process. The procurement process begins by issuing SPK or Surat Perintah Kerja and ends by receiving nota timbangan and LHPK from Satgas ADA DN or MKP.

2. Delivery Cycle Time (RS 1.2)

The average time associated with deliver processes. The delivery process begins by releasing the delivery order and ends by receiving the MBA document.

3. Accuracy Payment on Time (RS 1.3)

The average time associated with payment process. The payment process begins by receiving SKBDN Red Clause and ends after receiving all the payment which is happens after all the document is complete.

- **Asset (AM)**

The asset management efficiency attribute describes the ability to efficiently utilize assets. Asset management strategies in supply chain include inventory reduction and in-source vs outsource (Supply Chain Council, 2012).

a. Right on Quantity (AM 1)

1. Inventory Turnover (AM 1.1)

Inventory turnover is a ratio showing how many times a company's inventory is sold and replaced over a period.

2. Inventory Days of Supply (AM 1.2)

The amount of inventory or stock expressed in days of sales. It is a financial measure of a company's performance that gives investors an idea of how long it takes for a company to turn its inventory into sales.

4.3 Performance Indicator Validation

After the process of identifying the performance indicators that comply the objectives of Raskin program which are on time, right quantity, right price, right quality, right on target and complete administration, then the next step that should be taken is the verification process to Perum BULOG to determine whether the performance indicators that have been identified can be applied, measured and represent the existing condition of Perum Bulog Divre Jatim. In this validation process, there are several performance indicators that being replaced due to their unsuitability with the conditions of the company. The number of validated performance indicators are 11 out of 12 with replacement of indicator RL 3.1 from perfect condition into conformity of subsidized rice quality and source of cycle time into % of accurate procurement, abolition of indicator RS 1.1 Source cycle time, AM 1.3 Inventory Days of Supply, and RS 1.3 Arears payment cycle time, the last is addition of indicator RL 1.3 Conformity of the quantity of subsidized rice.

Perfect condition indicator is removed and substituted with conformity of rice quality. This replacement aims to measure the performance of Perum BULOG

ability to provide subsidized rice that fulfill the standard requirement and accepted by RTS-PM. The measurement is conducted based on the conformity questionnaire which are distributed to the RTS-PM and distribution Point. The reason of having questionnaire result as the source of data is because the issue regarding the quality of the rice that received by RTS-PM having low quality but the result of LHPK or *Lembar Hasil Pemeriksaan Kualitas* show that the rice fulfill the standard requirement set by BULOG. This causing a discrepancy information for Perum BULOG, this why Perum BULOG choose to conduct direct observation to the end customer or RTS-PM. Referring to BULOG objective, Perum BULOG aims to provide subsidized rice that fulfill the standard requirement for RTS-PM.

Indicator source cycle time is replaced with % of accurate procurement due to lack of data regarding the exact date of procurement activity. The data provided by Perum BULOG are in the form of percentage of procurement realization for each month. Arrears payment cycle time indicator is removed due to incompatible with Perum BULOG Divre Jatim. There is no standard time regarding the process of subsidy billing to Pemkot.The amount of subsidy arears are taken into consideration when distributing the subsidized rice. Additional indicator, conformity of subsidized rice quantity, is added to conform the quantity that received by RTS-PM is the same as stated in Perdum Raskin which is 15 kg per each family for each month. There is an issue regarding the quantity of rice received by RTS-PM which is less than 15 kg. This indicator is needed to assess the performance of the supply chain which covers the right quantity purpose of Perum BULOG Divre Jatim.

4.4 Weighting

Weighting process is applied for both attributes and indicators. The attributes that used are based on the SCOR model which are reliability, responsiveness, and asset. Weighting procedure is conducted by using AHP-Pairwise comparison method. The value of AHP is obtained from a questionnaire with a scale of grades 1-9, which compares attributes and indicators, and then given to the Bulog representatives. The AHP questionnaire addressed to all the stakeholders that involved in the supply chain structure of Raskin program which

are *Kasi Pengadaan, Kasi Penyaluran and Kasi Analisa Harga Pasar*, in which in this research the representatives are discussing together to obtain a single value. The example of weighting questionnaire (AHP) is attached in appendix A.

The example of AHP questionnaire recapitulation for performance attribute weighting process is given in table 4.2. The rest of questionnaire recapitulation is given in appendix B.

Table 4. 2 AHP questionnaire recapitulation

Attributes	Reliability	Responsiveness	Asset
Reliability		8	7
Responsiveness	1/8		2
Asset	1/7	1/2	

After obtaining the value from AHP questionnaire, the next step is to input these values to the *expert choice software version 11.0.* The weighting results are declared valid if the output calculation produces inconsistencies below or equal to 10% or 0.1

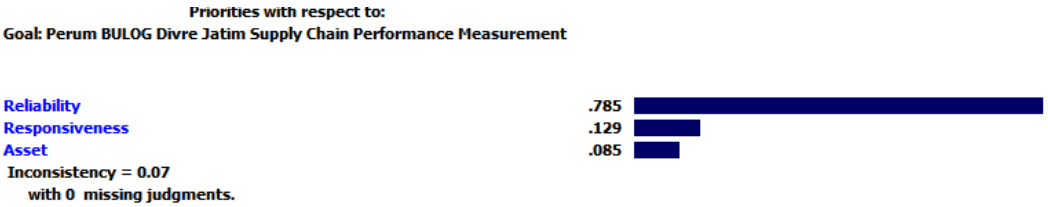

Figure 4. 9 Weighting Result of Performance Attributes at Perum BULOG Divre Jatim

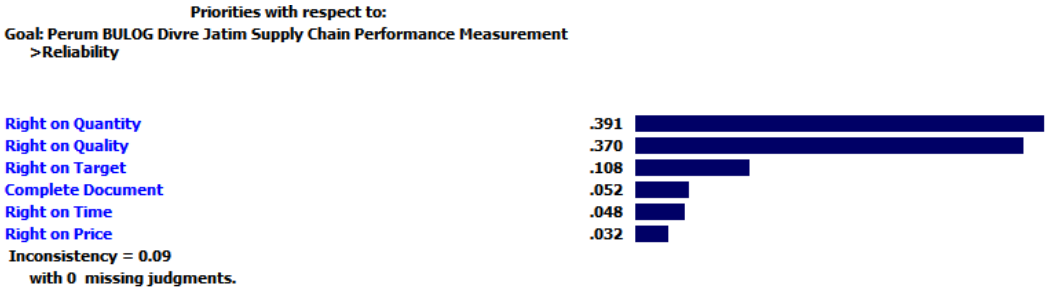

Figure 4. 10 Weighting Result of Performance Attributes Level 1 at Perum BULOG Divre Jatim

Figure 4.10 shows the weighting result of 6 Raskin objectives which are right quantity, quality, target, time, price and complete document. Based on the output of expert choice software right on quantity is the most important objectives compare to others. It contributes 0.39 to the supply chain performance.

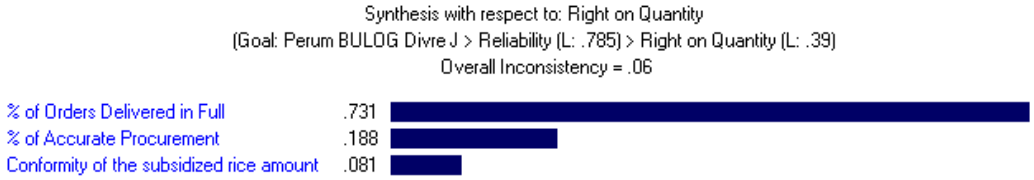

Figure 4. 11 Weighting Result of Performance Indicator *Right Quantity*

Because right quantity attribute has three indicators, those indicators need to be weight to know the contribution for each indicator to the supply chain performance. Based on the questionnaire result and expert choice software show that % of orders delivered in full has the highest contribution among others indicators.

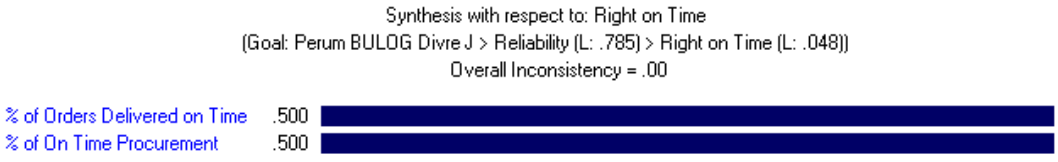

Figure 4. 12 Weighting Result of Performance Indicator Right On Time

Build upon the questionnaire and expert choice software, both % of orders delivered on time and % of on time procurement have the same contribution, 0.05 with inconsistency rate of 0.00.

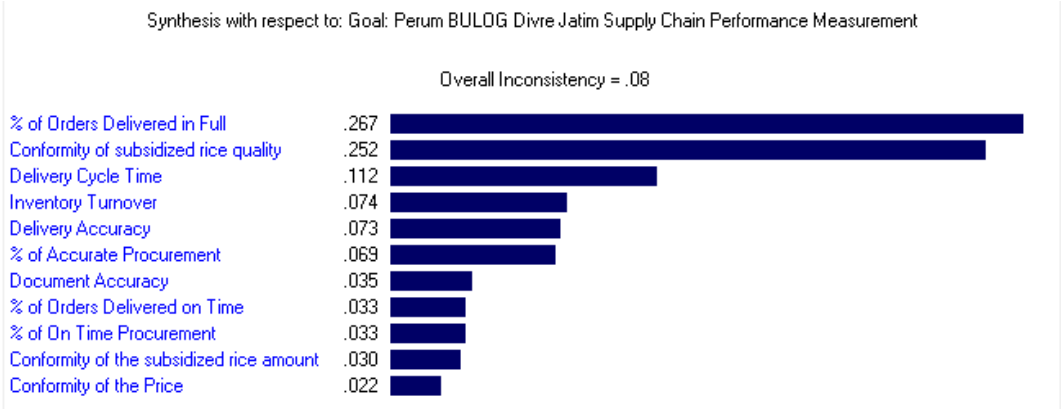

Figure 4. 13 Overall Weighting Result of Performance Indicators at Perum BULOG Divre Jatim

Figure 4.13 is the overall weighting result of Performance Indicators that will be used in the performance measurement process. The overall inconsistency is 0.08 which is less than 0.1, so it can be concluded that the weight is valid and can be used.

4.5 Performance Indicator Final Validation

Final validation aims to ensure that the indicators that have been identified as suitable and can be applied at BULOG. Distinction element between the initial validations and the final validation is the weight for each indicator and attribute. The weight of each indicator is obtained by using pair-wise comparison that has been explained in the sub-chapter 4.4. Final validation is conducted by giving a questionnaire to the company for validation of indicators and weights. The questionnaire is given in Table 4.1.

