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The Performance of the Supply Chain of Arabica Coffee Processing Business (Case Study: Kintamani Arabica Coffee Processing Business, Bangli Regency, Bali Province)

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Abstract: Arabica Coffee is one of Bali's primary products in trade activities, both foreign and domestic. The rise of the downstream coffee industry has resulted in an increasing demand for Arabica coffee. Balinese Arabica coffee processing businesses are required to be able to compete by strengthening their supply chains. Changes in the very dynamic business situation require coffee processing businesses to be able to adapt and take adjustment steps. For this reason, evaluations related to supply chain performance must be carried out consistently. This study aims to evaluate the performance of the Kintamani Bali Arabica coffee supply chain. The research approach utilised a quantitative survey method. The research informants used were 55 people, consisting of farmers, agricultural extension workers, coffee processing businesses, coffee shops, and academics. The data was analysed using *the SCOR (Supply Chain Operation References*) approach and *the Analytical Hierarchy Process (AHP) method*. The results of this study obtained as many as 49 validated key performance indicators. The results of the measurement of the performance of the Kintamani Bali Arabica Coffee processing business supply chain showed a result of 84.97%, with a good category. It is hoped that the coffee processing business will be able to improve the performance of the supply chain in the plan process, through improving the information system by continuously recording, and deploying workforces that have expertise in business information documentation activities.

Key words: supply chain, Arabica Coffee, Kintamani, *SCOR*

BACKGROUND

Kintamani Bali Arabica Coffee is one of the main agricultural products of the Province of Bali. This coffee is also one of the agricultural products that has been registered as a geographical indication product since 2008. The uniqueness of Kintamani Bali Arabica Coffee lies in its distinctive taste, which is citrus-scented. This flavour is widely loved by coffee lovers both abroad, domestically, and locally in Bali. Kintamani Bali Arabica Coffee has the potential to continue to be developed.

Good market potential does not necessarily make the Balinese coffee industry, especially for Arabica Coffee, able to compete with other Arabica Coffee. According to BPS Bali (2023), the production of Bali Arabica Coffee in 2021-2023 is 3983 tons, 3892 tons, and 3644 tons, respectively. The production in 2022 decreased by 2.28% from 2021 and production in 2023 decreased by 6.37% from the previous year. This picture shows that there is a tendency for Arabica Coffee production in Bali Province to decrease. This has a bad impact on the sustainability of the Bali Arabica Coffee industry.

The excellence is not only seen from the quantity but also from the quality. According to Yadessa et al (2020), the main factor that affects the quality of Arabica coffee in natural coffee forests in southwestern and southeastern Ethiopia is the interaction of various natural and human factors in each area which includes agroclimatic, soil conditions, site height, cultivation techniques, coffee picking process, and coffee handling. In line with this, the results of Deribe's (2019) research stated that the factors that determine the quality of Arabica coffee in Ethiopia are genotype, climatic conditions, and soil characteristics in the area, agronomic practices, harvest methods and times, post-harvest processing techniques, sorting, packaging, storage conditions, and transportation. Viewing this, to maintain the quality of coffee, all supply chain actors have

roles and responsibilities. This is in line with the opinion of Lambert and Martha (2000) that the key to successful supply chain management comes from the important role of the relationship of cross-functional integration and marketing of the product, from production preparation, production process to product marketing to consumers. In fact, good cooperation between supply chain actors aims to satisfy consumers in terms of providing cheap products, on-time delivery, and good quality (Karuntu, et al, 2021).

On the supply chain of the Kintamani Bali Arabica coffee, the local coffee processing industry is the main point of management in the supply chain. The local Arabica Coffee processing unit in Bali processes the coffee harvest in the form of red bean. Kintamani Arabica coffee farmers do not process their crops. Farmers sell the red coffee beans harvest to collectors and local processing units in their villages. The collector traders buy coffee harvested by farmers in the MPIG area of Kintamani Arabica coffee and sell it to processing units or inter-provincial wholesalers. The processing unit sells the products produced to distributors outside the province and to local coffee shops.

The local coffee processing businesses, especially Arabica Coffee, have an important role in the Balinese coffee industry to increase the selling value of Arabica coffee. Based on the policy of Government Regulation No. 14 of 2015, the coffee processing industry is one of the priority industries that need to be developed. The National Industrial Development Master Plan 2015-2035 emphasizes the importance of increasing the competitiveness of the national coffee processing industry to be more competitive globally.

