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RAW MATERIAL INVENTORY CONTROL AT THE ROCKZ HOTDOG BUSINESS

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VIKKI

16 14 08990

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HALAMAN PENGESAHAN

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yang disusun oleh

VIKKI

161408990

dinyatakan telah memenuhi syarat pada tanggal 30 Juli 2020

		Keterangan
Dosen Pembimbing 1	: The Jin Ai, D.Eng.	Telah menyetujui
Dosen Pembimbing 2	: The Jin Ai, D.Eng.	Telah menyetujui
Tim Penguji		
Penguji 1	: The Jin Ai, D.Eng.	Telah menyetujui
Penguji 2	: Ririn Diar Astanti, D.Eng.	Telah menyetujui
Penguji 3	: Dr. T. Baju Bawono, ST., MT.	Telah menyetujui

Yogyakarta, 30 Juli 2020

Universitas Atma Jaya Yogyakarta

Fakultas Teknologi Industri

Dekan

ttd

Dr. A. Teguh Siswantoro, M.Sc

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Signature :

Student name : Vikki

Student ID : 161408990

Date : Yogyakarta, July 2020

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ABSTRACT

Raw materials are one of the most important elements that must be controlled by every industry or business in order to get the best outcomes. If this element is not controlled good enough, it can lead to ineffective raw material flow. It may affect the business in terms of outcomes such as sales. The sales affected can come from an ineffective inventory control strategy that leads to high total cost or the inability to fulfill customers' demand. In other words, when it comes to controlling raw materials, elements included in total cost such as setup cost, shortage cost, scrapped cost, and holding cost must be considered. To control these elements, inventory control method is used considering the order quantity and reorder point as its variables of the analysis.

The purpose of this research is to apply inventory control knowledge to help The Rockz Hotdog business, as one of the food industry business in reviewing and improving its raw material inventory control policy considering the expiry dates and order lead time of the raw materials. With inventory control application towards the business, it is hoped it can improve the business' outcomes such as minimized total costs and maximized customers' demand fulfillment rate.

The first step is to collect important data for the analysis, such as past sales data and supporting data. After that, the past sales data are being classified based on the amount of demand at certain times. Then, the classified data are put in input analyzer software in order to help generating random demand values that correspond to the actual demand data. Then alongside supporting data, the simulations in Excel software are carried out. These simulations are made to represent the actual conditions of the business. Then, using inventory control knowledge, methods are used to find an approximation of optimal solutions for the business. Then, the optimal solution can be selected between candidates stated in the simulations.

Keywords: Inventory control, order quantity, reorder point, Input Analyzer, Simulation, Replication.

CHAPTER 1

INTRODUCTION

1.1. Background

Nowadays, many industries operate in the food and beverage sectors. The food and beverage industry become the highest contributor to the state income in the manufacturing sector. According to the Industry Ministry of Republic Indonesia, until mid of 2019, the food and beverage industry continues to record significant growth. Even in the second quarter of 2017, the food and beverage industry recorded an increase of 7.19 percent. This achievement also played a role in the Gross Domestic Product (GDP) of the non-oil and gas industry, which reached 34.17 percent or the highest compared to other sectors.

Food and beverage industries are divided into two kinds. The first one is more focused on producing tangible products. Food and beverage industries and manufacturers such as Indofood are included in this group. The other kind is more focused on producing intangible products (services) such as restaurants.

In running the food industry sector, there are many aspects to consider. One of the essential aspects is about the inventory. Without any inventory, the company will be confronted at risk of not being able to meet customer needs. The risk of not being able to meet customer needs will lead to an opportunity lost in gaining more profit and resulting in unfulfilled customer needs. Inventory control is needed if there is inventory needed to meet demand in the future during a specified planning horizon. Aspects concerned in matters of inventory are the decision to set how much resources and when to place the order. The purpose of the IE worker, in this case, is to carry out inventory control activity to minimize lost opportunity or scrapped product. The other purpose is to ensure that customers are satisfied with product availability in a certain period.