Table 4. 3 Final Validation Questionnaire

Code	Indicator or Attributes	Weight	Validation	
			Valid	Not Valid
RL	**Reliability**	**0.785**	V	
RL 1	*Right on Quantity*	*0.39*	V	
RL 1.1	% of Order Delivered in Full	0.731	V	
RL 1.2	% of Accurate Procurement	0.188	V	
RL 1.3	Conformity of subsidized rice amount	0.081	V	
RL 2	*Right on Target*	*0.108*	V	
RL 2.1	Delivery Accuracy	0.108	V	
RL 3	*Right on Quality*	*0.370*	V	
RL 3.1	Conformity of Subsidized Rice Quality	0.370	V	
RL 4	*Right on Price*	*0.032*	V	
RL 4.1	Conformity of the price	0.032	V	
RL 5	*Right on Time*	*0.048*	V	
RL 5.1	% of orders delivered on time	0.5	V	
RL 5.2	% of on time procurement	0.5	V	
RL 6	*Complete Administration*	*0.052*	V	
RL 6.1	Documentation Accuracy	0.052	V	
RS	**Responsiveness**	**0.13**	V	
RS 1	*Right on Time*	*0.129*	V	
RS 1.1	Deliver Cycle Time	0.129	V	
AM	**Asset Management**	**0.085**	V	
AM 1	*Right on Quantity*	*0.085*	V	
AM 1.1	Inventory Turnover	0.25	V	

The hierarchy of validated supply chain performance indicator and weight for each indicator and attribute of Perum Bulog Divre Jatim is shown in figure 4.14.

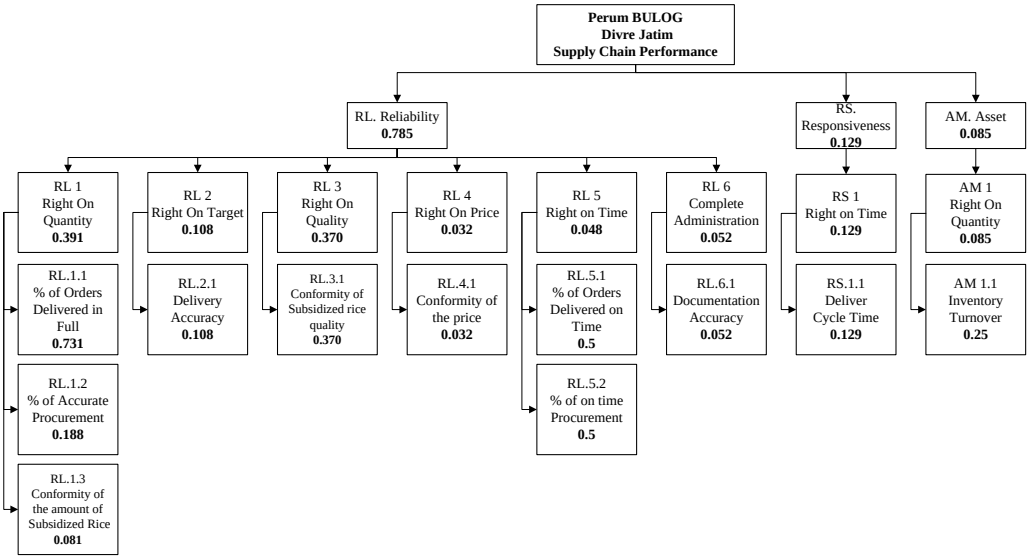

Figure 4. 14 Final Indicators of Perum BULOG Divre Jatim

4.6 Target Determination at Perum BULOG Divre Jatim

Target determination is required in order to measure the performance of a company while achieving the goal. Each indicator that has been validated will be given a target that later will be compared with the results of existing performance measurement of the company. The process of target determination is carried out by reviewing the historical data and brainstorming with Perum BULOG Divre Jatim representatives. The result of target determination is summarized in table 4.4.

Table 4. 4 List of Target Determination in Perum BULOG Divre Jatim

Performance Attribute	Performance Indicator of Perum BULOG Divre Jatim		Perum BULOG Divre Jatim Target
	1	2	
Reliability	Right on Quantity	% of Order Delivered in Full	100%
		% of Accurate Procurement	100%
		Conformity of subsidized rice amount	0.9
	Right on Target	Delivery Accuracy	0.95
Reliability	Right on Quality	Conformity of Subsidized Rice Quality	0.8
	Right on Price	Conformity of the price	0.8

Performance Attribute	Performance Indicator of Perum BULOG Divre Jatim		Perum BULOG Divre Jatim Target
	1	2	
	Right on Time	% of orders delivered on time	100%
		% of on time procurement	100%
	Complete Administration	Documentation Accuracy	100%
Responsiveness	Right on Time	Deliver Cycle Time	30 days
Asset Management	Right on Quantity	Inventory Turnover	2.75

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CHAPTER V
SUPPLY CHAIN PERFORMANCE RESULT AND ANALYSIS

This chapter consist of supply chain performance measurement of Perum BULOG Divre Jatim that explains about the performance indicator that being measured, the actual performance measurement, scoring system, and traffic light system while the supply chain performance evaluation sub-chaper is consist of Perum BULOG Divre Jatim Supply Chain Performance Analysis

5.1 Perum BULOG Supply Chain Performance Measurement

This sub-chapter consist of explanation regarding the chosen indicator, data collection, scoring system, and measurement process of supply chain performance at Perum BULOG Divre Jatim.

5.1.1 Validated Performance Indicator

After going through validation process with Perum BULOG representatives, there are eleven indicators that validated and can be used to measure the supply chain performance of Perum BULOG Divre Jatim for Raskin program. The eleven indicators are as follow:

1. % of Orders Delivered in Full (RL 1.1)

% of Orders Delivered in Full indicator aims to determine the supply chain performance regarding order fulfillment in the right quantity. Each indicator has properties that contains the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of % of orders delivered in full indicator are provided in Table 5.1.

Table 5. 1 % of Orders Delivered in Full Properties

Category	Higher is Better
Unit	%
Source of Data	Distribution Realization Report
Period	Monthly
Formula	$\frac{Total\ number\ of\ orders\ delivered\ in\ full}{Total\ Number\ of\ Orders\ Delivered} x\ 100\%$

% of orders delivered in full is measured by using distribution realization report from February 2015 until December 2015, which is shown in Table 5.2.

Table 5. 2 Distribution Report February 2015-December 2015

No.	Month	Target (Kg)	Realization (Kg)	%
1	February	1,979,730	-	0.00%
2	March	989,865	1,823,295	184.20%
3	April	989,865	1,052,610	106.34%
4	May	989,865	994,305	100.45%
5	June	989,865	1,246,380	125.91%
6	July	989,865	1,084,095	109.52%
7	August	989,865	756,630	76.44%
8	September	989,865	961,605	97.15%
9	October	989,865	1,000,440	101.07%
10	November	989,865	1,491,765	150.70%
11	December	989,865	1,467,255	148.23%
	Total	11,878,380	11,878,380	

From table 5.2 it can be seen, if the performance measurement is measured in the annual period it can be concluded that the distribution of Bulog has a great performance because the distribution realization is equal to the target number or in another way Perum Bulog carry out 100% orders delivered in full quantity. But when the measurement is conducted monthly when it should be, viewed in a period of months, there were several times Bulog did not distribute the rice in accordance with the monthly target, such in February, August and September. In another hand, there were also several times that Bulog distributed more than it monthly target which the rice excess were dedicated to fulfill the previous target.

2. % of Accurate Procurement

% of accurate procurement aims to determine the supply chain performance regarding the right quantity procurement. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of % of accurate procurement indicator are provided in Table 5.3.

Table 5. 3 % of Accurate Procurement Properties

Category	Higher is Better
Unit	%
Source of Data	Procurement Realization Report
Period	Monthly

Formula	$\frac{Total\ number\ of\ goods\ purchased\ in\ full}{Total\ Number\ of\ Orders\ Delivered} x\ 100\%$

% of accurate procurement is measured by using procurement realization report from February 2015 until December 2015, which is shown in Table 5.2.

Table 5. 4 Procurement Realization Report February 2015-December 2015

No.	Month	Target (Ton)	Realization (Ton)	%
1	February	8.924	8.924	100.0%
2	March	1,785	1,785	100.0%
3	April	6,998	6,998	100.0%
4	May	9,330	9,330	100.0%
5	June	2,366	5,358	226.5%
6	July	2,163	3,669	169.6%
7	August	2,177	7,614	349.8%
8	September	1,107	2,775	250.6%
9	October	1,582	1,873	118.4%
10	November	446	1,674	375.2%
11	December	297	1.190	0.4%
Total		**50,293**	**63,120**	

From table 5.4 it shows that Perum BULOG Divre Jatim fulfilled the monthly target, and sometimes exceed the target. The procurement of medium rice is dedicated not only for raskin program but also for market operation. Based on information obtained from Bulog, Perum Bulog conducted a continuous procurement along the year. In addition, based on Perdum Raskin Perum Bulog is required to receive rice from local farmers as much as possible to avoid import activity. The target set by Perum BULOG Divre Jatim was fluctuate, this happened because of differences in harvesting time and demand for each month. In the data, there was dramatically rose in procurement target for May, it happened because of demand increased ahead of Ramadhan and Eid al-fitr, which falls on June-July 2015. The majority of the rice were used in market operation to stabilize the rice price. In December, it can be seen that the procurement rate is drastically decreases, this happened because Perum BULOG Divre Jatim decided to stop the procurement activity because the procurement target was fulfilled.

3. Conformity of Subsidized Rice Amount

Conformity of subsidized rice aims to determine the supply chain performance that will fulfill right quantity objective. Each indicator has properties

that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of conformity of subsidized rice indicator are provided in Table 5.5.

Table 5. 5 Conformity of Subsidized Rice Amount Properties

Category	Higher is Better
Unit	Ratio
Source of Data	Direct observation and Survey
Period	Monthly
Formula	$\frac{Total\ survey\ that\ shows\ accurate\ amount\ of\ goods\ received}{Total\ Number\ of\ Surveys\ Conducted}$

Conformity of subsidized rice quantity is measured by using direct observation and survey or questionnaire from 50 distribution locations, which is the result of survey is shown in Table 5.6.

Table 5. 6 The result of rice amount conformity survey

Total Survey	Conform	Not Conformed	Ratio
50	43	7	0.86

The survey is conducted in 50 distribution points which were chosen randomly to obtain the data. The questionnaire is consist of four questions with yes and no answers which were asking regarding the conformity of subsidized rice that received by RTS-PM. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on quantity goal. This indicator also used as a detector of circulating issue regarding the amount that received by RTS-PM. The issue that emerged lately is several non RTS-PM receive Raskin quota causing the original RTS-PM receive less than 15 kilos of subsidized rice. The result of this survey will be considered to generate improvement recommendation. 43 out of 50 surveys stated that the subsidized rice amount for each RTS-PM is conform to the quality that has been set by Perum BULOG based on Perdum Raskin 2015 which is 15 kg. In another hand, 7 surveys stated that the amount of rice received by RTS-PM is not 15 kg. According to the one of correspondent said that the family only receive 13 kg per month because the 2kg which taken are collected and distributed to other poor families that its family has not been registered yet.

4. Delivery Accuracy

Delivery accuracy rice aims to determine the supply chain performance that will fulfill right target objective. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula. The properties of delivery accuracy indicator are provided in Table 5.7.

Table 5. 7 Delivery Accuracy Properties

Category	Higher is Better
Unit	Ratio
Source of Data	Direct observation and Survey
Period	Monthly
Formula	$\frac{Total\ survey\ that\ shows\ number\ of\ delivery\ accuracy}{Total\ Number\ of\ Surveys\ Conducted}$

Delivery accuracy indicator is measured by using direct observation and survey or questionnaire from 50 distribution locations, which is the result of survey is shown in table 5.8.