The big challenges faced in managing the coffee supply chain according to Baihaqi et al (2022) are natural and non-natural factors. According to Peluso (2023), challenges in the highly dynamic coffee industry are climate change which results in the reduction of fresh coffee production of the farmers, increasing consumer demand for environmentally friendly coffee, changes in consumer preferences, digital transformation, and changes in international and national regulations. Singh, et al. (2019) stated that in the current competitive and dynamic market conditions, the company's supply chain must be resilient.

Based on the dynamics of the external business situation, the evaluation of supply chain performance needs to be carried out continuously. Measuring supply chain performance involving many business actors (farmers, local processing units, and local coffee shops) to describe coordinating various business actors more appropriately by means of a process approach. Process performance can be measured by *the SCOR* method. The *SCOR method* has standardised parameters and metrics. It is just that the application of performance measurement based on *SCOR metrics* is not appropriate to be used in certain fields, especially in agroindustry (van Engelenhoven, et all, 2023). Viewing this, modifications to performance measurement metrics need to be made to adjust important indicators that are appropriate for the Arabica coffee processing business in the Kintamani Bali area.

Based on that, the purpose of this study is to measure the performance of the supply chain of the Kintamani Arabica Coffee processing business using the right key performance indicators (KPI). The KPI is used to measure performance which is adjusted to business conditions in Bali.

LITERATURE REVIEW

Supply Chain Management

According to Chopra and Peter (2013) a supply chain is a sequence of processes and flows that occur within and between different stages and combine to meet customer needs for a product. All supply chain processes can be classified into three macro processes based on the customers or supplier relationships or internal companies, namely (1) Customer Relationship Management (CRM): all processes that focus on the relationship between the company and its customers; (2) Internal Supply Chain Management (ISCM): all processes that occur within the company; and (3) Supplier Relationship Management (SRM): all processes that focus on the relationship between the companies and their suppliers.

As stated by Felea and Irina (2013), there are four main criteria in supply chain management (1) Management activities include planning, organizing, implementing, motivation, and control, (2) Logistics

activities include transportation, storage, inventory, and processes from preparation to customers, (3) Objectives involve added value, long-term relationships, and trust between supply chain players, (4) Supply chain actors include suppliers, producer, warehouses, stores, and other intermediaries. Similarly, Mentzer, et al., (2001) say that management in the supply chain should be seen as a traditional business function (marketing, sales, research and development, forecasting, production, procurement, logistics, finance, information technology, and customer service) that needs to be coordinated between functions within the company and across companies. According to Hugos, (2011) every company in the supply chain is obliged to make individual decisions in five main areas, namely (1) Production. This activity concerns with the smooth process of product creation, including the creation of production plans and factory capacity, the provision of raw materials and other resources, scheduling, quality control, and equipment maintenance, (2) Inventory. Inventory includes raw materials and finished products. The primary purpose of inventory is to serve as a buffer against supply chain uncertainty, (3) location. The choice of location is very important, both the location of the production/factory and the location of the storage of finished product inventory. The location chosen must be strategic, (4) Transportation. The consideration of the use of means of transportation needs to be adjusted to the purpose of the budgeting planned. The goal is whether it is maximum service or cost efficiency. Transportation by air and truck is generally faster and more reliable, but more expensive. Shipping by sea and rail is cheaper, but it requires longer transit times, and (5) Information. Right decisions can be obtained by creating good coordination between departments within the company and between companies in the supply chain. Good coordination will result in up-to-date and accurate information. The results of Prathita, et al's (2023) research show that the Arabica coffee supply chain in the Andung Tani I farmer group in Andungsari Village, Pakem District, Bondowoso Regency involves several members of the supply chain, namely farmers and farmer groups as Arabica coffee producers, collectors, wholesalers, resellers, and exporters as distributors of Arabica coffee products to end consumers.

Supply Chain Performance Measurement

The non-financial supply chain performance measurement approaches currently available can be classified into nine different types grouped according to their measurement criteria, including (1) Balance Scorecard Supply Chain, (2) SCOR Model, (3) Dimension-based measurement system, (4) *link-to-link-based* measurement system from point of origin to point of consumption, (5) perspective-based measurement system, (6) hierarchy-based measurement system, (7) function-based measurement system, (8) efficiency-based measurement system, and (9) general measurement system (Agami, et al, 2012). The results of the research of Montero, et al (2018) which aims to identify sustainable supply chain performance indicators, especially in Costa Rican coffee production, group indicators into three dimensions, namely economic, social and environmental. Performance indicators used in the economic dimension are production costs, profits, and flexibility. Performance indicators that represent the social dimension include communication (between farmers and other stakeholders), training, education, and personal skills. Performance indicators used for environmental dimensions include product quality (aspects needed to achieve quality requirements), pesticide use, storage and transportation facilities, water use, and energy utilization.

