Engineering and Technology Journal e-ISSN: 2456-3358
Volume 09 Issue 07 July-2024, Page No.- 4398-4403
DOI: 10.47191/etj/v9i07.08, I.F. – 8.227

Rice Supply Chain Performance Measurement Model Using Supply Chain Operational Reference and Data Envelopment Analysis Methods at PT XYZ

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ABSTRACT: During the covid-19 pandemic, consumer demand for product quality on production accuracy and product availability at PT XYZ has increased. Because demand from consumers is fluctuating but the company cannot meet this demand. One way to maximize supply chain performance assessment is to evaluate the performance measurement of supply chain management using the SCOR and DEA methods and assisted by LINDO 6.1 software. The results of the research, risk identification carried out using the SCOR method with five activities, namely plan, source, make, deliver, and return, obtained 22 risks that occur in the company's supply chain, each of which is divided into: 4 risks that occur in the plan activity, 9 risks that occur in the source activity, 4 risks that occur in the make activity, 3 risks that occur in the deliver activity, and 2 risks that occur in the return activity. And from data processing with the DEA method shows that the rice product that is the target of improvement is FSN Setra Wangi 5 kg (FPW017) obtained 0.8348271 or < 1 with the variable that is the target of improvement is plan. Further research is recommended to be developed by adding benchmarking so that the application of the SCOR model
can be carried out more completely. Then DEA calculations with more specific parameters so as to produce better data on each supply chain process.

KEYWORDS: Performance measurement, supply chain, Agroindustry, SCOR, DEA, LINDO.

1. INTODUCTION

Developments in the world of agro-industry often occur, making a company have to be able to adapt or adapt in order to be in harmony with other companies (Norita et al, 2023). In order to be able to compete in the development of agro-industry, companies are required to be able to know the weaknesses and advantages of each company, companies must create strategies to overcome shortcomings and show their advantages in order to compete with other companies (Satya et al. 2023). However, when the Covid-19 pandemic hit Indonesia, this had a huge impact on the agro-industrial sector, one of which was supply chain performance. One of the company's strategies is to improve supply chain management so that it can work better (APICS, 2017). During this pandemic, the government implemented several social restrictions, therefore the production sector became hampered. Quality control is no longer simply carried out using the product inspection model, but is more fundamental by looking at the process (Rully, 2020).

Currently, consumer demand for product quality, production accuracy and availability of agricultural products is increasing day by day. Because demand from consumers is fluctuating, the company cannot meet this demand because the production process takes quite a long time because the number of machines, the variety of product varieties, and the fulfillment of consumer needs are not met. Therefore, evaluation is needed to measure the value of supply chain performance. Agro-industry requires the right strategy to survive in the market. This agro-industry must have supply chain management performance to be able to orientate the goals that need to be achieved in improving business performance so that the business can survive in competition. Supply Chain Management is a unified process and production activities starting from raw materials obtained from suppliers, production processes and activities starting from raw materials to finished goods, the process of storing goods inventory to the process of sending finished goods to retailers and consumers (Sholeh et al. 2020). Apart from that, the SCOR model is also known, the SCOR (Supply Chain Operations References) model is a company's way of communicating a framework explaining the supply chain in detail, defining and categorizing the processes that build the supply chain function (Utami, 2018). Performance measurement is comparing the actual results obtained with those planned (Liputra et al. 2018). Performance measurement is needed to determine the level of achievement from time to time so that the targets that have been set can be achieved with efficient and effective use of resources (S. Azmiyati dan S. Hidayat, 2016).

PT XYZ is engaged in distribution, sales, warehousing services, warehousing in warehouse receipts, shop services, and transportation of foodstuffs (rice). Has a strategic function as a pillar of food security, a trading center for rice and staple foods in DKI Jakarta covering between regions and between islands, as well as being a government instrument for controlling rice prices in DKI Jakarta and becoming a price reference for the national rice market which will illustrate rice issues in a comprehensive manner national.