Table 5. 8 The result of delivery accuracy survey

Total Survey	Conform	Not Conformed	Ratio
50	50	0	1

The survey is conducted in 50 distribution points which were chosen randomly to obtain the data. The questionnaire is consist of four questions with yes and no answers which were asking regarding the delivery accuracy of Raskin distribution by Perum BULOG Divre Jatim. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on target goal. This indicator also used as a detector of circulating issue regarding the inaccuracy of the rice distribution that will affect in additional redeem price. Based on interviews with the Bulog representatives, there are some cases where the distribution process is hampered by the switched goods, as example the items that should be distributed to the district Sukolilo switched with Mulyorejo districts. Because the amount of goods received do not match the initial amount, satgas raskin has to return the subsidized rice and wait for another distribution which led to increased distribution costs and delay in rice distribution.

5. Conformity of Subsidized Rice Quality

Conformity of subsidized rice quality aims to determine the supply chain performance that will fulfill right quality objective. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of conformity of subsidized rice quality indicator are provided in Table 5.9.

Table 5. 9 Conformity of Subsidized Rice Quality Properties

Category	Higher is Better
Unit	Ratio
Source of Data	Direct observation and Survey
Period	Monthly
Formula	$\frac{Total\ survey\ that\ shows\ qualified\ subsidized\ rice}{Total\ Number\ of\ Surveys\ Conducted}$

Conformity of subsidized rice quality indicator is measured by using direct observation and survey or questionnaire from 50 distribution locations, which is the result of survey is shown in table 5.10.

Table 5. 10 The result of Rice Quality Conformity survey

Total Survey	Conform	Not Conformed	Ratio
50	39	11	0.78

The survey is conducted in 50 distribution points which were chosen randomly to obtain the data. The questionnaire is consist of four questions with yes and no answers which were asking regarding the conformity of subsidized rice quality of Raskin distributed by Perum BULOG Divre Jatim. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on quality goal. There are several issues regarding the quality of subsidized rice these days such as there are a lot of *beras patah,* fleas, has yellowish color and unpleasant odor. Based on observation and interview results, it is happen due to long saving time in the warehouse. According to Mr. Pras, Bulog representative, Perum BULOG has a policy that obligate it to have safety stock at least for the next 4 months.

6. Conformity of the Price

Conformity of subsidized rice price aims to determine the supply chain performance that will fulfill right price objective. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of conformity of subsidized rice price indicator are provided in Table 5.11.

Table 5. 11 Conformity of the Price Properties

Category	Higher is Better
Unit	Ratio
Source of Data	Direct observation and Survey
Period	Monthly
Formula	$\frac{Total\ survey\ that\ shows\ the\ appropriate\ price}{Total\ Number\ of\ Surveys\ Conducted}$

Conformity of subsidized rice price indicator is measured by using direct observation and survey or questionnaire from 50 distribution locations, which is the result of survey is shown in table 5.12.

Table 5. 12 The result of Price Conformity Survey

Total Survey	Conform	Not Conformed	Ratio
50	36	14	0.72

The survey is conducted in 50 distribution points which were chosen randomly to obtain the data. The questionnaire is consist of four questions with yes and no answers which were asking regarding the conformity of subsidized rice price of Raskin distributed by Perum BULOG Divre Jatim. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on price goal. Based on the Perdum Raskin 2015, the redeem price for subsidized rice is Rp 1.600,00 for each kg. In the field 14 out of 50 stated that they have to pay more than Rp 1.600,00 per kg, in average they have to pay around Rp 2.000,00-2.500,00 for each kg. This condition might occur because there is misappropriation of Raskin funds by local officer.

7. % of Orders Delivered on Time

% of orders delivered on time aims to determine the supply chain performance regarding the on time objective. Each indicator has properties that contain the indicator category, units of measurement, source of data, the

measurement period and measurement formula, the properties of percentage of orders delivered on time indicator are provided in Table 5.13.

Table 5. 13 % of Orders Delivered on Time Properties

Category	Higher is Better
Unit	%
Source of Data	Distribution Realization Report
Period	Monthly
Formula	$\frac{Total\ number\ of\ orders\ delivered\ on\ the\ original\ commitment\ date}{Total\ Number\ of\ Orders\ Delivered} x\ 100\%$

Percentage of on time delivery is measured by using distribution realization report from February 2015 until December 2015, which is shown in Table 5.14.

Table 5. 14 Distribution Realization report February 2015-December 2015

No.	Month	On Time Delivery
1	February	0.00%
2	March	100.00%
3	April	100.00%
4	May	100.00%
5	June	100.00%
6	July	100.00%
7	August	76.44%
8	September	97.15%
9	October	100.00%
10	November	100.00%
11	December	100.00%

Table 5.14 shows the distribution realization that delivered in accordance with the commit date. From February until December 2015, Perum BULOG did not deliver the subsidized rice on time on February, August and September. There are several factors that affect the on time delivery. Based on observations and interview conducted with Perum BULOG representatives, problems such as delay in issuing delivery order and inadequate transportation to distribute the subsidized rice become the main factor that causing delays in delivery process. There is issue whicgh say that the delay in distribution process due to lack of rice stock owned by Perum BULOG Divre Jatim, but this issue can be disproved by the provision and

inventory data which states that Perum BULOG Divre Jatim rice stock are available more or less for the next 5 months.

8. % of on Time Procurement

% of on time procurement aims to determine the supply chain performance regarding the on time procurement objective. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of % of on time procurement indicator are provided in Table 5.15.

Table 5. 15 % of on Time Procurement Properties

Category	Higher is Better
Unit	%
Source of Data	Procurement Realization Report
Period	Monthly
Formula	$\frac{Total\ number\ of\ goods\ purchased\ on\ the\ original\ commitment\ date}{Total\ Number\ of\ Goods\ Purchased}\ x\ 100\%$

Percentage of on time procurement is measured by using procurement realization report from February 2015 until December 2015, which is shown in Table 5.16.

Table 5. 16 Procurement realization report February-December 2015

No.	Month	On Time Procurement
1	February	100%
2	March	100%
3	April	100%
4	May	100%
5	June	100%
6	July	100%
7	August	100%
8	September	100%
9	October	100%
10	November	100%
11	December	0%

In table 5.16 is the recapitulation of on time procurement for year 2015. It can be seen from the table that procurement process was conducted on time means that the procurement activity was done within the specific range of time set in procurement monthly target. The on-time procurement activity was conducted for

the entire year except in December, which in December Perum BULOG Divre Jatim could not fulfill the procurement target within the time range that had been set.

9. Documentation Accuracy

Documentation accuracy indicator aims to determine the supply chain performance regarding the complete administration objective. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of documentation accuracy indicator are provided in Table 5.17.

Table 5. 17 Documentation Accuracy Properties

Category	Higher is Better
Unit	%
Source of Data	MBA report
Period	Monthly
Formula	$\frac{Total\ number\ of\ orders\ delivered\ with\ accurate\ documentation}{Total\ Number\ of\ Orders\ Delivered} x\ 100\%$

Documentation accuracy is measured by using procurement realization report from February 2015 until December 2015, which is shown in Table 5.18.

Table 5. 18 Percentage of MBA report from February-December 2015

No.	Month	% MBA-01
1	February	0.00%
2	March	0.00%
3	April	34.42%
4	May	51.15%
5	June	77.38%
6	July	79.82%
7	August	85.37%
8	September	75.00%
9	October	88.78%
10	November	85.57%
11	December	100.00%

Table 5.18 shows the percentage of submitted MBA-01 document to Perum BULOG Divre Jatim. MBA-01 is a document that consist of BAST, *nota timbang* and LHPK or *Lembar Hasil Pengecekan Kualitas.* MBA-01 document will be used for billing toward government regarding the rice subsidy. Based on the observation and interview, Perum BULOG Divre Jatim tends to complete the

MBA-01 documents at the end of the year, in which at the end of the year the billing process of rice subsidy to government is done. It can be seen that the percentage of MBA-01 completion is not fully 100%, 100% MBA-01 completion only happen in December, where in this month the process of document completion of the previous month also conducted.

10. Delivery Cycle Time

Delivery cycle time aims to determine the supply chain performance regarding the on time delivery. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of delivery cycle time indicator are provided in Table 5.19.

Table 5. 19 Delivery Cycle Time Properties

Category	Lower is Better
Unit	Days
Source of Data	Date of Delivery Order Released and Date of BAST
Period	Monthly
Formula	*MAX {[Resources & Determine Delivery Date Cycle Time* *+ (Consolidate Orders Cycle Time + Schedule Installation Cycle Time) +* *Build Loads Cycle Time* *+ Route Shipments Cycle Time* *+ Select Carriers and Rate Shipments Cycle Time], Receive Product from Source Cycle Time}* *+ Pick product Cycle Time + Ship Product Cycle Time* *+ (Receive & Verify Product Cycle Time)*

Delivery cycle time is measured by using delivery order release date and the latest date of BAST or *Berita Acara Serah Terima* submitted to the warehouse from February 2015 until December 2015, which is shown in Table 5.20.

Table 5. 20 Delivery Cycle Time February 2015-December 2015

No	Month	Target (Days)	Delivery Cycle Time (Days)
1	February	30	60
2	March	30	35
3	April	30	34
4	May	30	37
5	June	30	32
6	July	30	35
7	August	30	49
8	September	30	55
9	October	30	42
10	November	30	31

No	Month	Target (Days)	Delivery Cycle Time (Days)
11	December	30	34

Delivery cycle time is used to measure the average time needed to perform distribution activity from the beginning till the end. The distribution process of subsidized rice starts by releasing delivery order which is performed by Perum BULOG Divre Jatim to warehouse office and ends by submitting BAST which is Berita Acara Serah Terima, document that needed after distributing the rice to the distribution point, to the warehouse officer. The data shown in table 5.20 is the recapitulation of the delivery cycle time for each period. The delivery cycle time is the result in a reduction of the delivery order released date and the latest date of BAST document that submitted to the warehouse per each month.

11. Inventory Turnover

Inventory turnover indicator aims to measure the efficiency of Perum BULOG Divre Jatim in the management of its assets. Each indicator has properties that contain the indicator category, units of measurement, source of data, the measurement period and measurement formula, the properties of inventory turnover indicator are provided in Table 5.21.

Table 5. 21 Inventory Turnover Properties

Category	Higher is Better
Unit	Ratio
Source of Data	Inventory Warehouse Report
Period	Monthly
Formula	$\frac{Cost\ of\ Goods\ Sold}{(Beginning\ Inventory + Ending\ Inventory)/2}$

Inventory turnover ratio is measured by using the data that consist of beginning-ending stock, input-output and amount of loss product from warehouse report for period February 2015 until December 2015, which is shown in Table 5.22.

Table 5. 22 Inventory Report January – December 2015

No	Month	Beginning Stock (Ton)	Input (Ton)	Output (Ton)	Loss (Ton)	Ending Stock (Ton)	Inventory Turnover
1	January	93,828	0.00	0.00	0.00	93,828.00	0.000
2	February	93,828.00	8.92	0.00	0.00	93,836.92	0.000
3	March	93,836.92	1,784.79	1,823	0.00	95,619.89	0.019
4	April	95,619.89	6,998.15	1,053	0.00	102,616.98	0.010
5	May	102,616.98	31,364.00	994	0.00	133,979.99	0.007
6	June	133,979.99	5,357.93	1,246	0.00	139,336.67	0.009
7	July	139,336.67	3,668.63	1,084	0.00	143,004.22	0.008
8	August	143,004.22	7,614.49	757	0.00	150,617.96	0.005
9	September	150,617.96	2,775.34	962	0.00	153,392.34	0.006
10	October	153,392.34	1,872.54	1,000	0.00	155,263.88	0.006
11	November	155,263.88	1,674.13	1,492	0.00	156,936.51	0.010
12	December	156,936.51	1.19	1,467	0.00	156,936.24	0.009

Inventory turnover indicator is needed by Perum Bulog to determine the existing assets turnover of Perum BULOG, in this case is the subsidized rice turnover. It is known that BULOG tend to store the subsidized rice in a long period of time which holding the inventory too long will increase the inventory holding cost, overhead cost and decrease the profitability of the company. Table 5.22 shows the beginning and ending stock of subsidized rice following with the input from rice provision and output from rice distribution.