The Rockz Hotdogs is a business that operates in the fast-food industry and categorized as the intangible food and beverage industry. This industry has been established since 2011. This business is located in Manado, Sulawesi Utara, Indonesia, and now has seven branches in several locations. Those seven branches are located in the first and third floor of Megamall, Hypermart Mantos, Multimart around Megamas, Multimart Zero Point, Multimart Ranotana, and

Sahabat Supermarket. This business sells hotdogs and burgers as its main product.

Inventory is an essential aspect that this business does not notice until now. The high frequency of stock out causes the business to lost opportunity in selling more products to the customer while giving a bad impression to the customer whose demand is not fulfilled. The cause of a stock out usually comes from unorganized inventory and a lack of skills in forecasting demands. The purpose of this thesis research is to eliminate or minimize the stock out condition that happens in this business at certain times in The Rockz Hotdogs Business. This attempt will be made by using an inventory control technique to determine when and how much raw material to purchase from the supplier based on historical demand analysis. Through inventory system skills, it is expected to be able to quickly minimize the stock out condition in this business while being concerned about overstock conditions too.

The Rockz Hotdogs business already has an inventory of raw material. Nevertheless, the owner does not have the inventory knowledge about when and how much of the raw materials to order from the supplier. Currently, the owner only uses basic estimating skills to determine how much raw material to supply to each branch. The estimation comes from the past average demand multiplied by 20%. As for when to order from the supplier, the owner only set a target to order around two to three times a week without really consider the raw material inventory level. The owner also does not consider the high and low season aspect. That is why many stock-outs happens in this business, and resulting opportunity lost and unsatisfied customers when the stock-outs occur. That is why this problem needs to be solved for the business to have better income and satisfy more customers.

1.2. Problem Formulation

Based on the background, the problems that can be formulated in this research are:

a. How is the current policy regarding raw material inventory control in The Rockz Hotdogs Business?
b. When does the owner need to place the raw material order from the supplier?
c. How much raw materials does it need to be ordered to minimize stock-out or overstock conditions for every specific season?

1.3. Research Objectives

The objectives of this research are to:

a. Evaluate current raw material inventory control policy in The Rockz Hotdogs Business.
b. Propose a new raw material order policy about when and how much to order based on Inventory System Techniques and compare it with the current policy.
c. Decide the best raw material order policy for every specific season classification.

1.4. Scope of Problem

For this research to be more focused on the primary purpose, then there must be a limitation of the problem. The problem limitations in the research are:

a. The object of this research is only the main raw materials, namely, bread and sausages.
b. Evaluation and Improvements made are only in the scope of Inventory System knowledge.
c. The object of this research is only subjected to the Megamall branch out of the other eight branches, considering the amount of inventory problem occurrence happens in that branch comparing to other branches.
d. The research will be conducted from January until June in 2020
e. Sales Data for raw materials when the stockout condition occurs are considered as Demand Data.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.1. Literature Review

2.1.1. Previous Research

Sutjiadi (2014) discussed inventory control activities of bread raw material in U.D. Minang Jaya. The problem that occurs, in this case, is the inventory control system settings raw materials that have not been calculated properly. This problem makes the system of raw material inventory control does not run optimally. The problem happens because of the amount of order is determined with just a rough estimation of the owner. The purpose of this research is to determine when and how much bread to order in minimizing inventory costs while giving maximum income. The method used in this research is a comparison between several decisions to order considering EOQ and ROP as the aspect of decision-making activity. The first scenario is to order based on the EOQ policy. The second scenario is to order periodically with changing order quantity for every order placed. The third scenario is to order based on the ROP policy. The last scenario is to order based on the ROP policy with changing order quantity for every order placed (Sutjiadi, 2014).

Sari (2007) discussed the cost analysis of raw material inventory in Hartz Chicken Buffet Restaurant in Bogor. The problem that occurs, in this case, is the high inventory cost. The problem occurs because the amount of raw material ordered does not consider the demand (the owner only uses simple estimation skills). The purpose of this research is to find the amount of raw material needed to be ordered so that the inventory cost reaches the minimum level while avoiding opportunity loss too. The method used in this research is the EOQ method and it is compared with the previous method that HCB used. The parameter for decision making is based on inventory costs (Sari, 2007).