One way to maximize the assessment of supply chain performance and overall production efficiency is to carry out an evaluation by measuring supply chain management performance using the Supply Chain Operation Reference (SCOR) method. By using the Supply Chain Operational Reference (SCOR) and Data Envelopment Analysis (DEA) methods. SCOR has been developed in terms of determining work indicators for supply chain management and structured implementation by looking at customer and internal aspects of the company (Sriwana et al. 2021). According to research, SCOR can be used as a reference to determine work indicators to measure a company's supply chain performance. This can maximize production efficiency and supply chain performance. The advantage of the SCOR method is that it can be used to integrate supply chain reference frameworks for business process redesign, benchmarking, and best practice analysis (I. H. Rambe, dan M. R. Syahputra, 2017). DEA is a method that can be used to measure the comparative efficiency of homogeneous operating units such as schools, hospitals, and so on (Zai'matun, 2014). DEA functions to determine efficiency in the production process and determine improvement strategies for inefficient production processes (Ahmi et al. 2018). DEA has the advantage of accommodating many inputs and outputs in many dimensions, so that a more accurate efficiency measurement can be obtained. Previous research conducted by Dennis (2020) and Fauziah (2019) using the Data Envelopment Analysis (DEA) method obtained efficiency and inefficiency values for UPK. The results of each UPK value are the basis for making further improvements. The aim of this research is to measure the relative efficiency value in the production section.

2. METHOD

This research uses various data collection methods to obtain complete data and information. The data collection methods referred to are primary data and secondary data. Primary data was obtained directly from the company through interviews with company managers, as well as observations and surveys regarding the company's current situation. In this case, secondary data are documents and written reports available at the company and information related to company problems, namely a general description of the company including its history and development, organizational and management structure, as well as areas of activity which constitute secondary data about the company. After all the data needed to carry out the calculations has been obtained, then the data processing regarding the calculations is carried out to answer the proposed problem formulation, and data analysis.

2.1 Supply chain performance matrix processing with SCOR 12.0

Determining the attributes that influence UPK efficiency is carried out before calculating efficiency. Attribute definitions are obtained from the SCOR matrix values. The following is a performance indicator matrix based on SCOR 12.0

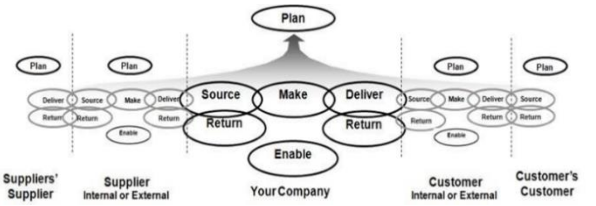

Figure 1. Management Process in the SCOR 12.0 Model
Source: SCOR 12.0 Quick Reference Guide

In the SCOR 12.0 model, performance measurement has a matrix that is used in performance evaluation (Heru, 2020). The matrix is divided into several levels that influence each other in evaluating supply chain performance (Zulfa, 2020). The matrix levels are:

a) Level 1 or what is usually called key indicators. Level 1 explains the key activities contained in the company's business processes.
b) Level 2 is the assessment criteria for level 1 matrix. Level 2 can diagnose level 1 execution performance.
c) Level 3 contains matrices that are also used to diagnose the performance of level 2 matrices.

Based on the above matrix, the SCOR model performs attribute-based studies, for example:

a) Reliability, namely the ability to carry out or complete work in accordance with previously established criteria.
b) Responsibility, namely the speed of implementation and distribution of work according to client expectations.
c) skills, namely skills aimed at adapting to changes in the external environment, such as fluctuations in market demand.
d) Assets, namely the ability to manage assets or manage expenses with income.
e) Costs, namely cost components owned by the company such as material costs, transportation and others.

Determining the characteristics that influence UPK efficiency is carried out before calculating efficiency. Attribute definitions are obtained from the SCOR matrix values.