5.1.2 Results of Perum BULOG Overall Supply Chain Performance

This sub-chapter is consist of existing supply chain performance measurement. The measurement process for each indicator is conducted based on the source data and formula that have been determined in previous sub-chapter. Table 5.23 is the result of supply chain performance measurement in Perum BULOG Divre Jatim.

Table 5. 23 Perum BULOG Divre Jatim Supply Chain Performance Measurement

Code	Description	Performance Accomplishment
RL 1.1	% of Order Delivered in Full	72.73%

Code	Description	Performance Accomplishment
RL 1.2	% of Accurate Procurement	90.91%
RL 1.3	Conformity of subsidized rice amount	0.86
RL 2.1	Delivery Accuracy	1
RL 3.1	Conformity of Subsidized Rice Quality	0.78
RL 4.1	Conformity of the price	0.72
RL 5.1	% of orders delivered on time	72.73%
RL 5.2	% of on time procurement	90.91%
RL 6.1	Documentation Accuracy	9.09%
RS 1.1	Deliver Cycle Time	40.3636
AM 1.1	Inventory Turnover	0.02647

The following is an example of performance calculation for % or Oder delivered in full, it is the percentage of orders which all of the items are received by customer in the quantities committed. The number of orders that are received by the customer in the quantities committed divided by the total orders. The formula to measure the percentage of orders delivered in full is given as follow:

$$\% \text{ of Orders Delivered in Full} = \frac{Total\ Number\ or\ orders\ delivered\ in\ full}{Total\ Number\ of\ Orders\ delivered}\ x\ 100\%$$

As given in table 5.2, the data of target and realization of subsidized rice distribution. The total number of order delivered in full for year 2015 is 8 out of 11. From 11 times delivery process, three distribution process on February, August and July did not fulfill the target. So the calculation of percentage of orders delivered in full is:

$$\% \text{ of Orders Delivered in Full} = \frac{8}{11}\ x\ 100\% = 72.23\%$$

The next process after obtaining the existing performance accomplishment score is scoring. Scoring process is carried out to equalize the parameter and unit among the indicators. The process of Scoring is conducted by using these following formulas:

- Higher is better

$$Higher\ is\ Better = \frac{Realization}{Target}\%$$

- Smaller is better

$$Smaller\ is\ Better = 2 - \left(\frac{Realization}{Target}\right)\%$$

The result of the Scoring produces a value that can be compared among the indicators because it has the same units and category which is the higher the better. The result of scoring calculation based on the targets is given in the table 5.24.

Table 5. 24 The result of scoring process

Code	Description	Target	Performance Accomplishment	Scoring Result
RL 1.1	% of Order Delivered in Full	100%	72.73%	72.73%
RL 1.2	% of Accurate Procurement	100%	90.91%	90.91%
RL 1.3	Conformity of subsidized rice amount	0.9	0.86	95.56%
RL 2.1	Delivery Accuracy	0.95	1	105.26%
RL 3.1	Conformity of Subsidized Rice Quality	0.8	0.78	97.50%
RL 4.1	Conformity of the price	0.8	0.72	90.00%
RL 5.1	% of orders delivered on time	100%	72.73%	72.73%
RL 5.2	% of on time procurement	100%	90.91%	90.91%
RL 6.1	Documentation Accuracy	100%	9.09%	9.09%
RS 1.1	Deliver Cycle Time	30 days	40.3636	65.45%
AM 1.1	Inventory Turnover	2.75	0.02647	0.96%

The following is an example of Scoring calculation for % or Oder delivered in full which includes in the higher the better category and delivery cycle time which includes in the smaller the better category. The Scoring process for the higher the better category is given as follow:

$$\%\ of\ Order\ delivered\ in\ full = \frac{Realization}{Target}\% = \frac{72.73\%}{100\%} = 72.73\%$$

While the Scoring process for the smaller the better category is given as follow:

$$Delivery\ Cycle\ Time = 2 - \left(\frac{Realization}{Target}\right)\% = 2 - \left(\frac{40.36}{30}\right)\% = 65.45\%$$

After obtaining the Scoring result the next step will be conducting an aggregate performance calculation which is the calculation that produce supply chain performance of Perum BULOG Divre Jatim as a whole company. The

formula used to calculate the overall supply chain performance of Perum BULOG Divre Jatim is given as follows:

$$Overall\ Supply\ Chain\ Performance = \sum_{a=1}^{n}(normalization\ result\ of\ indicator\ a\ x\ weight\ a) + \cdots + normalization\ result\ of\ indicator\ n\ x\ weight\ n)$$

Table 5.25 shows the recapitulation of weight for each indicators that have been determined in sub-chapter 4.4 and also the result of multiplication between the Scoring result and the weight of each indicator.

Table 5. 25 Overall Supply Chain Performance of Perum BULOG Divre Jatim 2015

Code	Indicator or Attributes	Weight	Performance Accomplishment	Score
RL 1.1	% of Order Delivered in Full	0.225	72.73%	16.36%
RL 1.2	% of Procurement in Full	0.058	90.91%	5.23%
RL 1.3	Conformity of subsidized rice amount	0.025	95.56%	2.37%
RL 2.1	Delivery Accuracy	0.085	105.26%	8.92%
RL 3.1	Conformity of Subsidized Rice Quality	0.290	97.50%	28.32%
RL 4.1	Conformity of the price	0.025	90.00%	2.26%
RL 5.1	% of orders delivered on time	0.019	72.73%	1.37%
RL 5.2	% of on time procurement	0.019	90.91%	1.71%
RL 6.1	Documentation Accuracy	0.041	9.09%	0.37%
RS 1.1	Deliver Cycle Time	0.129	65.45%	8.44%
AM 1.1	Inventory Turnover	0.085	0.96%	0.08%
Total		**1.000**		
Aggregate Performance of Perum BULOG Divre Jatim Supply Chain				**75.45%**

5.2 Evaluation of Perum BULOG Supply Chain Performance

Supply chain performance evaluation explains about the identification of performance indicator and the measurement of the existing supply chain performance at Perum BULOG Divre Jatim.

5.2.1 Perum BULOG Supply Chain Performance Evaluation

According to sub-chapter 5.1.2, the aggregate supply chain performance value of Perum BULOG Divre Jatim is 75.45%. The highest contribution is given by the conformity of the subsidized rice quality for 28.32% and followed by orders delivered in full with 16.36%. The high contribution that given from both the indicators are affected by the large portion of weights for both indicators. Inventory

turnover contributes more or less of 0.08%, which is the lowest contribution that given compare to other indicators.

Overall performance results cannot be separated from the contribution of every indicators that support it. In the percentage of accurate procurement and the percentage of on-time procurement. The procurement realization of February-December 2015 is shown in figure 5.2, it can be seen that the graph is fluctuated with increasing trend. Eleven times procurement activity within a year, the % of procurement in full is 90.91% with exception of December procurement that did not fulfill the target. The procurement of medium rice is dedicated not only for raskin program but also for market operation. Based on information obtained from Bulog, Perum Bulog conducted a continuous procurement along the year. In addition, based on Perdum Raskin Perum Bulog is required to receive rice from local farmers as much as possible to avoid import activity. The target set by Perum BULOG Divre Jatim was fluctuate, this happened because of differences in harvesting time and demand for each month. In the data, there was dramatically rose in procurement target for May, it happened because of demand increased ahead of Ramadhan and Eid al-fitr, which falls on June-July 2015. The majority of the rice were used in market operation to stabilize the rice price. In December, it can be seen that the procurement rate is drastically decreases, this happened because Perum BULOG Divre Jatim decided to stop the procurement activity because the procurement target was fulfilled.

The on-time procurement was determined based on the procurement realization, the procurement is categorized as on-time procurement if MKP or SATGAS Pengadaan are able to deliver the rice provision in accordance with the target and the time period. The on-time procurement activity was conducted for the entire year except in December, which in December Perum BULOG Divre Jatim could not fulfill the procurement target within the time range that had been set.

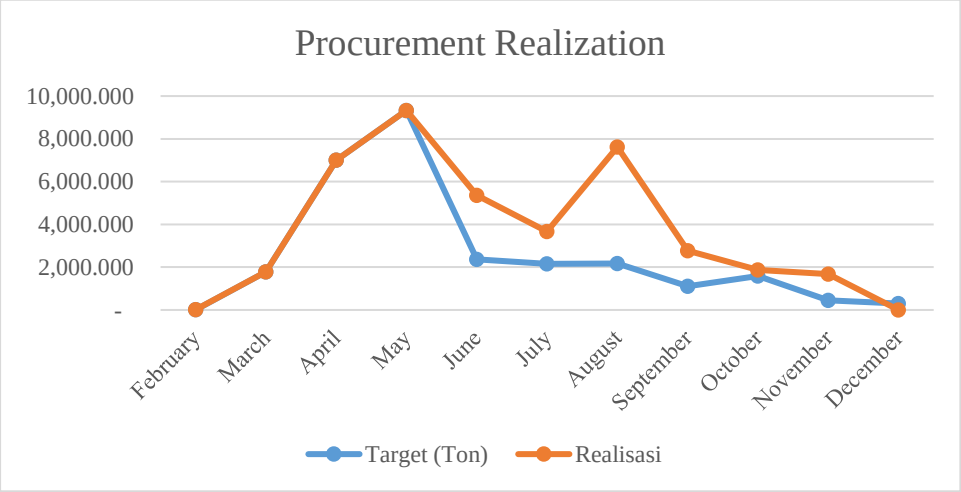

Figure 5. 2 Graphic of Procurement Realization

The percentage of Orders Delivered in Full indicator aims to determine the supply chain performance regarding order fulfillment in the right quantity. The graphic of distribution realization is shown in figure 5.3, the figure shows the fluctuated trend of distribution realization. 72.73% is the score of percentage orders delivered in full which indicates that there are several orders that did not fulfill the demand or target. For year 2015, there is no data regarding the activity of both procurement and distribution in January. Based on the interview conducted with Perum BULOG Divre Jatim the distribution of year 2015 was started at February to distribute the rice of January and February quota, it was happening because in 2014, Perum BULOG Divre Jatim distributed extra subsidized rice which is called as *beras ke-13 dan ke-14*, this extra quota works the same way as 13th month salary and given occasionally. The distribution of *beras ke-13 dan ke-14* finished at the end of January, which makes the distribution of January quota are pushed alongside February and March quota. Based on the data, there were several times Bulog did not distribute the rice in accordance with the monthly target, such in February, August and September. In another hand, there were also several times that Bulog distributed more than it monthly target which the rice excess were dedicated to fulfill the previous target.

The on-time delivery aims to determine the supply chain performance measurement to fulfill on time objective. Works almost the same way as the on-time procurement, the distribution is categorized as on-time delivery if Perum

Bulog is able to deliver the subsidized rice to the distribution point in accordance with the target and the time period. Based on observations and interview conducted with Perum BULOG representatives, problems such as delay in issuing delivery order and inadequate transportation to distribute the subsidized rice become the main factor that causing delays in delivery process. There is issue which say that the delay in distribution process due to lack of rice stock owned by Perum BULOG Divre Jatim, but this issue can be disproved by the provision and inventory data which states that Perum BULOG Divre Jatim rice stock are available more or less for the next 5 months.