In the study of Karla, et al, (2018) it was found that 10 main performance indicators support supply chain resilience, namely capacity utilization, stock level, quality of goods delivered on time, waiting for orders, delivery time, delivery time of goods on time, efficiency of supplier delivery, rate of supplier rejection, consumer satisfaction, and rate of damage product return. Research by Riantini, et al. (2023) on Supply Chain Performance Analysis was carried out using the SCOR Method consisting of reliability, flexibility, responsiveness, and asset management. Performance measurement metrics used for reliability include: delivery performance, standard conformity, order fulfilment. The flexibility performance measurement metric is the average time that takes to respond when there is an order change without any penalty fees. Responsiveness performance measurement metrics include order fulfilment lead time and order fulfilment cycle. Asset management performance measurement metrics include *cash to cash cycle time* and daily inventory.

The SCOR model consists of five main processes: *Plan, Source, Make, Deliver*, and *Return* Processes. The model also provides performance metrics and supply chain measurement metrics. Performance attributes are supply chain criteria that allow to analyse and evaluate supply chains against other supply chains with competitive strategies. Several metrics can be used as a measure of supply chain performance (Nurhasanah, et al., 2017). The following are five *attributes of SCOR* model version 11.0: (1) *Supply Chain Reliability*: The ability of the supply chain to deliver products appropriately, in the right place, at the right time, with the right quantity and well documented, (2) *Supply Chain Responsiveness*: The speed of the supply chain in providing products to consumers, (3) *Supply Chain Agility*: The ability of the supply chain to respond to market changes in an effort to win market competition, (4) *Supply Chain Cost*: The costs related to supply chain operation, and (5) *Supply Chain Asset*: Management of the value of the effectiveness of an organization to manage its assets, and to support demand satisfaction. This includes *fixed capital* and *working capital*.

Novi and Sriati's (2021) research on the performance of the people's coffee supply chain in Empat Lawang Regency began by observing at level-1 business processes including *plan, source, make, delivery*, and *return*. Level-2 performance attributes are represented by level-2 processes, namely *Reliability, Responsiveness, Agility, Cost,* and *Asset*. The level-3 performance indicator matrix is represented by order fulfilment, delivery quantity accuracy, perfect condition order, order fulfilment cycle time, packaging cycle time, delivery scheduling cycle time, processing cycle time, upper supply chain adjustment, lower supply chain adjustment, upper supply flexibility, labour cost, production cost, shipping cost, cash cycle time, debt repayment duration, and debt receipt duration.

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There are 24 indicators of the performance of the Liberica coffee supply chain in North Kayong Regency. Coffee supply chain indicators consist of on-time order fulfilment, order payment time, customer complaint rate, damage/defect-free, conformity with quality standards, raw material fulfilment time, production time, storage time, transportation time, packaging time, delivery time, unexpected alternatives, supplier availability, product setup flexibility, product cost, raw material cost, purchase cost, order acceptance cost, transportation cost, sales costs, the range of debt payment days, the range of receivables payment days, the amount of inventory, and the duration of the provision (Hilma et al., 2023).

METHODOLOGY

1. Research Location and Time

The object of this research is the actors in the supply chain of Kintamani Arabica Coffee production in partnership relationships spread across the Bali region. The main point of this research is the Kintamani Arabica Coffee Product Processing Unit under the supervision of the Bali Provincial Trade and Industry Office and located in Kintamani District, Bangli Regency. The selection of the location of this research was chosen purposively with the consideration that the main producer of Arabica Coffee (cherry coffee) in Bali is Kintamani District, Bangli Regency.

The observations were carried out from July to August 2023, adjusted to the harvest time of Arabica coffee. The data collection was carried out from February to May 2024, to measure the performance of the supply chain for the 2023 harvest period.

2. Data Collection and Research Informants

This research focuses on measuring the performance of internal processes of the supply chain of the Kintamani Bali Arabica Coffee processing business. The observation method was carried out to observe the internal process (SCOR) that occurred at the level of the local processing unit of Kintamani Arabica coffee. The data collection was carried out by direct surveys through interviews with research informants. The research informants were from academics, local processing business actors of Kintamani Arabica Coffee, Kintamani Arabica Coffee farmers, field extension officers, coffee shop business actors. The research

informants are limited to the Bali Province area considering the growing development of the domestic target market. The number of research informants used can be seen in Table 1

Table 1.

