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Implementation of Collaborative, Planning, Forecasting and Replenishment (CPFR) to Reduce the Bullwhip Effect in MSME Sate Madura Cak Kholil

Hamidi Sjurahudin[1], Resista Vikaliana[2]
Institut Ilmu Sosial dan Manajemen STIAMI, Indoneisa
Correspondent : hamidisyurahudinr5@gmail.com[1], dosenresistaok@gmail.com[2]

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ABSTRACT: The aims of this study are: (1) to identify and analyze the estimated demand for chicken and goat satay products in the MSME of Sate Madura Cak Kholil; and (2) to find out the stock safety to overcome the surge inproduct demand at the MSME of Sate Madura Cak Kholil. The research method used is a descriptive method with a quantitative approach. Thesample was determined based on a non-probability sampling technique using the purposive sampling method. The data used in this study included primary data and secondary data, namely data on supply and demand for the MSME of Sate Madura Cak Kholil. The results of the study indicate that the application of collaborative planning, forecasting, and replenish menthasan effecton reducing the bullwhip effectin the MSME of Sate Madura Cak Kholil.

Keywords: bullwhip effect, MSME, CPFR

INTRODUCTION

Sate or satay is a food made from meat that is cut into small pieces and stabbed in such a way with a stick of coconut or bamboo leaf bone, then grilled using wood charcoal coals. The satay is served with a variety of spices depending on the variations in the satay recipe in different regions. Meats that are commonly used as satay include chicken, goat, lamb, beef, pork, rabbit, horse, and others. The growth in demand for more satay causes higher production of satay sales which makes entrepreneurs need forecasting accuracy to be able to predict the amount of production that must be increased in the future (Ridwan et al., 2012; Shoukohyar & Seddigh, 2020). Forecasting production sales is the basis for planning factory operations such as the preparation of work plans, production scheduling, production of raw material inventory and production control. (Lengkey et al., 2014; Ramanathan, 2014).

Supply Chain is a network of companies that work together to create and deliver a product to end users (Pujawan & Mahendrawathi, 2017). This chain is also a network of various interconnected organizations that have the same goal (Zaid et al., 2018). The essence of supply chain management is synchronization and coordination upstream and downstream (Desai & Rai,

2016). The meaning of upstream and downstream is starting from the company to the hands of consumers. This is absolutely necessary to maintain the effectiveness of a built supply chain (Yuliana & Rahayu, 2019) . In a supply chain, distortion of information often occurs, which is one source of obstacles in creating an efficient supply chain (Dai et al., 2021; Karimi & Zaerpour, 2021; Wong et al., 2020). Information about consumer demand for a product from time to time but the demand from the store to the factory is much more volatile than the pattern of demand from consumers. Demand changes to be volatile in the upstream supply chain and gets bigger, which is called the Bullwhip Effect (Pujawan & Mahendrawathi, 2017).

Sate Madura Cak Kholil is a small and medium-sized business engaged in the culinary field by providing various processed satay meats. Its products include chicken satay and goat satay. To be able to survive in the midst of increasingly fierce competition in the culinary field, the main thing that needs to be considered by entrepreneurs is how to meet consumer demand (Jabbour et al., 2020). Sate Madura Cak Kholil has 3 E-Commerce Platforms so that consumers can more easily reach products from Sate Madura Cak Kholil, namely Grab Food, Go-Food and Shopee Food.

MSME Sate Madura Cak Kholil applies production policies to supply chain actors which include supply chain structure actors, namely upstream in the form of raw material suppliers, mid stream in the form of meat processing manufacturers and down stream, namely sales shops. This study covers a discussion on the midstream to the downstream by providing products based on the number of orders at the sales store and adding 10% of the order results to anticipate a surge in demand. With an increase in orders from regional sales stores by 10%, the impact of this policy will result in overstock if demand is less than predicted at the store and result in stockout if demand is more than predicted at the store.