Kindangen, *et al*. (2018) discusses the inventory control activity of the raw material of Tinutuan in Minahasa Baru Restaurant in Manado. The problem that occurs, in this case, is the overstock condition that occurs a lot. Because the raw material has a short lifespan, the raw materials sometimes are scrapped. The purpose of this research is to minimize scrapped raw material and holding cost of raw material.

The method which is used in this case is the EOQ method and simple Simulation for applying the EOQ method in 2 years scale (Kindangen, *et al.*, 2018).

Irza (2016) discusses the optimization of raw material in Ceker and Sayap Mercon Bang Gendut 4 Restaurant. The problem that occurs, in this case, is the overstock and understock conditions that sometimes happen because of the demand uncertainty. Therefore, the optimization of raw material inventory is needed to minimize the inventory cost while maximizing profit. The purpose of the research is to analyze the classification of the main raw material that is used in the production process and recommending a suitable inventory control policy that suits the restaurant's condition. Methods that are used in this research are ABC analysis, EOQ method, and Probabilistic method (Irza, 2016).

Saragi and Setyorini (2014) discuss the inventory control analysis of meat and chicken raw material using the EOQ method in the Steak Ranjang Restaurant in Bandung. The problem is that the restaurant does not have a management system or method in carrying out the procurement or ordering raw material. This makes the restaurant experience the condition when there is an excessive stock of raw material or stock-out conditions that happen in a certain period while the restaurant runs. The purpose of this research is to find the optimal order quantity and to know the total raw material inventory cost before and after the improvement. The method used in this research is the EOQ method and cost analysis about inventory (Saragi and Setyorini, 2014).

Putra and Yudoko (2012) discuss the inventory management activity at MJS Restaurant in Jakarta. The problem that occurs in the restaurant is the understock condition that happens because of no policy in how much raw material to order. The purpose of the research is to minimize costs that come from inventory inefficiency and maximize profit. The methods that are used in this research is forecasting method and optimal order quantity method (Putra and Yudoko, 2012).

Kawet, *et al.* (2016) discusses raw material analysis in Sabuah Oki Sario Restaurant in Manado. The problem that occurs is a hard-controlling activity of raw material inventory. This happens because of the lack of concern in the number of demand and no policy in when and how much raw material to order. The purpose of this research is to make a policy of when and how much raw material to order so that it will become easier to control the raw material inventory with the right

policy as a foundation. The method that is used in this journal is the EOQ method with the POM QM application (Kawet, *et al.*, 2016).

Mwangi and Nyambura (2015) discusses the role of inventory management on the performance of food processing companies with a case study of Crown Foods Limited Kenya. The problem stated in this journal is that the food processing companies in recent decades have been facing challenges of non-performance due to poor cost control, failure of production, increased cost, lack of available supply. The overall operations of the supply chain are affected by the increase of demand uncertainty. The purpose of this journal is to appeal the importance of inventory management in the food industries. Theories that are used in this journal are stochastic inventory theory, multi-echelon inventory model, and management theory (Mwangi and Nyambura, 2015).

Liang (2013) discusses the smart inventory management system of the food processing and distribution industry. A food processing and distribution company typically store products in a warehouse before shipping them to customers. Inventory management is important to the food-processing-and-distribution industry because of the large number of products typically stored. Large amounts of stored products increase inventory cost and management cost.It can reduce warehouse efficiency. This becomes the problem that happens in this case. The purpose of this journal is to increase the efficiency of the warehouse with an inventory management system. The method used in this case is the AHP method. Using the AHP method will give analytical results in the number of stored foods, the input/output frequency of the same food, and the frequency of input/output food are with the high weighted value (Liang, 2013).

Sukamto (2017) discusses the raw material inventory control analysis towards total inventory and operating profit at Benedict Restaurant. The problem that occurs in the restaurant is about the overstock and understock condition that happens in a certain period. It happens because the restaurant is currently still using simple inventory management or traditional, which is ordering of goods that are done by adjusting it to the estimated needs, without considering time intervals and the right amount of raw material. Because of that, the company only uses a rough estimation technique regarding the amount of raw material that will be processed and stored. The purpose of the research is to prove the impact of fixed order

interval policy. The method used in this case is the fixed order interval method (FOI) method (Sukamto, 2017).

