

PRODUCTION PLANNING CONCEPTS FOR SMALL AND MEDIUM ENTERPRISES (SMES): A CASE STUDY IN A BAKERY COMPANY

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ABSTRACT – Production planning and control (PPC) is a branch of knowledge that commonly discusses the available concepts and methods for operation management. The knowledge and understanding of PPC concepts, together with proper implementation can assist an organization in fulfilling customer demands with minimum cost. Large organizations are exposed to PPC concepts due to the qualification of workers and the availability of training. However, for small and medium enterprises (SMEs), awareness and knowledge of PPC concepts are lacking. This study is carried out in an SME, a bakery company located in Selangor, Malaysia, to determine how PPC concepts can be applied in SMEs. The case study found several problems faced by the company, ABC Bakery, that relate to supplier selection and workforce planning. In order to overcome the problems, two PPC techniques are introduced. Firstly, the quantity discount model is proposed to solve supplier selection issues. Secondly, the aggregate planning concept is utilized to overcome the workforce issue. From the calculation and analysis conducted, it is found that ABC Bakery can make a wise decision in the supplier selection process when the quantity discount model is implemented, in which selection is based on the minimum total cost incurred. Next, by applying aggregate planning; specifically varying workforce size and influencing demand strategies, the number of workforces required can be estimated and then further improved to increase demand in the future. In conclusion, this study shows that PPC concepts are suitable to be implemented in SMEs specifically to solve operations problems, and then help SMEs in increasing productivity and sales in the long term.

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INTRODUCTION

In Malaysia, the majority of small and medium enterprises (SMEs) run food and beverages business. Data shows in the SME Directory that the number of registered SMEs under the food and beverages category is 767 enterprises (Malaysia SME Directory, 2022). Unlike main industries such as manufacturing, construction, and agriculture, SMEs are commonly facing problems such as a lack of knowledge on operation, poor operation management, and lack of capital (Abd. Bachik & Morshidi, 2017; Maherilham, 2019). These problems occur due to family business that the workers are from family members without any professional or related qualifications, and improper training. This situation leads to poor productivity and sales. However, the SMEs themselves do not realize the importance of proper management since these are all soft skills and intangible. There is a need to give awareness, knowledge, and training to SMEs on operation management and how the success of operation management can affect an operation's performance such as productivity and sales (Hasheminasab et al., 2015; Kachwala & Mukherjee, 2009).

ABC Bakery is a company that bakes cakes and desserts around Sabak Bernam and Sungai Besar, Selangor. The business was founded 20 years ago by the owner, who decided to open this business because of her hobby towards the bakery industry and interest in cakes or dessert baking. The business runs on a part-time basis and is assisted by her children. Her homemade cakes and desserts are ordered every day by customers, especially on weekends and holidays for weddings, birthday celebrations, and other occasions. The estimated sales of cakes and desserts are 5-15 orders on a weekday while 20-30 orders for weekends and holidays. Among the cakes that are often ordered by the customers are Chocolate Moise, Pandan Gula Melaka, Butterscotch, Red Velvet, Bento Cake etc. As for dessert, Cream puff, Batik Indulgence Cake, Brownies, Tiramisu, and others are the most popular. In addition, the owner also distributed her desserts at several shops around Sabak Bernam and Sungai Besar for sale to locals.

Unfortunately, upon observation, ABC Bakery runs without applying related concepts of PPC in its operation. PPC offers basic and advanced concepts in planning, managing, and controlling an operation so that the operation can meet customer orders and requirements with specified quality, delivery, and cost. Improper management of production may lead to the inability to fulfill customer demands, operation waste, and profit loss. Among the problems encountered by

ABC Bakery are supplier selection, especially for main ingredients like butter, flour, milk and eggs, and the inability to meet customer demands.

Suppliers' variable raw material costs affect the company's earnings. ABC Bakery had trouble buying raw materials, especially butter in large quantities from several suppliers due to inconsistent prices and discounts being given. This can disrupt the profits of any product sold. Type of quantity discount may be implemented depending on the total amount purchased over a period of time to encourage customers to stay with their existing supplier and prevent them from shifting to another. The inability to meet company demand is due to poor production planning which makes it difficult for ABC Bakery to achieve monthly sales targets. Among the things that need to be fixed are production rates, labor levels, inventory levels, overtime work, subcontracting work, and other controllable variables.

LITERATURE REVIEW

Production Planning and Control

Production is the creation of goods and services, in which values are created in the form of goods and services by transforming inputs into outputs, or raw materials into finished goods (Drane & Faramarzi, 2019). Activities of creating goods and services take place in all organizations. Operations management (OM) is the set of activities involved during production. Operations are planned and controlled using a variety of concepts and methods. Production planning and control (PPC) is a branch of knowledge that commonly discusses those available concepts and methods. The knowledge and understanding of PPC concepts are very beneficial especially when properly implemented in the operations. Large organizations are normally well-equipped with the knowledge, awareness, and training, as well as the skills required in PPC. However, SMEs are still lacking behind (Burggraf et al., 2022; Mishra, 2017).

PPC provides concepts that are relevant from the beginning of operations until finished, from external scope to internal, from top to bottom. Forecasting methods, inventory management, aggregate planning, and master production schedule (MPS) are among the body of knowledge available in PPC. Additionally, PPC also emphasizes the importance of lean management in operations.

Quantity Discount Model

Quantity discounts are price reductions designed to induce large orders (Heizer et al., 2017; Stevenson, 2012). If quantity discounts are offered, the buyer must weigh the potential benefits of the reduced purchase price and fewer orders against the increase in carrying costs caused by higher average inventories. Hence, the buyer's goal, in this case, is to select the order quantity that will minimize total costs, where the total cost is the sum of the carrying cost, ordering cost, and purchase cost. According to Huang et al. (2015), the quantity discount model is applied when a single buyer is dealing with multiple suppliers in a supply chain. Quantity discount is one of the selection criteria for purchasing to occur.