Previous research has shown that the Collaborative Planning, Forecasting, And Replenishment (CPFR) method can be used as a problem solving solution to reduce the bullwhip effect using the Collaborative Planning, Forecasting, and Replenishment (CPFR) method to control inventory (Saptaria, 2017). This model can help determine the amount of safety stock that must be prepared every time an order is made to the distributor more optimally by minimizing the total purchase cost, using the Collaborative Planning, Forecasting, And Replenishment (CPFR) approach to forecast product demand data and to calculate safety stock on demand (Yao et al., 2013; Zhan et al., 2020). The Collaborative Planning, Forecasting, and Replenishment (CPFR) method was used to calculate production policies in the coming year by forecasting time series to minimize the bullwhip effect (Hill et al., 2018).

Based on the description that has been stated above, it is necessary to conduct research by implementing Collaborative Planning, Forecasting, And Replenishment (CPFR) to Reduce the Bullwhip Effect in MSMEs Sate Madura Cak Kholil. By using the Collaborative Planning, Forecasting, and Replenishment (CPFR) method, a product production policy will be obtained which includes the size of the order and safety stock so as to minimize the increase in inventory in the supply chain (Chen & Romanowski, 2014; Hoogstra-Klein & Meijboom, 2021). This study aims to determine the demand forecast for chicken satay and goat satay products and to

determine the safety stock of demand to anticipate a surge in product demand at MSME Sate Madura Cak Kholil.

METHOD

This research approach uses quantitative research (Ghozali, 2016; Sugiyono, 2019). While the type of research is descriptive research (Bretas & Alon, 2021; Eksoz et al., 2014; Toufaily et al., 2013; Wang et al., 2019). The research was conducted at MSME Sate Madura Cak Kholil, using secondary data derived from data or entrepreneur records or from other sources. The secondary data in this study is the Supply and Demand Data for Sate Madura SMEs Cak Kholil for the period January to December 2020

RESULTS AND DISCUSSION

From the research, data on supply and demand were obtained at MSME Warung Sate Madura Cak Kholil from January 2020 to December 2020 in skewers.

Table 1. Supply and Demand Data on MSMEs at Warung Sate Madura Cak Kholil in 2020

Bulan	Sate Ayam		Sate Kambing	
	Supply	Demand	Supply	Demand
Januari	46.500	45.200	15.500	17.400
Februari	43.500	42.600	14.500	13.600
Maret	46.500	44.900	15.500	14.700
April	45.000	43.800	15.000	14.400
Mei	46.500	45.300	15.500	17.600
Juni	45.000	44.600	15.000	18.000
Juli	46.500	45.700	15.500	13.200
Agustus	46.500	45.100	15.500	16.400
September	45.000	43.600	15.000	12.100
Oktober	46.500	44.800	15.500	12.600
November	45.000	43.700	15.000	16.600
Desember	46.500	45.400	15.500	16.200

Based on Supply and Demand data on MSME Warung Sate Madura Cak Kholil in 2020 in Table 1 above, the next step is to process the data according to the methods and steps that have been determined. The initial step that needs to be done is to identify the bullwhip effect that occurs in the supply chain network. The first step to determine the level of the bullwhip effect is to measure the coefficient of variation of supply with the coefficient of variation of demand (Table 2).

Table 2. Data on Bullwhip Effect Value of Chicken Satay and Goat Satay

Produk	Supply			Demand			Nilai Bullwhip Effect	Keterangan
	Standar Deviasi	Rata-rata	CV Supply	Standar Deviasi	Rata-rata	Cv Demand		
Sate Ayam	313,47	45750	0,007	280,31	44.558,33	0,006	1,17	Terjadinya amplifikasi permintaan
Sate Kambing	101,78	15.233,3	0,007	55,05	12.733,33	0,004	1,75	Terjadinya amplifikasi permintaan

The next step is the selection of a forecasting method. Forecasting method is an activity carried out to be able to estimate demand for products within a certain period. Forecasting is done at different levels for each supply chain actor. The purpose of forecasting is to predict the systematic component of demand and estimate the independent component. The systematic components of the data are characterized by levels, trends and seasonal factors. The selection of the best forecasting method can be done through calculations, namely Mean Absolute Deviation (MAD), Mean Absolute Percentage Error (MAPE) and Mean Square Deviation (MSD). The research parameters are based on the minimum value of each of these error calculations. Forecasting methods used consist of Trend Linear, Moving Average, Exponential Smoothing, and Winter Model Method (Guritno et al., 2015).