Table 2.1. Summary of Previous Researches

No	Authors	Problem	Purpose	Method Used
1	Sutjiadi (2014)	the inventory control system settings raw materials	determine when and how much bread	Comparison of 4 scenarios using ROP, and EOQ policies
2	Sari (2007)	high inventory costs	find the amount of raw material needed to be ordered	Comparison between EOQ policy and previous HCB policy
3	Kindangen, *et al.* (2018)	overstock conditions in a certain period	minimizing scrapped raw material and holding cost of raw material	are the EOQ method and simple Simulation for 2 years scale
4	Irza (2016)	overstock and understock conditions	analyze the classification of main raw material that is used in the production process and recommending a suitable inventory control policy	ABC analysis, EOQ method, and Probabilistic method.
5	Saragi and Setyorini (2014)	does not have a management system in carrying out the ordering raw material activity	find the optimal order quantity and to know the total raw material inventory cost before and after the improvement	EOQ method and cost analysis about inventory

Table 2.1. Continued

No	Author	Problem	Purpose	Method Used
6	Putra and Yudoko (2012)	understock condition	minimize costs which come from inventory inefficiency and maximize profit	forecasting method and optimal order quantity method
7	Kawet, *et al.* (2016)	the hard-controlling activity of raw material inventory	make a policy of when and how much raw material to order	EOQ method with POM QM application.
8	Mwangi and Nyambura (2015)	poor cost control, failure of production, increased cost, lack of available supply	appeal to the importance of inventory management in the food industries	stochastic inventory theory, multi-echelon inventory model, and management theory.
9	Liang (2013)	. Large amounts of stored products increase inventory cost and management cost and can reduce warehouse efficiency	increase the efficiency of the warehouse with the inventory management system	AHP Method
10	Sukamto (2017)	overstock and understock condition	give proves about the impact of fixed order interval policy	FOI Method

2.1.2. Current Research

The research that currently conducted is about the raw material inventory control in The Rockz Hotdogs Business in Manado. The problem that happens, in this case, is the understock condition at a specific time because of the unpredicted event and high seasons. The purpose of the research is to determine when and how much raw material to order based on inventory system policies. The method that will be used in this research is the EOQ method, basic cost analysis, and Simulation.

2.2. Theoretical background

2.2.1. Inventory

Inventory is materials or goods stored that will be used to meet particular objectives. Its existence is not only considered as a burden (liability) because it is a waste but at the same time can also be considered as assets that can be immediately disbursed in cash. Every company that carries out business activities generally has stock. Distinct products that are kept in stock are called items. Inventory is a list of the items held in a stock (Waters, 2003).

2.2.2. System

The definition of the system, according to the book of information technology systems, is a collection from components that are interconnected with one another form one unity to achieve specific goals. It can be seen from two groups' approach which emphasizes procedures and component or element. System is an integrated set of elements, subsystems, or assemblies that accomplish a defined objective. These elements include products (hardware, software, firmware), processes, people, information, techniques, facilities, services, and other support elements. It is combination of interacting elements organized to achieve one or more stated purposes (Forsberg, K.J., *et al*., 2014).

2.2.3. Inventory system

Inventory system is an activity in the process of processing data items that are in a warehouse. The inventory system has a big influence on the industry because the inventory system can help resolve the problem of goods data processing and facilitate reporting data of goods available. An industry that does not have an inventory system, will experience problems in processing data items.

2.2.4. Inventory system Control

Inventory system control is a set of control policies to determine the level of inventory that must be maintained. If the amount of inventory is too large (overstock) resulting in the emergence of large idle funds, it also creates the risk of damage to larger goods and high storage costs. However, if there is too little inventory, there is a risk of a shortage (stock out) because often the goods cannot be brought in suddenly and as large as needed, causing a halt to the production process, sales delays, and even loss of customers.

2.2.5. EOQ Method

Economic Order Quantity (EOQ) is a method or an approach to build a model of an idealized inventory system and calculate optimal order quantity that minimizes total costs (Waters, 2003). EOQ method can be used both for items that are purchased and those that are self-produced. EOQ is widely used up at this time because it is easy inside its use, though deep its application must pay attention to assumptions used. The basic assumptions to use the EOQ method are as follows:

1. Requests can be determined on a basis certain and constant so that the cost of stock out and related to capacity does not exist.
2. Items ordered are independent with other items.
3. Orders are accepted immediately and surely.
4. Constant item prices.