2.2 Rice product supply chain performance

This research focuses on the performance of the rice product supply chain at PT XYZ. Performance measurements of 4 rice products were carried out in this research. These four units were then made into UPK. The resulting UPK contains: namely FSN Setra Wangi 5 kg (FPW017), FS Setra Pulen 5 kg (FSR043), FS Sego Pulen 5 kg (FSR060), FSN Setra Ramos 5 kg (FSR040).

UPK p = UPK whose efficiency will be measured
UPK i = UPK ke-i
UPK i=1= FSN Setra Wangi 5 kg (FPW017)
UPK i=2 = FS Setra Pulen 5 kg (FSR043)
UPK i=3= FS Sego Pulen 5 kg (FSR060)
UPK i=4= FSN Setra Ramos 5 kg (FSR040)

2.3 De Boer Snorm Normalization

Each performance measure has different parameter values. Therefore, normalization is carried out to equalize the performance indicator parameter values used to calculate the final value of each company's supply chain performance. Normalized values are calculated using the Snorm De Boer equation. The Snorm De Boer equation formula is:

If the measurement is larger, the better : $Snorm = \frac{(Si-Smin)}{Smax-Smin} \times 100$

If the measurement is smaller, the better: $Snorm = \frac{(Smax-Si)}{Smax-Smin} \times 100$

With ,

SI : Actual achievement of performance metrics.
Smax : Maximum performance achievement value.
Smin : Minimum performance achievement value.

Table 1. Results of Supply Chain Performance Measurement

	FSN Setra Wangi 5 kg (FPW017)	FS Setra Pulen 5 kg (FSR043)	FS Sego Pulen 5 kg (FSR060)	FSN Setra Ramos 5 kg (FSR040)
X1 (*Plan*)	11.0	22.4	16.3	11.0
X2 (*Source*)	204.7	203.1	121.2	115.3
X3 (*Make*)	141.5	61.1	150.4	117.8
X4 (*Deliver*)	132.9	52.9	124.1	82.9
Y1 (*Return*)	28.0	27.7	49.7	28.0

Source: Research

2.4 Model identification

The general equation for relative efficiency is the ratio of output to input. The DEA method that uses linear programming to measure the relative efficiency of the primary 2. Constant Return of Scale model is as follows:

Efisiensi relative Max Zp = V1pY1
U1p.X1 + U2p.X2 + U3p.X3 + U4p.X4 = 1
V1p.Y1 - U1p.X1 - U2p.X2 - U3p.X3 - U4p.X4 ≤ 0 *(DMU1)*
V1p.Y1 - U1p.X1 - U2p.X2 - U3p.X3 - U4p.X4 ≤ 0 *(DMU2)*
V1p.Y1 - U1p.X1 - U2p.X2 - U3p.X3 - U4p.X4 ≤ 0 *(DMU3)*
V1p.Y1 - U1p.X1 - U2p.X2 - U3p.X3 - U4p.X4 ≤ 0 *(DMU4)*
$y1, \geq 0$
$x1, x2, x3, x4 \geq 0$

with,

Z = Objective function
I = 1,2,3 etc. as limiting UPK
P = 1, 2, and 3 are UPK whose relative efficiency is calculated
v1 = Constants for output 1, namely the output plan data
u1 = Constant for input 1, namely source
u2 = Constant for input 2, namely make
u3 = Constant for input 3, namely deliver
u4 = Constant for input 4, namely return
Yki = Variable output to-k, from UPK to-i
Xji = Variable input j, from UPK ke-i

he above calculations were carried out for each UPK using Lindo 6.1 software to determine the relative effectiveness of each UPK and which UPKs were effective or ineffective. In the following, the dual CRS model is used:

Min Z - 0.0001O1 - 0.0001O2 - 0.0001I1 - 0.0001I2 - 0.0001I3 Subject to
V11P1 + V12P2 + V13P3 + V14P4 + V15P5 + V16P6 − O1 = V1p
U11P1 + +U12P2 + U13P3 + U14P4 + U15P5 + U16P6 − U1pZ + I1= 0
U21P1 + U22P2 + U23P3 + U24P4 + U25P5 + U26P6 − U2pZ + I2 = 0
U31P1 + U32P2 + U33P3 + U34P4 + U35P5 + U36P6 - U3pZ + I3 = 0
U41P1 + U42P2 + U43P3 + U44P4 + U35P5 + U36P6 - U3pZ + I4 = 0
P1>=0
P2>=0
P3>=0
P4>=0
O1>=0
I1>=0
I2>=0