Based on the forecasting that has been done, a comparison will be made between each forecast based on the error value contained in each forecast to get the best forecasting method with the smallest error value and can be seen in Table 3 below

Table 3. Forecasting Error Data using 4 Forecasting Methods

Metode	Error Peramalan			Keterangan
	MAPE	MAD	MSD	
Trend Linear	1,36747	1,73364	4,39342	Terpilih
Moving Average	1,47244	1,88148	5,96370	
Exponential Smoothing	1,71185	2,17102	6,83603	
Winter Model	7,89572	1,00926	1,49829	

Based on the above recapitulation, it can be concluded that the best forecasting method with the smallest error on the Mean Absolute Deviation (MAD), Mean Precentage Error (MAPE) and Mean Square Deviation (MSD) is to use the Trend Linear Method.

Forecasting results obtained using the Trend Linear method are massive data in the total product, so it is necessary to disaggregate to determine the number of requests for each product. The following is the calculation of the results of the demand forecast for each product:

1. Chicken Satay = Forecasting x Size Percentage

   = 127.839.394 x 70%

   = 89.487.575,8

2. Goat Satay = Forecasting x Size Percentage

   = 127.839.394 x 30%

   = 38.351.818,2

Tabel 4. Peramalan pada masing-masing produk

Month	Forecasting	IDR		Skewers Amount	
		Chicken Satay (70%)	Goat Satay (30%)	Chicken Satay (2000)	Goat Satay (3000)
January	127.839.394	89.487.575,8	38.351.818,2	44.744	12.784
February	127.919.814	89.543.869,8	38.375.844,2	44.772	12.792
March	128.000.233	89.600.163,1	38.400.069,9	44.800	12.800
April	128.080.653	89.656.457,1	38.434.195,9	44.828	12.811
May	128.161.072	89.712.750,4	38.448.321,6	44.856	12.816
June	128.241.492	89.769,044,4	38.472.447,6	44.884	12.824
July	128.321.911	89.825.337,7	38.496.573,3	44.913	12.832
August	128.402.331	89.881.631,7	38.520.699,3	44.941	12.840
September	128.482.751	89.937.925,7	38.544.825,3	44.969	12.848
October	128.563.690	89.994.583	38.569.107	44.997	12.856
November	128.643.170	90.050.219	38.592.951	45.025	12.864
December	128.724.009	90.106.806,3	38.617.202,7	45.053	12.872

Based on the forecast, the results of the demand data will be used in the future period. The forecasting results will be used to measure the occurrence of the bullwhip effect. The measurement of demand variability is as follows:

1. Calculation of the variability of demand for chicken satay after forecasting is as follows :

$$\text{CV (Supply)} = \frac{\alpha(Supply)}{\mu\,(Supply)}$$

$$\mu = \frac{\sum X\,i}{n}$$

$$\mu = \frac{(44.744 + 44.770 + \cdots + 45.053}{12}$$

$$\mu = 44.898,5$$

$$\alpha = \frac{\sqrt{\sum(xi \ldots n - \mu)^2}}{n-1}$$

$$\alpha = \frac{\sqrt{\sum(44.744 - 44.898,5)^2 + (44.770 - 44.898,5)^2 + \cdots (45.053 - 44.898,5)^2}}{11}$$