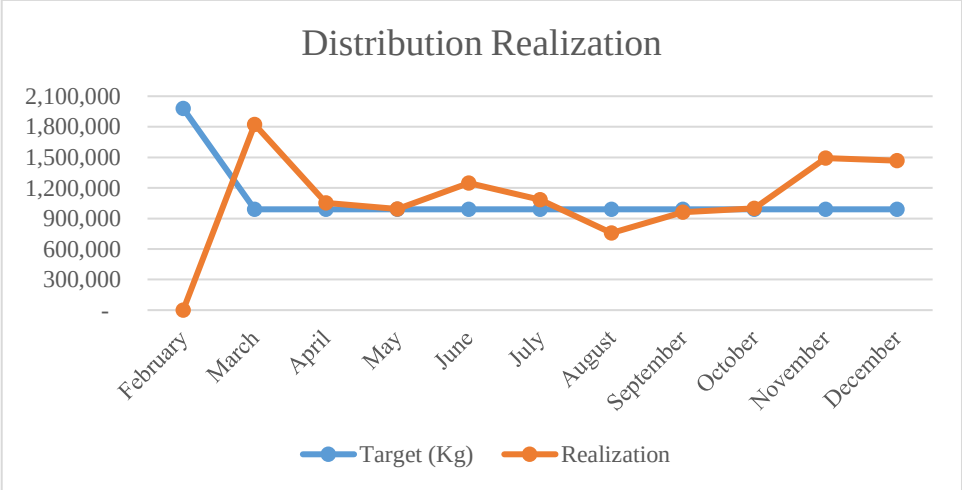

Figure 5. 3 Graphic of Distribution Realization

The complete documentation contributes 9.09% to the overall supply chain performance measurement. Documentation accuracy indicator aims to determine the supply chain performance regarding the complete administration objective. Figure 5.4 shows the percentage of complete documentation, the complete documentation is represented by document MBA-01. MBA-01 is a document that consist of BAST, *nota timbang* and LHPK or *Lembar Hasil Pengecekan Kualitas.* MBA-01 document will be used for billing toward government regarding the rice subsidy. Based on the observation and interview, Perum BULOG Divre Jatim tends to complete the MBA-01 documents at the end of the year, in which at the end of the year the billing process of rice subsidy to government is done. It can be seen that the percentage of MBA-01 completion is not fully 100%, 100% MBA-01

completion only happen in December, where in this month the process of document completion of the previous month also conducted.

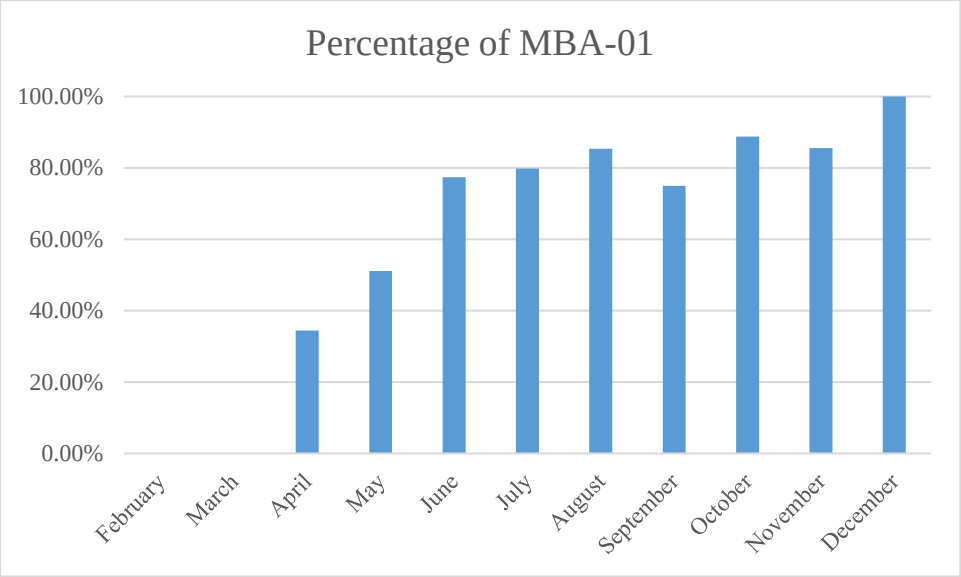

Figure 5. 4 Percentage of MBA-01 Chart

Conformity ratio is an indicator requested by Perum BULOG Divre Jatim to fulfill the objectives of delivery subsidized rice with the right quality, quantity, price and place. This conformity ratio used to be performed around 5-6 years ago where the result indicates that there were no significant uniformity for those four categories, but after the ratio measurement were stop performed there were a lot of issues regarding the quantity, quality, and price conformity. The conformity ratio data is obtained by using questionnaire that consist of four questions with two answer, either yes or no.

Rice quantity conformity contributes 2.37% for the overall supply chain performance, the result of 50 questionnaires show 95.56 % respondents said that the quantity of subsidized rice they receive each month is 15 kg. Conformity of subsidized rice quantity aims to determine the supply chain performance that will fulfill right quantity objective. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on quantity goal. This indicator also used as a detector of circulating issue regarding the amount that received by RTS-PM. The issue that emerged lately is several non RTS-PM receive Raskin quota causing the original RTS-PM receive less than 15 kilos of subsidized rice. The result of this survey will be considered to generate improvement

recommendation. 43 out of 50 surveys stated that the subsidized rice amount for each RTS-PM is conform to the quality that has been set by Perum BULOG based on Perdum Raskin 2015 which is 15 kg. In another hand, 7 surveys stated that the amount of rice received by RTS-PM is not 15 kg. According to the one of correspondent said that the family only receive 13 kg per month because the 2kg which taken are collected and distributed to other poor families that have not been registered yet.

Delivery accuracy contributes 8.92% for the overall supply chain performance, the result of 50 questionnaires show 100% respondents said that they always take the subsidized rice in the designated place. Delivery accuracy rice aims to determine the supply chain performance that will fulfill right target objective. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on target goal. This indicator also used as a detector of circulating issue regarding the inaccuracy of the rice distribution that will affect in additional redeem price. Based on interviews with the Bulog representatives, there are some cases where the distribution process is hampered by the switched goods, as example the items that should be distributed to the district Sukolilo switched with Mulyorejo districts. Because the amount of goods received do not match the initial amount, satgas raskin has to return the subsidized rice and wait for another distribution which led to increased distribution costs and delay in rice distribution.

Subsidized rice quality conformity contributes 28.32% for the overall supply chain performance which is the highest among others indicators, the result of 50 questionnaires show 97.50 % respondents said that the subsidized rice they receive each month has decent quality. Conformity of subsidized rice quality aims to determine the supply chain performance that will fulfill right quality objective. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on quality goal. There are several issues regarding the quality of subsidized rice these days such as there are a lot of *beras patah,* fleas, has yellowish color and unpleasant odor. Based on observation and interview results, it is happen due to long saving time in the warehouse. According to Mr. Pras, Bulog representative, Perum BULOG has a policy that obligate it to have safety stock at least for the next 4 months.

Subsidized rice price conformity contributes 2.26% for the overall supply chain performance, the result of 50 questionnaires show 90 % respondents said that the redeem price for 1kg or rice is Rp1.600,00 which is in accordance with the HT or *Harga Tebus* that has been determined in Perdum Raskin 2015. Conformity of subsidized rice price aims to determine the supply chain performance that will fulfill right price objective. This indicator is needed to measure the performance of Perum BULOG Divre Jatim in achieving right on price goal. Based on the Perdum Raskin 2015, the redeem price for subsidized rice is Rp 1.600,00 for each kg. In the field 14 out of 50 stated that they have to pay more than Rp 1.600,00 per kg, in average they have to pay around Rp 2.000,00-2.500,00 for each kg. This condition might occur because there is misappropriation of Raskin funds by local officer.

Figure 5. 5 Quantity, Quality, Price and Place Conformity Ratio

Delivery cycle time contributes 8.44% for the overall performance. Delivery cycle time aims to determine the supply chain performance regarding the on time delivery. Delivery cycle time is used to measure the average time needed to perform distribution activity from the beginning till the end. The distribution process of subsidized rice starts by releasing delivery order which is performed by Perum BULOG Divre Jatim to warehouse office and ends by submitting BAST which is *Berita Acara Serah Terima,* document that needed after distributing the rice to the distribution point, to the warehouse officer. The graphic shown in figure 5.6 is the recapitulation of the delivery cycle time for each period and its monthly

target which is 30 days. During 2015, all delivery cycle time exceed the target that has been set, this is because Perum BULOG Divre Jatim has policy to extend the distribution time for another 30 days, this policy makes room for the distribution department to have not pushed itself to reach the initial target which is 30 days. The average value of overall delivery cycle time is 40.36 days. Based on the observation conducted in Perum BULOG Divre Jatim, Distribution department release the delivery order for the next month every Monday of the 4th week of the previous month. For example, the delivery order for June is released on Monday the 4th week of May. This early release is performed by Perum BULOG Divre Jatim to avoid any delay because of error in administration. The delivery cycle time is the result in a reduction of the delivery order released date and the latest date of BAST document that submitted to the warehouse per each month.

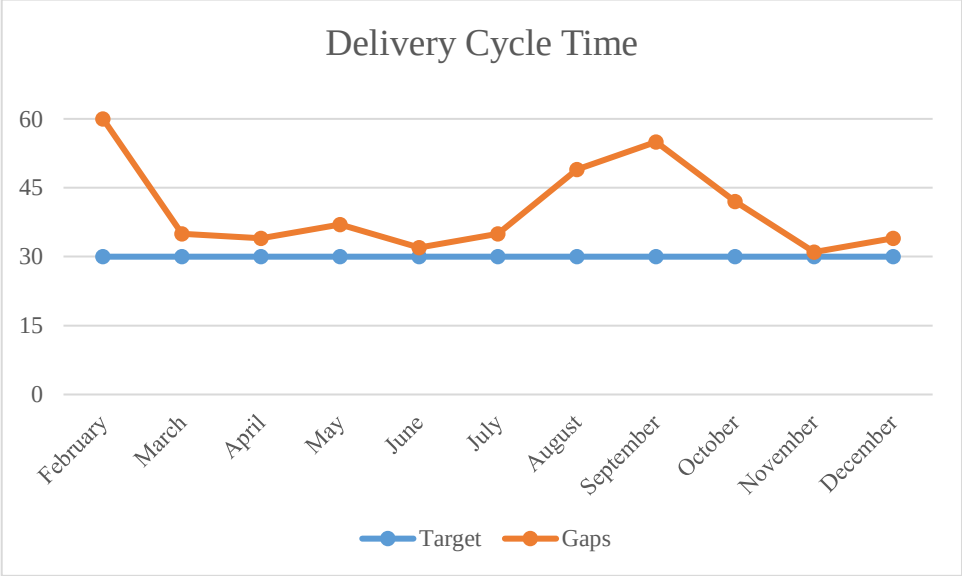

Figure 5. 6 Graphic of Delivery Cycle Time

Inventory turnover indicator aims to measure the efficiency of Perum BULOG Divre Jatim in the management of its assets. Inventory turnover indicator is needed by Perum Bulog to determine the existing assets turnover of Perum BULOG, in this case is the subsidized rice turnover. It is known that BULOG tend to store the subsidized rice in a long period of time which holding the inventory too long will increase the inventory holding cost, overhead cost and decrease the profitability of the company. Table 5.26 shows the beginning and ending stock of

subsidized rice following with the input from rice provision and output from rice distribution. The ratio inventory turnover of Perum BULOG Divre Jatim is low, it happens because of the amount of input is much higher than the amount of output number. The surplus amount of rice procurement causing longer storage time, which lead to the decreased of the quality of the rice. Perum BULOG Divre Jatim also has policy regarding the absorption of medium rice from local farmer, which also contributes in the excess amount of rice provision. Another policy or target of Perum BULOG is to have reserve stock at least for the next 4 months.