I3>=0
I4>=0
END
FREE Z

With,
Vki = Constant for output -k, from UPK -i
uji = Constant for input -j, from UPK –i
Z = Substitute efficiency (Ø) in dual CCR formulation
Ok = Substitute the output slack variable (s_k^+) from the CCR formulation
ε = a constant whose value is very small and is a positive number between 0 -1
θ = Efficiency value
Pr = Lambda replacement r (λr) in the dual CCR formulation
Ij = Substitute the input slack variable ($sj -$) from the CCR formulation
0.01 = Small positive values between 0 to 1 (ε)

Table 2. Results of CRS efficiency values

No.	UPK	Efisiensi	Information
1	UPK 1	0.8348271	Inefisien
2	UPK 2	1	Efisien
3	UPK 3	1	Efisien
4	UPK 4	1	Efisien

Source: data processing

The VRS (Variable Return to Scale) model is the same as the CCR (CRS Dual) model, VRS calculations are carried out for each UPK so that UPKp is the UPK whose efficiency is calculated. The VRS model formulation only adds a curvature limitation function to the dual CRS formulation. The VRS formula is as follows:

Min Z - 0.0001O1 - 0.0001O2 - 0.0001I1 - 0.0001I2 - 0.0001I3 Subject to
V11P1 + V12P2 + V13P3 + V14P4 + V15P5 + V16P6 − O1 = V1p
U11P1 + U12P2 + U13P3 + U14P4 + U15P5 + U16P6 − U1pZ + I1 = 0
U21P1 + U22P2 + U23P3 + U24P4 + U25P5 + U26P6 − U2pZ + I2 = 0
U31P1 + U32P2 + U33P3 + U34P4 + U35P5 + U36P6 - U3pZ + I3 = 0
U41P1 + U42P2 + U43P3 + U44P4 + U35P5 + U36P6 - U3pZ + I4 = 0
P1 + P2 + P3 + P4 = 1
P1>=0
P2>=0
P3>=0
P4>=0
O1>=0
I1>=0
I2>=0
I3>=0
I4>=0
END
FREE Z

Table 3. CRS Dual calculation results

UPK		TE	*Slack Variabel*
UPK 1	1	1	0
UPK 2	1	1	0
UPK 3	1	1	0
UPK 4	1	1	0

Source: data processing

3. RESULT AND DISCUSSION

In SCOR data processing, at this stage there is a SCOR value of 12.0 in each calculation matrix. The data is then processed into a cumulative value for each process (Plan, Make, Source, Deliver, Enable). The results of the SCOR 12.0 calculation are obtained by identifying the UPK. This step is carried out by determining which object will be used as the UPK in the research. The UPK produced includes: FSN Setra Wangi 5 kg (FPW017), FS Setra Pulen 5 kg (FSR043), FS Sego Pulen 5 kg (FSR060), and FSN Setra Ramos 5 kg (FSR040).

Then process the data by calculating the count with Snorm de Boer so that the total score for each process can be calculated as a whole. Then the results obtained from the normalization of Snorm FSN Setra Wangi 5 kg (FPW017) on the plan variable were 11.0, source variable 204.7, make variable 141.5, deliver variable 132.9, return variable 28.0. Then, for the FS Setra Pulen 5 kg rice product (FSR043) the plan variable is 22.4, source variable 203.1, make variable 61.1, deliver variable 52.9, return variable 27.7. Then, for the FS Sego Pulen 5 kg rice product (FSR060) the plan variable is 16.3, source variable 121.2, make variable 150.4, deliver variable 124.1, return variable 49.7. And for the FSN Setra Ramos 5 kg rice product (FSR040) the plan variable is 11.0, source variable 115.3, make variable 117.8, deliver variable 82.9, return variable 28.0.