There are several kinds of EOQ models based on their own purposes. One of them is probabilistic EOQ model. This model is used when the optimum order quantity is needed considering uncertain demand and reorder point. The notations used for this model are:

yi = order quantity (unit)
r = reorder point (unit)
X = number of demands during lead time (unit)
Xmax = maximum demand at certain distribution (unit)
μ = Average value of certain demand distribution (unit)
σ = Standard deviation of certain demand distribution
S = number of expected shortage (unit)
D = Expected demand rate (unit)
Stc = Setup Cost (Money unit)
h = holding cost (Money unit/Unit)

p = shortage cost (Money unit/Unit)

f(x) = pdf of a certain demand during lead time

For number of expected shortages, the equation used is:

$$S = \int_{r}^{Xmax} (x - r)\, f(x) dx \quad (2.1)$$

Then the equations to get optimum order quantity and reorder point are:

$$yi = \sqrt{\frac{2*D(Stc+p*S)}{h}} \quad (2.2.)$$

$$\int_{r}^{Xmax} f(x) dx = \frac{h*yi}{p*Xmin} \quad (2.3.)$$

Besides those equations, an equation used to find the f(x) in normal distribution is:

$$z = \frac{X - \mu}{\sigma} \quad (2.4.)$$

2.2.6. Simulation

A simulation is an animated model that mimics the operation of an existing or proposed system. A key advantage of simulation modeling is that it has the capability of modeling the entire system and its complex interrelationships. The representational power of Simulation provides the flexible modeling that is required for capturing complex processes. As a result, all the important interactions among the different components of the system can be accounted for within the model. The modeling of these interactions is inherent in simulation modeling because Simulation imitates the behavior of the real system (as closely as necessary). The prediction of the future behavior of the system is then achieved by monitoring the behavior of different modeling scenarios as a function of simulated time. Real-world systems are often too complex for analytical models and often too expensive to experiment with directly. Simulation models allow the modeling of this complexity and enable low cost experimentation to make inferences about how the actual system might behave (Rossetti, 2016).

2.2.7. ARENA Software

Arena™ is a commercial software program that facilitates the development and execution of computer simulation models. The Arena™ provides access to an underlying simulation language called SIMAN through an environment that permits the building of models using a drag and drop flow chart methodology. The Arena™ environment has panels that provide access to language modeling constructs. In

addition, the environment provides toolbar and menu access to common simulation activities, such as animating the model, running the model, and viewing the results (Rossetti, 2016).

2.2.8. Verification and Validity

verification is a process that is useful to ascertain whether the simulation model created has been running as expected and to ensure a free simulation model 10 from errors and runs according to the expected concept (Sugiarto & Buliali, 2012). Furthermore, validity is performed which will determine whether the model conceptual is a meaningful and accurate picture of the real system. Validation is an activity to find out whether the Simulation is an accurate representation of the system that is running (Manuj, 2009).

2.2.9. Confidence interval

The Confidence Interval method is a statistical way to shows how accurate is the estimated average value. Usually, at narrow intervals, the results obtained will be more accurate. A confidence interval expresses a degree of certainty associated with a point estimate (Rossetti, 2016). confidence interval can be formulated as 1 – α, where α refers to the likelihood that the true population parameter lies outside the confidence interval.

2.2.10. Replication

Replication theory is to run a simulation model using the flow of certain random numbers, which in turn causes random events from the order of these numbers. Doing some replication is equivalent to take some samples in statistics. Replication is generally the only method available to obtain sufficient data output from the end of the Simulation. Meanwhile, for non-terminating simulation models, Users can use long runs or multiple replications. The purpose of doing replication is to produce several samples and to get a better estimate of how to improve performance the performance.