Stages of research	Research Informant				
	Arabica Coffee Farmer	Agricultural extension worker	Local processing business owners	Coffee shop owner	Academics
1. Identification supply chain processes	√	√	√	√	√
2. Validation of the hierarchical structure of supply chain performance measurement			√	√	√
3. Real performance measurement key performance indicators	√	√	√	√	
4. Weighting	√		√	√	√
Sum	30	5	5	10	5
Total research informants					**55**

Table 1 shows the total number of research informants was 55 people out of a target of 170 people (32.35%). The farmers used as research informants are the managers of farmer groups that cultivate dryland (*subakabian*). The Kintamani Arabica Coffee processing business used in this study is a local processing unit fostered by the Bali Provincial Industry and Trade Office, which is still actively operating, and willing to provide information. The coffee shop owners who are used as the research informants are consumers recommended by a local processing business and are willing to provide information for this study. The academics used in this study are coffee researchers and lecturers of supply chain management courses in the last five years.

The instruments used in this study include: a. Interview guidelines were used to collect data related to the identification of SCOR-based supply chain processes that occurred in the supply chain of the local processing business of Kintamani Arabica Coffee; b. closed questionnaires were used to validate parameters and K PI on performance measurement. Closed questionnaires are also used to weighting supply chain performance; c. Open questionnaires are used to input quantitative data on KPI performance measurement at level-3. This measurement is to determine the performance of reliability, speed, flexibility, cost, and asset management in the planning, resource procurement, production (make), and distribution (deliver).

3. Data Analysis

Measurement of the performance of the supply chain of the local processing business of Kintamani Arabica Coffee uses the SCOR (plan, source, make, deliver) process approach. Performance measurement parameters are latent variables including reliability, speed, flexibility, cost, and asset management. Performance parameters are measured by multiple performance metrics. The determination of performance metrics in this study uses key performance indicators (KPI) that are in accordance with local coffee processing businesses based on small and medium enterprises. The KPI used are modifications of several similar studies that have been described in the literature review that has been validated by the research informants. The KPI measurement applied ratio data.

The data analysis stage consists of determining and validating the *SCOR* process structure, KPI measurement (level-3 structure in the *SCOR* approach), weighting on the validated process structure, and measuring supply chain performance. The determination and validation of the *SCOR* process structure is

analysed descriptively by describing the supply chain processes that are formed. The KPI measurement was done by comparing real results with the targets set by business actors in the form of percentages. The weighting of the process structure was carried out by paired comparison using the process hierarchy analysis approach. Hierarchy is a representation of a complex problem in a multi-level structure where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and further down (Saaty, 2008). Supply chain performance measurement is carried out by multiplying the performance achievement by the performance weight at each level starting from level-3 to level-1.

RESEARCH RESULTS

1. Results of Identification and Validation of *SCOR* Process Structure

Based on the results of previous research, as many as 78 relevant KPI were obtained to be applied in this study. Based on the results of validation carried out by academics, local processing business actors of Kintamani Arabica Coffee, and coffee shop owners, the results of the *SCOR* process structure were obtained as seen in Figure 1 below.

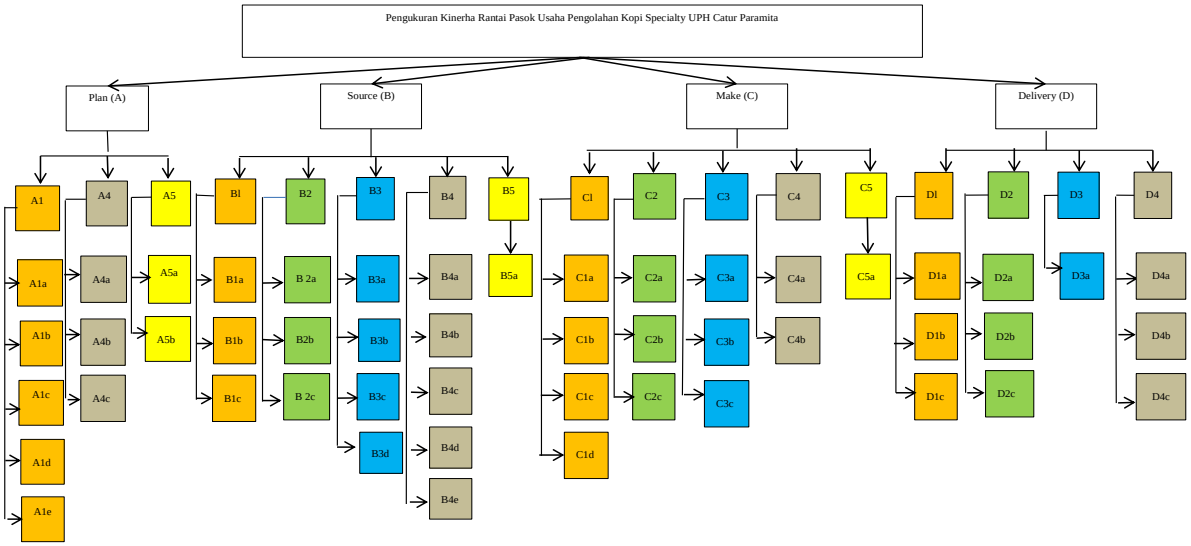

Figure 1. SCOR Process Structure Validated in the Supply Chain of Kintamani Bali Arabica Coffee Processing Business

Based on Figure 1, it can be seen that there are four main processes and 49 validated KPI. The explanation of the symbols can be seen in Appendix 1.