$$\alpha = 101,5$$

$$\text{CV Supply} = \frac{\alpha(Supply)}{\mu\,(Supply)}$$

$$\text{CV Supply} = \frac{101,5}{44.898,5}$$

CV Supply = 0,002

2. Calculation of the variability of demand for goat satay after forecasting is as follows:

$$\text{CV (Supply)} = \frac{\alpha(Supply)}{\mu\,(Supply)}$$

$$\mu = \frac{\sum X\,i}{n}$$

$$\mu = \frac{(12.784 + 12.792 + \cdots + 12.878}{12}$$

$$\mu = 12.828,75$$

$$\alpha = \frac{\sqrt{\sum(xi \ldots n - \mu)^2}}{n-1}$$

$$\alpha = \frac{\sqrt{\sum(12.784 - 12.828,75)^2 + (12.792 - 12.828,75)^2 + \cdots (12.878 - 12.828,75)^2}}{11}$$

$\alpha = 29.13$

$$\text{CV Supply} = \frac{\alpha(Supply)}{\mu\,(Supply)}$$

CV Supply = $\frac{\mathbf{29,13}}{\mathbf{12.828,75}}$

CV Supply = 0,002

In this study, the amount of inventory is determined based on the number of requests on the forecasting results plus safety stock. This is to anticipate an increase in demand volume and uncertainty in consumer demand.

The safety stock formulation is as follows.

Where :

Z = desired service level

LT = Lead Time (2 days)

$\boldsymbol{\alpha}$ = standard deviation of demand

Calculation of chicken satay products in January, so the value of safety stock (SS) is:

ss = $z\sqrt{\boldsymbol{LTx\alpha}}$

= $1.645\sqrt{\boldsymbol{2x101,5}}$

= 236,12 ~ 236

Calculation of goat satay products in January, so the safety stock value is:

ss = $z\sqrt{\boldsymbol{LTx\alpha}}$

= $1.645\sqrt{\boldsymbol{2x29,13}}$

= 67,76 ~ 68

After obtaining the safety stock value for chicken satay and goat satay products, then the calculation of the value of the bullwhip effect was carried out after the application of the value of the Collaborative Planning, Forcasting and Replenishment method on MSME Sate Madura Cak Kholil. The following results were obtained:

Table 7. The value of the Bullwhip Effect after the application of the CPFR method

Produk	Supply			Demand			Nilai Bullwhip Effect	Keterangan
	Standar Deviasi	Rata-rata	CV Supply	Standar Deviasi	Rata-rata	Cv Demand		
Sate Ayam	101,5	44.898,5	0,002	280,31	44.558,33	0,006	0,3	Tidak Terjadi amplifikasi permintaan
Sate Kambing	29,13	12.828,75	0,002	55,05	12.733,33	0,004	0,5	Tidak Terjadi amplifikasi permintaan

Based on the results of the research above, it is evident that the Bullwhip effect on MSMEs Sate Madura Cak Kholil can be minimized. These results are in accordance with the theory that CPFR is a supply chain implementation model in which suppliers and retailers collaborate in planning and forecasting demand which aims to ensure supply chain members get the correct amount of raw material (Desai & Rai, 2016; Galbreth et al., 2015; Makarius & Srinivasan, 2017). In accordance with previous research on CPFR implementation, it is proven that the CPFR variable can affect the risk reduction of the Bullwhip Effect (Fildes & Goodwin, 2021; Gao, 2015; Peng et al., 2014; Walker et al., 2021).

CONCLUSION

At the Sate Madura Cak Kholil UMKM which produces Chicken Sate and Goat Satay products in the January - December 2020 period before using the Collaborative Planning, Forecasting, And Replenishment (CPFR) method, the bullwhip effect value on chicken satay products is 1.17 and for the bullwhip effect value is 1.17. goat satay product is 1.75. After using the Collaborative Planning, Forecasting, and Replenishment (CPFR) method, the bullwhip effect value on chicken satay products is 0.3 and the bullwhip effect value for goat satay products is 0.5. The value of the safety stock used from the research results of the Sate Madura Cak Kholil MSME is for chicken satay products of 236 and goat satay products of 68.

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