Table 5. 26 Inventory Report February-December 2015

No	Month	Beginning Stock (Ton)	Input (Ton)	Output (Ton)	Loss (Ton)	Ending Stock (Ton)	Inventory Turnover
1	January	93,828	0.00	0.00	0.00	93,828.00	0.000
2	February	93,828.00	8.92	0.00	0.00	93,836.92	0.000
3	March	93,836.92	1,784.79	1,823	0.00	95,619.89	0.019
4	April	95,619.89	6,998.15	1,053	0.00	102,616.98	0.010
5	May	102,616.98	31,364.00	994	0.00	133,979.99	0.007
6	June	133,979.99	5,357.93	1,246	0.00	139,336.67	0.009
7	July	139,336.67	3,668.63	1,084	0.00	143,004.22	0.008
8	August	143,004.22	7,614.49	757	0.00	150,617.96	0.005
9	September	150,617.96	2,775.34	962	0.00	153,392.34	0.006
10	October	153,392.34	1,872.54	1,000	0.00	155,263.88	0.006
11	November	155,263.88	1,674.13	1,492	0.00	156,936.51	0.010
12	December	156,936.51	1.19	1,467	0.00	156,936.24	0.009

5.2.2 Traffic Light System

Evaluation and analysis process can be done by using traffic light system, where the traffic light system categorizes each value of the indicator into 3 categories differentiated by color which are red, yellow and green. The benefits of categorizing indicators into these colors category is to facilitate the company in understanding and evaluating the company' supply chain performance.

The value range of each indicator is determined based on brainstorming and discussion with Perum BULOG representatives. This method or approach is

used due to limitation of the literature regarding the method of determining the range for each category in traffic light system. The range for each category is given as follow:

- Red (Score is < 60%)
- Yellow (Score is 60% < x < 85%)
- Green (Score is > 86%)

The red indicator shows the achievement of performance indicators that do not reach the target or below the target value whereas the yellow color indicates the achievement of the performance indicator is still below target but closer to achieving the target. Under these conditions the company should be careful and suggested to take action in improving the performance. Improvement can be done by finding the root causes that cause the performance indicator does not fulfill the target. Green indicator shows the achievement of performance indicators that are very close to the target, or even exceed the target.

Table 4. 5 Traffic Light System

Code	Description	Scoring Result	Traffic Light System
RL 1.1	% of Order Delivered in Full	72.73%	
RL 1.2	% of Accurate Procurement	90.91%	
RL 1.3	Conformity of subsidized rice amount	95.56%	
RL 2.1	Delivery Accuracy	105.26%	
RL 3.1	Conformity of Subsidized Rice Quality	97.50%	
RL 4.1	Conformity of the price	90.00%	
RL 5.1	% of orders delivered on time	72.73%	
RL 5.2	% of on time procurement	90.91%	
RL 6.1	Documentation Accuracy	9.09%	
RS 1.1	Deliver Cycle Time	65.45%	
AM 1.1	Inventory Turnover	0.96%	

Table 4.5 shows the result of traffic light assessment. Based on the assessment, there are two indicators that categorized in red color, three indicators that categorized in yellow color and the rests are categorized in green color. Based on this assessment, indicators that categorized in red and yellow need to be improved. The improvement analysis is conducted by using failure mode and effect

analysis and improvement suggestion based on root cause analysis in the next chapter.

CHAPTER VI
FAILURE MODE ASSESSMENT AND ANALYSIS

This chapter is consist of failure mode and effect analysis and improvement strategies. The failure mode and effect analysis describe the failure mode and effect identification, failure mode and effect assessment and analysis. While the improvement strategies section is consist of the strategy to mitigate the failure and to improve the performance of Perum BULOG Divre Jatim.

6.1 FMEA Assessment

This sub-chapter consist of failure mode and effect identification and the failure mode assessment to determine the RPN value.

6.1.1 Failure Mode and Effect Identification

The identification was performed by mapping the supply chain process using SCOR model (Source, Make, and Delivery) and the matrix or indicators that categorized in red and yellow color based on the traffic light system assessment. The list of indicators that need to be improve or categorized in red and yellow category of traffic light system is given in table 6.1.

Table 6. 1 List of Indicators that need to be improve

Code	Indicator	Performance Accomplishment	Traffic Light Category
AM 1.1	Inventory Turnover	0.96%	
RL 6.1	Documentation Accuracy	9.09%	
RS 1.1	Deliver Cycle Time	65.45%	
RL 5.1	% of orders delivered on time	72.73%	
RL 1.1	% of Order Delivered in Full	72.73%	

The failure mode and effect were derived from interview, group discussion and historical data that have been verified by Perum BULOG. The failure mode and effect identification results are the representative of the failure that could occur in the company.

Table 6. 2 Failure Mode and Failure Effect Identification

SCOR Process	Code	Metric	Failure Mode	Failure Effect
Make	AM 1.1	Inventory Turnover	Amount of rice stored in the warehouse is higher than the amount of rice that being distributed	The rice quality will be decrease
Delivery	RL 1.1	% of Orders Delivery in Full	There is an error in the preparation of SPPB and Delivery Order	Realization of Distribution is not in accordance with the targets that have been prepared
	RL 5.1	% of Orders Delivery on Time	RTS-PM is not willing to accept raskin due to quality issue	Delays in the delivery of the rice to the distribution point
			The existence of payment arrears in certain area	Delays in the delivery of the rice to the distribution point
			Inadequate transportation modes	Delays in the delivery of the rice to the distribution point
	RS 1.1	Delivery Cycle Time	Delay in issuing SPPB and DO	Delays in the delivery of the rice to the distribution point
	RL 6.1	Documentation Accuracy	BAST is not submitted to Perum BULOG Divre Jatim	The arrears payment process will be delayed
			The validity of BAST is questionable	

6.1.2 Failure Mode and Effect Assessment

The next process after failure mode and effect identification is assessment. The assessment process is conducted to obtain RPN or risk priority number which is the multiplication result of severity, occurrence and detection. The value of severity, occurrence and detection are obtained from discussions with *Kasi Pelayanan Publik* who is appointed to handle *RASKIN* program and understand the overall condition of *RASKIN* program in Perum BULOG Divre Jatim. The purpose of failure mode and effect assessment is to know what the most influential failure in company's supply chain process. The failure value was determined by looking at RPN value. The highest RPN value indicates the most critical failure.

Table 6. 3 Severity, Occurrence and Detection Score for each Failure Mode

Code	Metric	Failure Mode	Failure Effect	S	O	D
AM 1.1	Inventory Turnover	Amount of rice stored in the warehouse is higher than the amount of rice that being distributed	The rice quality will be decrease	7	5	3
RL 1.1	% of Orders Delivery in Full	There is an error in the preparation of SPPB and Delivery Order	Realization of Distribution is not in accordance with the targets that have been prepared	7	2	3
RL 5.1	% of Orders Delivery on Time	RTS-PM is not willing to accept raskin due to quality issue	Delays in the delivery of the rice to the distribution point	7	3	3
		The existence of payment arrears in certain area	Delays in the delivery of the rice to the distribution point	7	2	3
		Inadequate transportation modes	Delays in the delivery of the rice to the distribution point	7	4	3
RS 1.1	Delivery Cycle Time	Delay in issuing SPPB and DO	Delays in the delivery of the rice to the distribution point	7	3	2
RL 6.1	Documentation Accuracy	BAST is not submitted to Perum BULOG Divre Jatim	The arrears payment process will be delayed	3	2	2
		The validity of BAST is questionable	The arrears payment process will be delayed	3	5	3

The next step after scoring the severity, occurrence and detection for each failure mode is the calculation of RPN value. The RPN value is obtained by multiplying the value of severity, occurrence and detection that have been scored in table 6.3. The multiplication result or RPN value is shown in table 6.4.

Table 6. 4 RPN Value for each failure mode

Code	Metric	Failure Mode	Failure Effect	RPN
AM 1.1	Inventory Turnover	Amount of rice stored in the warehouse is higher than the amount of rice that being distributed	The rice quality will be decrease	**105**
RL 1.1	% of Orders Delivery in Full	There is an error in the preparation of SPPB and Delivery Order	Realization of Distribution is not in accordance with the targets that have been prepared	**42**
RL 5.1	% of Orders Delivery on Time	RTS-PM is not willing to accept raskin due to quality issue	Delays in the delivery of the rice to the distribution point	**63**
		The existence of payment arrears in certain area	Delays in the delivery of the rice to the distribution point	**42**
		Inadequate transportation modes	Delays in the delivery of the rice to the distribution point	**84**
RS 1.1	Delivery Cycle Time	Delay in issuing SPPB and DO	Delays in the delivery of the rice to the distribution point	**42**
RL 6.1	Documentation Accuracy	BAST is not submitted to Perum BULOG Divre Jatim	The arrears payment process will be delayed	**12**
		The validity of BAST is questionable	The arrears payment process will be delayed	**45**

6.1.3 Failure Mode and Effect Evaluation

In this subsection, the RPN values that obtained is evaluated to determine the failure rating. In the determination of the failure rating, the RPN value of the failure mode beforehand sorted from largest to smallest. In determining the categories of each failure mode whether it is categorized as high failure with high failure, medium failure, and low failure. Brainstorming, interview and discussion method are used to determine the categories. These methods or approaches are used

due to limitation of the literature regarding the method of determining the range for each category. The categories based on the RPN value are given as follow:

1. High failure: RPN 84 up to RPN 110
2. Medium failure: RPN 30 up to 83
3. Low Failure with low effect: RPN 0 up to RPN 29

The result of sorted and categorized failure mode is given in table 6.5

Table 6. 5 List of RPN Score and Category

Code	Failure Mode	RPN	Category
AM 1.1	Amount of rice stored in the warehouse is higher than the amount of rice that being distributed	105	**High**
RL 5.1	Inadequate transportation modes	84	**High**
RL 5.1	RTS-PM is not willing to accept Raskin due to quality issue	63	**Medium**
RL 6.1	The validity of BAST is questionable	45	**Medium**
RL 1.1	There is an error in the preparation of SPPB and Delivery Order	42	**Medium**
RL 5.1	The existence of payment arrears in certain area	42	**Medium**
RS 1.1	Delay in issuing SPPB and DO	42	**Medium**
RL 6.1	BAST is not submitted to Perum BULOG Divre Jatim	12	**Low**

The failure that has highest RPN value will be prioritized. Based on the FMEA assessment, there are three failure modes that will be prioritized during designing improvement strategies to mitigate the failure mode which are:

1. Amount of rice stored in the warehouse is higher than the amount of rice that being distributed
2. Inadequate Transportation Modes

6.2 Failure Mode and Effect Analysis

This sub-chapter explains the analysis and discussion of the failures that have been identified and assessed in the previous sub-chapter.