2. Results of Supply Chain Performance Measurement of Kintamani Bali Arabica Coffee Processing Business

Performance measurement with the SCOR approach was carried out in a structured manner consisting of three levels. Level 1 measures the performance of SCOR's key processes in the supply chain. Level 2 measures the performance of performance parameters which include reliability, responsiveness, flexibility, cost, and asset management. Level 3 measures the performance of selected and validated key performance indicators (KPI). The performance measurement mechanism starts from level 3 measurement, followed by level 2 and level 1 measurements, and finally is supply chain performance measurement. The results of the performance calculation at level 3 in the Kintamani Bali Arabica Coffee Processing Business Supply Chain can be seen in Figure 2a-2e.

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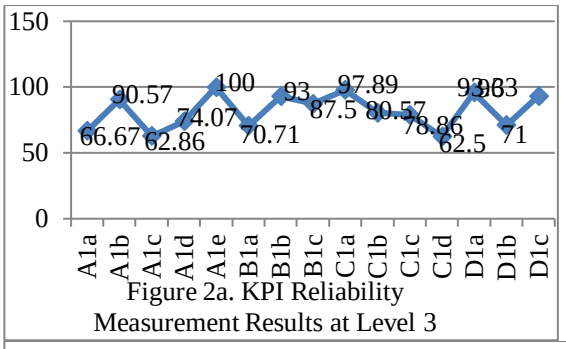