The initial CRS calculation was carried out to determine the relative efficiency value of each UPK studied. The aim is to find out which UPKs have effective and ineffective values. The initial calculation results of the CRS model were obtained by comparing the efficiency of a rice product with other rice products, using the efficiency value of other rice products as the limit for calculating the relative efficiency of the rice product. Based on calculations, the value obtained is less than 1 (not effective), namely FSN Setra Wangi 5 kg (FPW017). The efficiency value for FSN Setra Wangi 5 kg (FPW017) is 0.8348271 and FS Setra Pulen 5 kg (FSR043), FS Sego Pulen 5 kg (FSR060), FSN Setra Ramos 5 kg (FSR040) has a value of 1 which shows that the rice product It is efficient and there is no slack in the variables.

The dual CRS (constant return to scale) model is a continuation of the primary CRS, where there is no linear relationship between the output and input variables in the two CRS. The efficiency value of the dual CRS Setra Wangi FSN 5 kg (FPW017) is 0.6577910, which means the efficiency value of the CRS Setra Wangi FSN 5 kg (FPW017) is not optimal both technically and in scale. From the dual CRS calculations it is also found that the slack output value in the So1 plan is 0.022493.

The rice products FS Setra Pulen 5kg (FSR043), FS Sego Pulen 5kg (FSR060), FSN Setra Ramos 5kg (FSR040) have an effective and optimal double CRS value, namely 1 technical and scale at the same time and are not loose according to variables. The rice products FS Setra Pulen 5kg (FSR043), FS Sego Pulen 5kg (FSR060), FSN Setra Ramos 5kg (FSR040) have an effective and optimal double CRS value, namely 1 technical and scale at the same time and are not loose. according to variables. UPK with loose function results allows improvements to be made by adding or reducing the value of each UPK variable to achieve an optimal objective function based on the results of the two CRS.

The VRS model is a refinement of the dual CRS model, with the addition of a camber limiter or UPK load limiter, which represents a purely technical efficiency measure. The purpose of calculating the VRS model is to increase the validity of CRS calculations through scale efficiency (SE). VRS calculations are carried out to minimize errors in TECRS calculations, because a functioning UPK cannot work optimally due to the influence of external factors. When calculating the VRS for all rice products, none of them shows inefficiency because it has a value of 1 or optimal and the variable has no slack.

4. CONCLUSION

From the results of identifying supply chain performance criteria using the Supply Chain Operational Reference 12.0 method. From the results of initial research, risk identification was carried out using the Supply Chain Operations Reference (SCOR) method with five functions, namely. plan, source, make, deliver, and return. 22 risks that arise in a company's supply chain. each obtained is divided into: 4 risks that occur in planning activities, 9 risks that occur in source activities, 4 risks that occur in production activities, 3 risks that occur in delivery activities and 2 risks that occur in return activities.. Of the five activities, namely plan, source, make, deliver, and return, can be determined as input variables and output variables. With plan, source, make, deliver activities as input variables and return activities as output variables. Decisions are taken based on internal face variables and customer face variables.

Based on initial identification using the Supply Chain Operational Reference method, it is processed into a cumulative value for each process: Plan, Make, Source, Deliver, Return. The results of the SCOR 12.0 calculation are obtained by identifying the UPK and then processing the data to calculate the Snorm de Boer calculation, so that a composite score for each process as a whole can be calculated. Then we get the results from Snorm normalization. And data processing using the Data Envelopment Analysis method shows that the rice product that is the target for improvement is FSN Setra Wangi 5 kg (FPW017) because the value obtained is 0.8348271 or < 1 with the variable that is the target for improvement, namely plan.

Based on the results of DMU 1 data processing and analysis relative to the CRS Dual model calculations. For input variables that do not yet have optimal values, namely designing variables so that the 5 kg FSN Setra Wang rice product (FPW017) can be improved. Management must immediately improve or revise the schedule so that the expected planning process is achieved and the objectives of the schedule revision are achieved.

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