6.2.1 Analysis of Failure Identification

This section explains about the analysis of failure identification that have been identified in the previous sub-chapter. The failure identification starts by reviewing historical data of Perum BULOG Divre Jatim with an opportunity to identify the occurrence of the failure. Besides reviewing the historical data,

interview and discussion were also conducted to obtain the information needed. During the interview process not only identifying the failure but also validating the failures that have been identified. The failures are identified from the indicators that used to measure the supply chain performance. By identifying the failure of performance measurement indicators then Perum BULOG can identify kinds of failures that can affect the performance BULOG.

The failure identification is conducted by identifying the failure mode and failure effect for each indicator. The result of identification is shown in table 6.2. In table 6.1 the failure mode and failure effect is grouped based on its main activities which are source, make, and delivery. The recapitulation of failures that have been identified based on the main activity is given in table 6.6

Table 6. 6 Recapitulation of failures occurred based on the main activity

No.	Main Activity	Number of Failure Occurred
1.	Make	1
2.	Deliver	7

Table 5.26 shows that the failure often occurs in the delivery process, which is the main process of the Raskin program. There are several activities that include in delivery process such as distributing subsidized rice in full quantity and distributing rice on time. Besides identified the failures, the results of this process is the severity (S), occurrence (O) and detection (D) identification, which obtained from the discussion and interview with Perum BULOG representatives.

6.2.2 Analysis of Failure Assessment

Failure assessment carried out by using FMEA or failure mode and effect analysis method. The purpose of failure assessment by using FMEA is to know what is the most influential failure that might affect the company supply chain performance. The value of failure is obtained by determining the value of RPN or risk priority number which is the result of multiplication between severity (S), occurrence (O) and detection (D). The value of severity, occurrence and detection are obtained through the discussion and interview with Perum BULOG representatives. The failure that has highest RPN value indicates as the most critical failure that will be prioritized in designing the mitigation strategies.

6.2.3 Designing improvement strategies to mitigate the failure mode

This section will be carried out analysis of the failure mode evaluation that has been done in the previous sub-chapter and also designing the mitigation strategy. Based on the RPN calculation, there are two failure modes that categorized as high risk failure. High risk failure might interfere the supply chain performance of Perum BULOG Divre Jatim, so that Perum BULOG Divre Jatim needs a mitigation strategy for handling the potential failure that threats the company. The two failure modes that categorized as high and will be mitigated represent in table 6.7

Table 6. 7 Failure modes that will be mitigated

Metric	Failure Mode	Failure Effect	RPN
Inventory Turnover	Amount of rice stored in the warehouse is higher than the amount of rice that being distributed	The rice quality will be decrease	105
% of Orders Delivery on Time	Inadequate Transportation Modes	Delays in the delivery of the rice to the distribution point	84

Failure mitigation is expected to be recommendations and considerations for the company in the future, so that any failure can be anticipated as much as possible. Failure mitigation is the result of discussion with *Kasi Public Service, Kasi Pengadaan, Kasi Analisa Harga Pasar, Kasi Penyaluran* and warehouse officer of Perum BULOG Divre Jatim. During this stage, the identification of factors that cause failure is conducted. The identification process is conducted by using 5-whys method to find the root cause of the problem and propose improvement recommendation to mitigate the failure in the future.

1. Improvement strategies of inventory turnover

The failure mode and effect that might occur in inventory turnover indicator and the root cause of this failure is defined as follows:

Table 6. 8 Root cause analysis of inventory turnover

Failure	Why 1	Why 2	Why 3	Why 4	Why 5
The quality of the rice decreased	The storage period is too long	The number of goods procured exceeding the target	The absorption level of rice product is too high	The amount of safety stock set is too high	The uncertainty of the rice amount that will be obtained for each month

Based on the five-why analysis regarding the failure that might affect the inventory turnover, it can be seen that the failure is caused by sequential failure. The failure that might happen in the inventory turnover matric is the quality of the rice that might decreasing, it happens because the storage period is too long which is the effect of the number of goods procured that exceeding the target. The exceeding procurement is the effect of the high level of rice absorption that carried out by Perum BULOG Divre Jatim, it happens because of the amount of safety stock set by Perum BULOG Divre Jatim which is stock for at least the next four months. Perum BULOG Divre Jatim set the amount of the minimum safety stock because of the uncertainty of the rice amount that will be obtained for each month.

From the failure factors that have been identified, there are several proposal on improvement strategies, which are:

a. Coordinating with the government to re-evaluate the policy of rice absorption from the local farmer.
b. Coordinating with Perum Bulog in another divre or sub-divre to allocate the exceeding rice into their warehouse

2. Improvement strategies of on-time delivery

The failure mode and effect that might occur in on-time delivery indicator and the root cause of this failure is defined as follows:

Table 6. 9 root cause analysis of on-time delivery

Failure	Why 1	Why 2	Why 3	Why 4	Why 5

Delays in orders delivery	Bulog does not have the transportation to conduct distribution activity	Distribution process is conducted by 3PL	The performance of the 3PL does not optimal	Limited truck to distribute the goods	There are several trucks that inoperable.

Based on the five-why analysis in table 6.9, it can be seen that the failure is caused by some factors that could cause sequential failure. The failure that may happen in on-time delivery metric is delay in orders delivery which based on the root cause analysis there are several factors that causing the failure which are: Bulog does not have its own transportation to distribute the subsidized rice causing Perum BULOG to conduct the distribution process through the third party logistic, in this case is PT. Jasa Prima Logistik. During several time, the performance of PT. JPL is not optimal because of the limitation of truck that can be used, it happens because several trucks are inoperable due to damaged and old.

From the failure factors that have been identified, there are several proposal on improvement strategies, which are:

a. Coordinating with PT. JPL to have exclusive contract which is dedicated only in the distribution of subsidized rice for Raskin program. The contract can be either purchase agreement for a new truck or service priority for Perum BULOG.
b. Coordinating with PT.JPL to repair the inoperable truck.
c. Searching or selecting better third party logistic.

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CHAPTER VII
CONCLUSION AND SUGGESTION

This chapter consist of conclusions obtained from supply chain performance measurement and failure mode and effect analysis that have been done in the previous chapter. This chapter also provide suggestion for Perum BULOG DIvre Jatim to improve its supply chain performance.

7.1 Conclusion

The conclusion of this research are:

1. The supply chain performance measurement model for Perum BULOG Divre Jatim is made based on SCOR model. The indicators are identified based on the SCOR attribute, which is reliability-responsiveness-asset management, and the objectives of Perum BULOG Divre Jatim. Perum BULOG Divre Jatim has six objectives that need to be achieved which are on-time, right quantity, right quality, right price, right target and complete documentation. Based on the research conducted, there are eleven indicators that have been identified and will be used to measure the supply chain performance of Perum BULOG Divre Jatim which fulfill the objectives of Perum BULOG Divre Jatim and can be applied in Perum BULOG Divre Jatim.
2. Based on the supply chain performance measurement conducted by using eleven indicators that have been identified, Perum BULOG Divre Jatim has scored 75.45% out of 100% which is categorized in yellow according to traffic light system.
3. Based on the failure mode and effect analysis, there is two failure that categorized as high failure or critical that need to be mitigated, namely: the decreased of rice quality and delays in orders delivery. To avoid the potential failure that might affect the performance of Perum BULOG Divre Jatim, there are several improvement suggestions such as: coordinating with PT. JPL to have exclusive contract which is dedicated only in the distribution of subsidized rice for Raskin program, coordinating with the government to re-evaluate the policy

of rice absorption from the local farmer, coordinating with Perum Bulog in another divre or sub-divre to allocate the exceeding rice into their warehouse and coordinating with PT.JPL to repair the inoperable truck.

7.2 Suggestion

There are several suggestions for Perum BULOG Divre Jatim and future research.

1. Perum BULOG Divre Jatim may consider the result of supply chain performance measurement as a feedback to improve it supply chain performance.
2. In a subsequent study, improvement recommendation by using simulation and cost analysis of the failure mitigation process are suggested to give better comprehensive improvement recommendation for Perum BULOG Divre Jatim supply chain performance.

APPENDIX

Appendix A. AHP Questionnaire

KUISIONER
TINGKAT KEPENTINGAN INDIKATOR PERFORMANSI RANTAI PASOK DI PERUM BULOG DIVRE JATIM

Kepada Yth.
Bapak/Ibu/Saudara/i

Dengan hormat,

Dalam rangka melengkapi prosedur pengerjaan Tugas Akhir mahasiswa Teknik Industri ITS atas nama Profita Sari Aji dengan NRP. 2512100066 yang bertujuan untuk mengukur dan meningkat kinerja rantai pasok di PERUM BULOG Divre Jatim, saya memohon kesediaan Bapak/Ibu/Saudara/i untuk berkenan mengisi kuisioner mengenai **pembobotan tingkat kepentingan indikator performansi rantai pasok**. Atas perhatian dan kerja sama Bapak/Ibu/Saudara/i, saya ucapkan terima kasih.

Hormat Saya,

Profita Sari Aji

Data Responden

Nama : .....

Jabatan: .....

Tanda Tangan & Nama Responden

(.....)

1

Petunjuk Pengisian Kuisioner

1. Berilah nilai dengan menggunakan indikator penilaian pada tabel 1

Tabel 1 Skala Penilaian dan Deskripsi Penilaian

Nilai	Tingkat Prioritas
1	Indikator A ***sama penting*** dibandingkan dengan indikator B
3	Indikator A ***sedikit lebih penting*** dibandingkan indikator B
5	Indikator A ***lebih penting*** dibandingkan dengan indikator B
7	Indikator A ***sangat penting*** dibandingkan dengan indikator B
9	Indikator A ***jauh sangat penting*** dibandingkan dengan indikator B
2,4,6,8	Nilai Tengah

2. Contoh Pengisian Kuesioner

- Lingkarilah nilai yang menurut anda merepresentasikan tingkat kepentingan indikator rantai pasok di PERUM BULOG Divre Jatim

Indikator Performansi	Skala Penilaian																	Indikator Performansi
Reliability (Tepat Jumlah, Sasaran, Kualitas, dan Administrasi)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	(7)	8	9	Responsivenss (Tepat Waktu)

Arti tabel diatas: Indikator *responsivenss* yang mewakili tepat waktu ***sangat penting*** jika dibandingkan dengan indikator *reliability* yang merepresentasikan tepat jumlah, sasaran, kualitas, dan administrasi.

- Lingkarilah nilai yang menurut anda merepresentasikan tingkat kepentingan indikator rantai pasok di PERUM BULOG Divre Jatim

Indikator Performansi	Skala Penilaian																	Indikator Performansi
Reliability (Tepat Jumlah, Sasaran, Kualitas, dan Administrasi)	9	8	7	(6)	5	4	3	2	1	2	3	4	5	6	7	8	9	Responsivenss (Tepat Waktu)

Arti tabel diatas: Indikator *reliability* yang merepresentasikan tepat jumlah, sasaran, kualitas, dan administrasi berada diantara lebih penting dan sangat penting jika dibandingkan dengan indikator *responsiveness* yang mewakili tepat waktu.