Figure 2a. KPI Reliability Measurement Results at Level 3

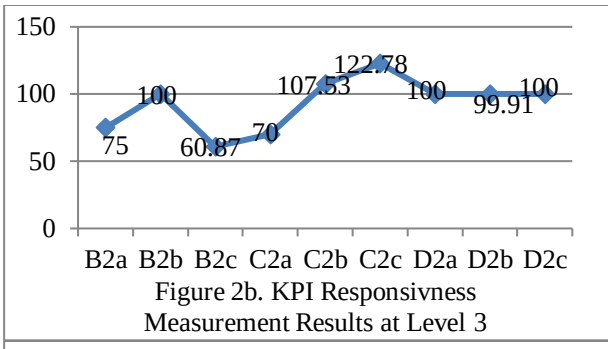


Figure 2b. KPI Responsivness Measurement Results at Level 3

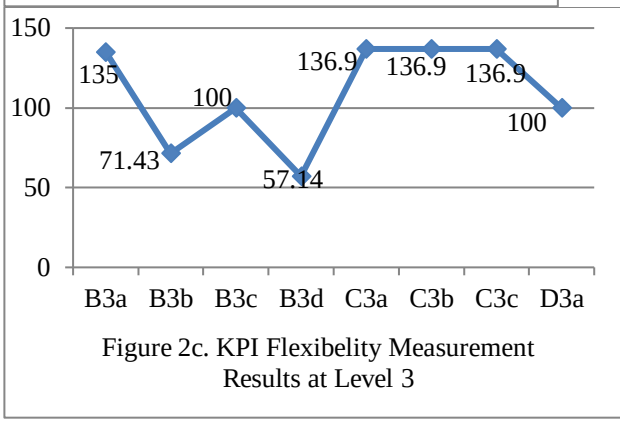


Figure 2c. KPI Flexibelity Measurement Results at Level 3

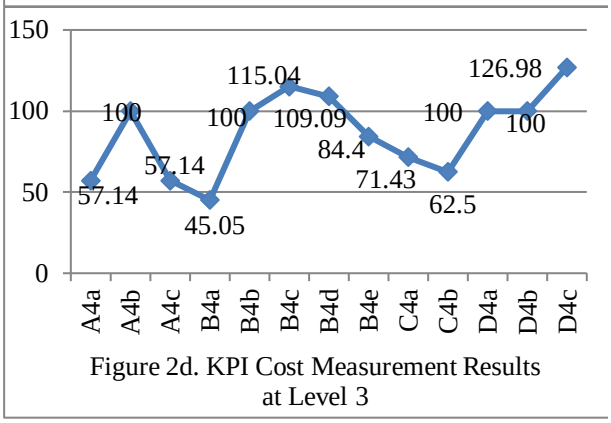


Figure 2d. KPI Cost Measurement Results at Level 3

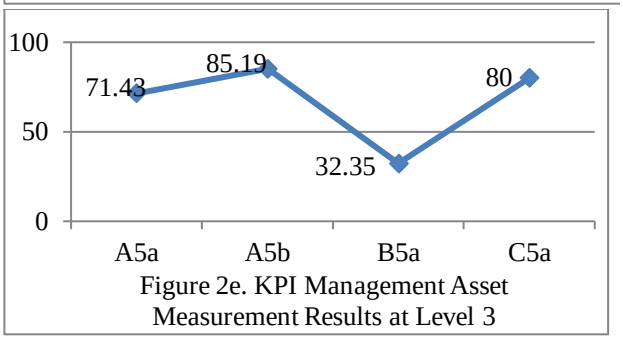


Figure 2e. KPI Management Asset Measurement Results at Level 3

Based on Figure 2a-2e, the KPI with the most reliability parameters which values are not in the good category show that performance measurement on this parameter is carried out in more detail than the other parameters.

In line with the performance measurement parameters of reliability, there are still seven KPI which values are not in the good category, namely the percentage of defective green bean coffee in one sack, the accuracy of the estimated availability of red coffee beans for production needs per year, the accuracy of customer demand estimation, the accuracy of farmers in providing red coffee beans needed by the processing unit, the accuracy of the estimated number of deliveries to customers, The delivery of products is in accordance with the quality of the products ordered by the customers, and the percentage of conformity of the resulting product quality with the quantity of the customers` order.

The results of the measurement of supply chain performance in the responsiveness parameter are three KPI that are still not in the good category. KPI is the time needed to verify the red coffee beans that enters the processing unit, the average turnover of hard skin (HS) coffee stored in the warehouse, and the time needed in the process of converting red coffee beans to HS coffee.

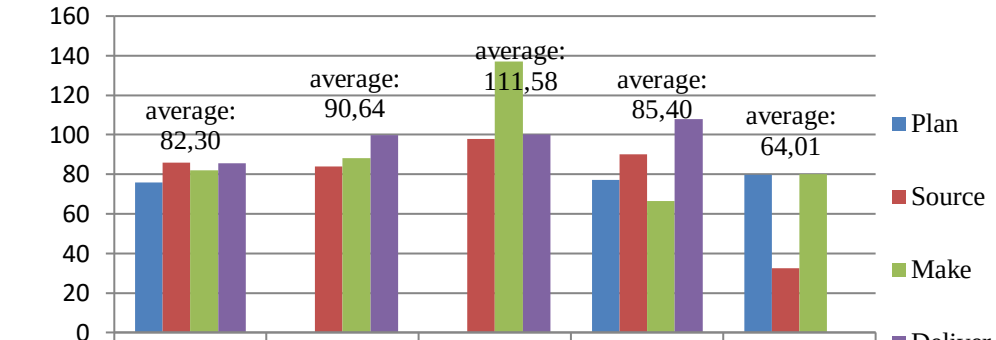
Measuring supply chain performance on the flexibility parameter resulted in two KPI that were not in the good category. The KPI that need to be improved in the flexibility parameter are the tolerance of non-

conformity of real coffee beans quality with the standards determined by the processing unit and the additional number of working hours when there is an increase in HS coffee processing.

The results of the evaluation of supply chain performance on cost parameters produced five KPI that need to be improved because their performance is still not good. These KPI include the cost of overtime labour when there is an increase in production, the additional cost of diesel fuel needed when there is an increase in engine working hours, the cost of maintaining machinery and equipment, the average value of raw materials that shrinks in the initial sorting process, and the opportunity cost due to physically defective green beans.

The measurement of the performance of the Kintamani Arabica coffee supply chain on asset management parameters shows that the results of only one KPI are not in the good category. The KPI that are not in the good category are to carry out maintenance on the machine.

The results of level 3 performance measurement are the formation of level 2 performance. Performance assessment at level 2 is the sum of the results of multiplying the KPI achievement value by its weight. The results of level 2 performance measurement can be seen in Figure 3.



	reliability	responsivnes s	flexibelity	cost	Managemen t asset
Plan	75.96	0	0	77.28	79.68
Source	85.83	83.92	97.84	89.98	32.35
Make	81.95	88.05	136.9	66.52	80
Delivery	85.44	99.96	100	107.82	0

Pigure 3. Results of SCOR Performance Measurement at Level II

The results of level 2 measurements can be seen Figure 3. Based on Figure 3, the lowest average performance value is in the asset management performance parameter (64.01), this value is in the category of poor, which needs to be addressed. The implementation of asset management in the four main processes of the supply chain of the Kintamani Bali Arabica Coffee processing business, which has the lowest performance value is source (32.35). This value indicates that the performance of the asset management parameters in the source process is very poor.