CHAPTER 6
CONCLUSION

Based on the analysis in the previous chapter, The Rockz Hotdog business has a problem with the raw materials control. This can be seen by looking at the number of overstock and scrapped raw materials. To solve this problem, it is hard just to use simple estimation because of the uncertain demand. Because of that, the demands are first being classified into several classes. After that, the probabilistic EOQ model is used to determine the approximation of the optimum order quantity and reorder point values for each class. After that, the simulation is used to generate the total cost value in every condition or classification. The simulation is made as similar as possible to the real situation happen at the business in order to help cover the probabilistic EOQ model's limitation and giving more accurate result of the analysis. After that, the replications activities are carried out in order for the decision-making activities to become possible.

6.1. Conclusion

Based on the analysis in the previous chapter about the current policy simulation, the current inventory control of the business can be rated as not so effective. For bread raw materials, the fixed amount of bread transported daily makes there are many pieces of bread scrapped at the low season. Besides that, the fixed daily stock of bread raw materials makes the stall cannot store all the bread at the end of the day in certain time. When this scenario happens, the worker must transport the excessive amount of bread back to the warehouse in the production place at the end of the day. This leads to more transportation costs. As for sausage raw materials, the estimation to order two to three times a week is already good enough based on the simulation. However, it can still be improved and optimized by changing order quantity and determining fixed date of placing order based on the inventory level.

On the analysis in previous chapter, the new policy proposed to the business on bread raw material is the number daily supply policy. In the proposed policy, the daily supply for bread raw materials are based on the maximum inventory of the stall in certain branch. For example, if the maximum inventory of bread is 250, and at the end of the previous day there are 50 breads left, even if the order quantity policy states that daily supply is 250, at the end, there will be only 200 breads transported. This is hoped to minimize overstocked bread that may lead to much

expired bread while trying to also fulfill all the demands as much as possible. For sausage raw material, the new policy proposed a more clear date on when to place an order to the supplier considering the supplier lead time and the demands of the sausage raw materials. Besides that, the new policy changes the number of raw materials supplied from the supplier (for sausage) and from the production sector towards the branch (for bread).

Based on the result of the analysis in chapter 5, it can be concluded that on weekdays in low season (February until November), the optimum order quantity and reorder point for bread raw materials are 370 and 200 (or more), respectively. As for sausage raw materials, the optimum order quantity and reorder point are 600 and 450, respectively. Next, on weekends in the low season (February until November), the optimum order quantity and reorder point for bread raw materials are 550 and 90 (or more), respectively. As for sausage raw materials, the optimum order quantity and reorder point are 890 and 450, respectively. Next, on weekdays in high season (December until January), the optimum order quantity and reorder point for bread raw materials are 540 and 100 (or more), respectively. As for sausage raw materials, the optimum order quantity and reorder point are 920 and 350, respectively. Lastly, on weekends in high season (December until January), the optimum order quantity and reorder point for bread raw materials are 540 and 100 (or more), respectively. As for sausage raw materials, the optimum order quantity is 1050 when the inventory level reaches 330 or below (expanded inventory level to 800 sausages in maximum). However, there is one note regarding these conclusions. No matter how much the order quantity proposed, if it exceeds the maximum inventory of Megamall branch, it will automatically mean that the raw materials arriving towards the branch is equal to the maximum capacity of the branch's inventory.

6.2. Suggestion

Based on this limitation of the branch, the suggestion that can be proposed towards the business is to expand the maximum inventory of sausage raw materials into 800 sausages capacity. For sausage raw materials, this can minimize the number of shortages that still happen even after obtaining the optimum solution from the analysis. As for bread raw materials, it might be beneficial to expand the maximum inventory at some point in order for the transportation activity not to be held daily. In other words, it might minimize the transportation cost. However, reckless expansion of bread inventory may have more bad impact if the owner does not

consider the demand of the bread. This is because the bread has three days of the expiry date. That is why the expansion of bread inventory and the policy of not transporting raw material every day must be analyzed further to make sure if it is beneficial to the business or not.

Besides that, based on the analysis for Sausage raw materials, it is showed that the conclusion still cannot be directly implemented towards the business because it consists of nine branches while the proposed order policy in the analysis is placed only considering the inventory level of that branch (it does not consider the other branches condition). Whereas, in the real case, the owner placed an order to the supplier while considering the availability of the raw materials in all the branches, not only one branch. Because of that, it is suggested that on future research, the reorder point value for the other branches is also calculated in order for the new proposed policy to be implemented in the business properly.

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