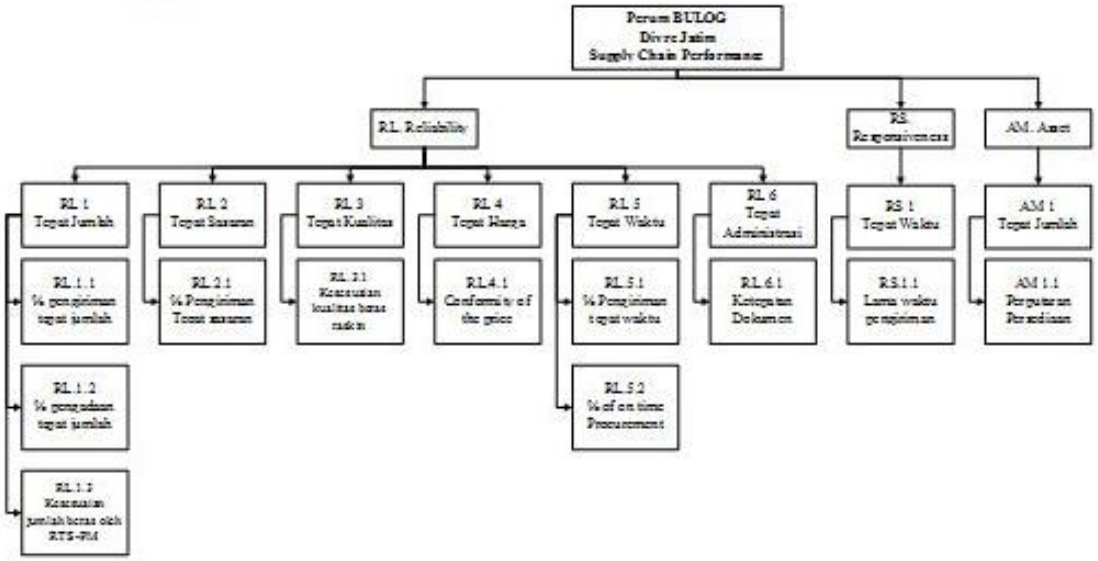

Figure 4. 1 Ilustrasi hierarki indikator dan attribut pengukuran kinerja rantai pasok

Level 0 Attribut Rantai Pasok.

Petunjuk: Lingkarilah nilai yang menurut anda merepresentasikan **tingkat kepentingan** attribut rantai pasok di PERUM BULOG Divre Jatim. Attribut yang dibandingkan adalah:

- ***Reliability*** adalah kemampuan untuk melaksanakan tugas sesuai yang diinginkan. Contoh indikator dalam attribut ini adalah *tepat sasaran, tepat kualitas, tepat jumlah dan tepat administrasi.*
- ***Responsiveness*** adalah kemampuan untuk melaksanakan tugas sesuai dengan waktu yang telah ditentukan. Contoh indikator dalam attribut ini adalah *tepat waktu.*
- ***Asset*** adalah kemampuan untuk memanfaatkan asset secara efektif dan effisien. Contoh indikator dalam attribute ini adalah *tepat jumlah-perputaran asset.*

Atribut	Skala Penilaian																	Atribut
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Responsiveness
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Aset
Responsiveness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Aset

Level 1 Indikator Rantai Pasok Tepat Jumlah, Tepat Sasaran, Tepat Kualitas, Tepat Harga, Tepat Waktu dan Tepat Administrasi.

Petunjuk: Lingkarilah nilai yang menurut anda merepresentasikan **tingkat kepentingan** indikator rantai pasok di PERUM BULOG Divre Jatim.

- **Reliability**

Indikator Performansi	Skala Penilaian																	Indikator Performansi
Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Sasaran
Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Kualitas

Indikator Performansi	Skala Penilaian																	Indikator Performansi
Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Harga
Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Waktu
Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Administrasi
Tepat Sasaran	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Kualitas
Tepat Sasaran	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Harga
Tepat Sasaran	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Waktu
Tepat Sasaran	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Administrasi
Tepat Kualitas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Harga
Tepat Kualitas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Waktu
Tepat Kualitas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Administrasi
Tepat Harga	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Waktu
Tepat Harga	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Administrasi
Tepat Waktu	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tepat Administrasi

Level 2.1 Indikator Rantai Pasok Atribut Reliability-Tepat Jumlah

Petunjuk: Lingkarilah nilai yang menurut anda merepresentasikan **tingkat kepentingan** indikator rantai pasok di PERUM BULOG Divre Jatim.

Indikator Performansi	Skala Penilaian																	Indikator Performansi
Pengiriman Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pengadaan Tepat Jumlah
Pengiriman Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Kesesuaian Jumlah beras yang diterima RTS-PM
Pengadaan Tepat Jumlah	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Kesesuaian Jumlah beras yang diterima RTS-PM

Level 2.5 Indikator Rantai Pasok Atribut Reliability-Tepat Waktu

Petunjuk: Lingkarilah nilai yang menurut anda merepresentasikan **tingkat kepentingan** indikator rantai pasok di PERUM BULOG Divre Jatim.

Indikator Performansi	Skala Penilaian																	Indikator Performansi
Pengiriman Tepat Waktu	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pengadaan Tepat Waktu

-SELESAI-

4

Appendix B. AHP Questionnaire Recapitulation

Objective	Right on Quantity	Right on Target	Right on Quality	Right on Price	On-Time	Complete Administration
Right on Quantity		8	1	8	7	7
Right on Target	1/8		1/7	3	3	5
Right on Quality	1	7		7	7	7
Right on Price	1/8	1/3	1/7		1/3	1/2
Right On-Time	1/7	1/3	1/7	3		1/2
Complete Administration	1/7	1/5	1/7	2	2	

Right on Quantity	RL 1.1	RL 1.2	RL 1.3
RL 1.1		5	7
RL 1.2	1/5		3
RL 1.3	1/7	1/3	

Right On-Time	RL 5.1	RL 5.2
RL 5.1		1
RL 5.2	1	

Appendix C. Conformity Questionnaire

SURVEI PENCAPAIAN INDIKATOR PERFORMANSI RANTAI PASOK PROGRAM RASKIN DI PERUM BULOG DIVRE JATIM

Kepada Yth.
Bapak/Ibu/Saudara/i

Dengan hormat,

Dalam rangka melengkapi prosedur pengerjaan Tugas Akhir mahasiswa Teknik Industri ITS atas nama Profita Sari Aji dengan NRP. 2512100066 yang bertujuan untuk mengukur dan meningkat kinerja rantai pasok di PT. BULOG Divre Jatim, saya memohon kesediaan Bapak/Ibu/Saudara/i untuk berkenan mengisi *survei pencapaian indikator-indikator performansi rantai pasok*. Hal ini bertujuan untuk mengukur kinerja Perum BULOG Divre Jatim dalam pelaksanaan program Raskin.

Hasil survei digunakan semata-mata untuk melengkapi pengerjaan Tugas akhir penulis dan identitas pengisi survei akan dirahasiakan. Atas perhatian dan kerja sama Bapak/Ibu/Saudara/i, saya ucapkan terima kasih.

Hormat Saya,

Profita Sari Aji

Data Responden

Kecamatan / Desa tempat tinggal:……

Tanda Tangan

(……)

1

Petunjuk Pengisian Survei

Lingkari atau Silang **SATU** Jawaban yang menurut anda dapat merepresentasikan kondisi yang sebenarnya.

1. Apakah proses penyaluran beras ***sesuai dengan waktu*** yang telah ditentukan?
   (Contoh: Beras Jatah Januari diberikan pada bulan Januari)
   a. Sesuai
   b. Tidak Sesuai……(isi perkiraan lama keterlambatan)
2. Apakah keluarga yang terdaftar dalam daftar penerima beras raskin menerima jumlah bantuan beras yang ***sesuai dengan alokasi*** pemerintah yaitu **15 kg per keluarga per bulan** selama satu tahun?
   a. Sesuai
   b. Tidak Sesuai,……(isi perkiraan jumlah yang diterima per bulan)
3. Apakah biaya untuk menebus atau membeli beras bantuan Raskin ***sesuai*** dengan pedoman umum Raskin 2015 yaitu **Rp 1,600.00 per kg?**
   a. Sesuai
   b. Tidak sesuai,……(isi dengan harga yang anda bayarkan)
4. Apakah lokasi pengambilan beras setiap bulannya ***sesuai dengan lokasi*** yang telah ditentukan pada perjanjian awal penyaluran beras?
   a. Sesuai
   b. Tidak sesuai

-SELESAI-

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CHAPTER VII
CONCLUSION AND SUGGESTION

This chapter consist of conclusions obtained from supply chain performance measurement and failure mode and effect analysis that have been done in the previous chapter. This chapter also provide suggestion for Perum BULOG DIvre Jatim to improve its supply chain performance.

7.1 Conclusion

The conclusion of this research are:

1. The supply chain performance measurement model for Perum BULOG Divre Jatim is made based on SCOR model. The indicators are identified based on the SCOR attribute, which is reliability-responsiveness-asset management, and the objectives of Perum BULOG Divre Jatim. Perum BULOG Divre Jatim has six objectives that need to be achieved which are on-time, right quantity, right quality, right price, right target and complete documentation. Based on the research conducted, there are eleven indicators that have been identified and will be used to measure the supply chain performance of Perum BULOG Divre Jatim which fulfill the objectives of Perum BULOG Divre Jatim and can be applied in Perum BULOG Divre Jatim.
2. Based on the supply chain performance measurement conducted by using eleven indicators that have been identified, Perum BULOG Divre Jatim has scored 75.45% out of 100% which is categorized in yellow according to traffic light system.
3. Based on the failure mode and effect analysis, there is two failure that categorized as high failure or critical that need to be mitigated, namely: the decreased of rice quality and delays in orders delivery. To avoid the potential failure that might affect the performance of Perum BULOG Divre Jatim, there are several improvement suggestions such as: coordinating with PT. JPL to have exclusive contract which is dedicated only in the distribution of subsidized rice for Raskin program, coordinating with the government to re-evaluate the policy

of rice absorption from the local farmer, coordinating with Perum Bulog in another divre or sub-divre to allocate the exceeding rice into their warehouse and coordinating with PT.JPL to repair the inoperable truck.

7.2 Suggestion

There are several suggestions for Perum BULOG Divre Jatim and future research.

1. Perum BULOG Divre Jatim may consider the result of supply chain performance measurement as a feedback to improve it supply chain performance.
2. In a subsequent study, improvement recommendation by using simulation and cost analysis of the failure mitigation process are suggested to give better comprehensive improvement recommendation for Perum BULOG Divre Jatim supply chain performance.

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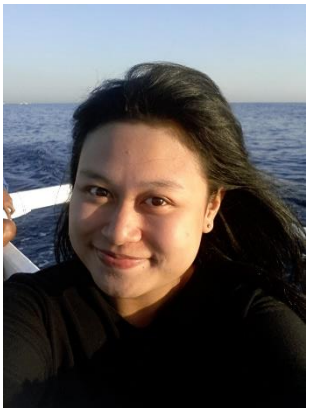
BIOGRAPHY



Profita Sari Aji was born in Surabaya, June 27th 1994. She received her formal education at SDN Kertajaya XII No. 219 from 2000-2006, SMPN 19 Surabaya from 2006-2009, and SMAN 15 Surabaya from 2009-2012. In 2012, she was accepted in Industrial Engineering Department, Institute Teknologi Sepuluh Nopember Surabaya and in July 2016 she finished her undergraduate study.

During her study, the author joined the international class for eight semesters. She also enrolled as the staff of education and welfare department during her second year, and become the vice president of Industrial Engineering Youth Club in her third year. The author can be contacted by email in: profitasariaji@ymail.com