The results of level 2 performance measurement are the formation of supply chain performance at level 1, where level 1 describes the main process of the supply chain consisting of plan, source, make, and deliver. The sum of the results of level 2 performance achievements with their weights in each main process is a level 1 performance achievement, the results of the calculation can be seen in Table 2.

Based on the results of the calculation of the main process performance (level-1) of the plan, source, make, and delivery processes, the supply chain performance can then be measured. The performance value of the supply chain of the Kintamani Bali Arabica Coffee processing business is obtained from the sum of the results of level 1 performance achievements with each weight, as shown in Table 2.

Table 2.

Final Value of Supply Chain Process Performance of Kintamani Bali Arabica Coffee Processing Business

SCOR	Performance Achievement Level I	Weight	Final Score	SCOR Performance
Plan (A)	76,72	0,33	25,32	84,97
Source (B)	80,97	0,31	25,10	
Make(C)	92,18	0,22	20,28	
Deliver (D)	95,17	0,15	14,28	

The results of the level 1 performance calculation show that one main process that has not been categorized well, namely the plan process, which is 76.72% (medium category). When viewed from the level of importance according to the expert assessments, the plan process is the most important process. Based on the results of level 1 measurement, the total supply chain performance value was 84.97% (good category).

Discussion and Implications

The performance of the plan process in the supply chain of the Kintamani Bali Arabica Coffee processing business is still moderate. Almost 89% of all local processing units fostered by the Bali Regional Government carry out the planning process not based on an up-to-date information system. This is due to the weak business registration process. Access to market information is weak due to consistency and detailed recording has not been able to be implemented. This is because the availability of workers who have information documentation skills related to their processing business is not available. The workforce used in local processing units is generally coffee farmers and women living in the surrounding environment. Male workers carry out the coffee processing process and female workers do the sorting process of the green beans.

Production capacity planning is determined by the number of orders that have been placed before the harvest season arrives, the price of red coffee beans at the farmer and collector levels, and the capital power of the processing unit to pay for raw materials in cash. When the price of red coffee beans at the farmer level is low (abundant harvest), processing units can buy more raw materials. But when the price of red coffee beans is high (crop failure), the processing unit maximizes the purchase based on incoming orders and the amount of local demand served. The selling price of red coffee beans in 2023 shows a very high price level that according to farmers is very high due to a decrease in harvest quantity, which was IDR 15,000 to IDR 16,000 per kg. The climate change that occurs has a major impact on the production of Kintamani Arabica coffee plants. High rainfall during the flowering process of Kintamani Arabica coffee plants is complained by farmers as the cause of the failure of the fertilization process which has a direct impact on the reduction of crop production.

This condition causes relatively high fluctuations in production capacity. Fluctuations in production capacity that are not accompanied by certainty of demand caused by inaccurate sales information result in processing units often having more HS coffee stock. Changes in the taste market for coffee processing methods (fullwash, honey, and natural) often make processing units have a large stock of HS coffee in certain types of coffee with certain processing methods, but often lack coffee stock in certain processing methods. This results in the reliability of the process plan not being categorized as good.

The plan process is not in the good category yet, it is due to the cost planning process is not in the good category. Some of the matters that affect this include unscheduled harvest times and diesel oil scarcity. The harvest time is not properly scheduled, resulting in a wide variety of daily quantities of raw materials for red coffee beans that enter the processing unit. There are times when there is an overstock of raw materials and sometimes lack of raw materials. Over stock occurs during the period of increasing crop yields from the 2nd to the 10th harvest. Over stock has an impact on increasing labour and machine hours. Government regulations that limit the availability of diesel fuel often hamper the implementation of the production. The

scarcity of diesel oil often makes the process of peeling of the coffee beans on red beans coffee being delayed. Overtime costs due to overstock and delays in diesel fuel resulted in an increase in working hours.

The plan process in asset management also shows results that are not categorized as good because the processing unit does not assess the economic life of the equipment. The economical life of the equipment is important to know by the processor because the economic life of the equipment can affect the production cost. The life of the machine that passes its economic life will result in a decrease in quality and quantity. This condition can increase the average fixed cost of output produced. The economic life can be determined by regular observation of the machine's work. The economic life of the equipment is greatly influenced by the way the machine/equipment is used. The way in operating the equipment that are not in accordance with operational standards will shorten the economic life of the machine and equipment.

The performance of the source process has shown a good category, but there are several KPI that need to be considered because the achievement is very poor, namely the maintenance of machines and equipment. In general, the local coffee processing unit of Kintamani Bali Arabica coffee does not carry out machine maintenance according to the standard maintenance of huller and pulper machines. The equipment maintenance carried out in almost all processing units only cleans the equipment after the equipment is used. Routine preventive maintenance, such as oiling, checking bolts, changing blades, and checking the belt on the engine is rarely done. This relates to the maintenance cost of the machine that the processing unit incurs is much smaller than the standard cost of machine maintenance. The low cost of machine maintenance is not a result of the efficiency implemented by the processing unit but because it does not perform optimal machine maintenance.

The accuracy of the amount of red coffee beans that farmers can provide for the processing unit is smaller than the need for the processing unit. This is due to not all farmers sell their crops to processing units. Some farmers sell their crops to collectors. This makes the processing unit compete fiercely with collector traders. Collector traders often use local farmer labour in their business activities; therefore, the existence of farm workers becomes difficult to find and farm workers' wages become expensive. The collector traders have a great role in Kintamani Arabica coffee farmers, they provide financial assistance to farmers both for farming activities and family consumption. This makes farmers bound to collectors strongly. Collector traders also often receive coffee beans with maturity level has not met the requirements. This results in farmers picking not optimally according to the 95% maturity level. In the long term, the decline in the quality of farmers' pickings will affect the quality and taste of Kintamani Arabica coffee. In addition, the speed of verifying coffee harvested by farmers entering the processing unit becomes longer because the tolerance of colour inconsistency of red coffee beans from farmers is increasing. This tolerance was accepted by the processing unit because they did not want difficulties in obtaining raw materials.

The performance of the make process is also in the good category, it is just that there are some KPI performance that is not good. The percentage of achievement of defective green beans coffee in 1 sack (50 kg) is higher than the target. The processing unit targets the physical defect limit of green bean coffee per sack of 5% but the green bean coffee produced by the processing unit reaches 8%. The high physical defects of green bean coffee are due to several causes, including perforated green bean coffee due to pest attacks, dwarf green bean coffee beans due to a lack of nutrients in the coffee plant cultivation process, and the most common defects are broken coffee beans because the maturity level is not optimal, the moisture content level of HS coffee is less than 12% due to the scorching sun or the drying process is too long, and the operational technique of the huller engine is not appropriate. These physical defects are also caused by farmers' behaviour towards the application of appropriate technology in coffee processing, which still has obstacles in wet coffee processing methods (Ariezona, et al., 2023). The rate of defect will affect the cost of production. The higher the defect rate, the higher the average production cost. In the process of selecting quality red bean coffee at the beginning of the production process, it is known that the percentage of coffee that shrinks (7-8%) is higher than the expected target (5%).

The production process speed from red bean coffee to HS coffee is slower than the processing unit's expected target. In general, the processing unit takes time for the HS coffee making process under normal

weather conditions of about 14 days. The average production time of Kintamani Arabica coffee in the form of HS in 2023 is 20 days. This is due to the rainfall in that year is often high, therefore, the drying process is longer. Not only are farmers greatly affected by the climate, but also the Chintamani's Arabica coffee processing unit is highly dependent on the presence of sunlight in the process of drying the coffee naturally.

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Conclusion

The results of the performance assessment of the Kintamani Bali Arabica coffee processing supply chain are 84.97% (classified as good). In process measurement, there is one main supply chain process that is not yet classified as good, namely the plan process. The performance of KPI in the most reliability parameters (7 KPI) that are not categorized as good, followed by cost (5 KPI), responsiveness (3 KPI), flexibility and asset management (2 KPIs each).

Improvement in the supply chain performance in the Kintamani Arabica coffee processing business can be done by improving the process plan through improving the information recording system. Recording information will help processing business managers to find out the development of sales numbers, thus, future sales forecasting is more accurate. Processing units should be more selective in receiving raw materials therefore, the selection process can be faster. Training related to machine maintenance is important to be carried out considering that machines are one of the most important equipments to make selling products have consistent quality.

The limitations of this study have not explored much in the measurement of asset performance, especially in machine performance to ensure the quality of the coffee produced. Further research can complement the shortcomings of this research. This study has not adopted green performance measurement considering that currently the maintenance of coffee plants in the Kintamani Bali area has begun to switch to organic systems. Further research can use green performance measurement indicators based on environmental security and supply chain sustainability. In this study, the use of research informants is not widespread, only limited to customers from the Bali area. Therefore, further research needs to involve exporters so that the supply chain is fully portrayed.

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