This quantity discount model aids in lowering the cost of ingredients used in cakes and desserts. Initial planning may be accomplished by comparing vendors who deal with shipping ingredients. Quantity discounts come in a variety of forms, and they may not be visible in some situations. Buyers are given varying buying incentives based on the type of quantity discount they receive.

Aggregate Planning

It is an operational activity that does an aggregate plan for the production process, in advance of 6 to 18 months, to give an idea to management as to what quantity of materials and other resources are to be procured and when, so that the total cost of operations of the organization is kept to the minimum over that period (Heizer & Render, 2011). The term "aggregate" means that the planning is done for a single overall output measure or, at most, a few aggregated product categories. In the face of variable or unpredictable demand, aggregate planning aims to define overall output levels in the near to medium future.

Aggregate planning could aim to influence both supply and demand. This would assist bakery management in determining the quantity of flour, salt, sugar, margarine, yeast, equipment, labour required, shift running, rate of production, and other factors in order to determine how they can meet their forecasted demand. In other words, aggregate planning is a set of decisions made in order to meet the forecasted demand for a certain period of time. It involves manipulating inventories, production rates, capacity, and other variables that may be controlled (Heizer et al., 2017). The strategy is either capacity options (tend to absorb demand fluctuations without changing the demand), or demand options (try to smooth out changes in the demand pattern over the planning period).

LITERATURE REVIEW

Two methods were used in this study. Specific techniques for the quantity discount model and aggregate planning are explained in the next section.

Quantity Discount

In order to identify which supplier is the best selection to buy certain ingredients, taking advantage of the discount offered by the available suppliers, and at the same time minimizing the total cost incur, the following equations are used:

$$Q^* = \sqrt{\frac{2DS}{H}} ; H = IP \quad (1)$$

Where.

- Q^* = Optimum order quantity
- D = Annual demand
- S = Setup cost for each order
- H = Holding cost
- I = Holding cost, as a percent of unit price
- P = Unit price

Where;

$$TC = \frac{D}{Q} S + \frac{Q}{2} H + PD; H = IP \quad (2)$$

TC = Total cost

H = Holding cost per unit per year

Below are the steps to identify the optimum order quantity by using the quantity discount model (Heizer et al., 2017); For each discount, calculate Q^* ; For any discount, if the order quantity is too low to qualify for the discount, adjust the order quantity upward to the lowest quantity that will qualify for the discount; Compute total cost for every Q^* obtained; Select the Q^* that has the lowest total cost

Aggregate Planning

Aggregate planning is used in a specific study to manipulate inventories, boost production rates, and other controllable variables. Several strategies are available. The selection is depending on the situation and to meet the purpose of minimizing the cost of operation.

The first strategy chosen for ABC Bakery is varying workforce size, that is hiring production workers to match production rates. Currently, ABC Bakery is conducted by the owner and also a baker for this bakery. During the interview with the owner, she said that sometimes she is unable to collect larger order quantities in a week due to the lack of workforce. Thus, it causes the sales to be limited to 15 to 20 cakes per day or based on her experience, she only received 5 cakes per day since 20 years ago. Sometimes, she was assisted by her children if they were available. Otherwise, she will manage the business alone. The addition of manpower is needed to help the owner in the financial department, packaging process, promotion, and providing tools to bake cakes and to do unskilled work. Hiring or laying off workers is one of the capacity options in aggregate planning, in which workers are viewed as assets rather than variable costs (Stevenson, 2012).

The second strategy selected is influencing demand, which is increasing demand through advertising, campaign, and promotion (Heizer et al., 2017). This strategy can be carried out by ABC Bakery once the problem with the workforce is settled. One of the most effective ways to increase product awareness and demand is to use social media. With social media platforms such as Instagram and Facebook page, SMEs like ABC Bakery can create brand awareness in society, which leads to increased site traffic and finally selling products or services (Fountain, 2021). With the right advertising, ABC Bakery was able to build a large follower for the brand and raise brand awareness, resulting in greater profits.

RESULT

Quantity Discount Model

ABC Bakery must utilize the quantity discount model to purchase raw materials for cake and dessert, such as butter, in order to minimize the operation cost. Butter is the main ingredient for making a cake and it takes up the most expenses. ABC Bakery employs a type of material that necessitates particular storage in order to remain in good shape and at the proper temperature at all times. According to the owner, since they used premium and commercial butter, they have been buying from 3 different suppliers according to the demand for the month. They bought 40 bulk block butter per month,

estimation for holding cost to be 10% of the purchase price and the estimation for ordering cost is RM30. Assuming 1 bulk = 2 cartons, ABC Bakery buys 80 cartons of block butter per month. The optimum order quantity was determined, in order to minimize the total cost of buying butter per year using Q* equation, providing that data from suppliers is available, as shown in Table 1.

Table 1. Price data from 3 butter suppliers

Supplier 1		Supplier 2		Supplier 3	
Quantity (carton)	Price, P (per carton)	Quantity (carton)	Price, P (per carton)	Quantity (carton)	Price, P (per carton)
1-30	262.50	1-50	259.80	1-49	255.90
31-60	250.35	51-99	245.55	50-99	245.90
More than 60	230.90	More than 100	229.95	More than 100	233.50

D = 960 carton
 S = RM30
 I = 10% = 0.10
 H = IP

The optimum order quantity and total cost were calculated for each supplier and each price range. The sample of calculation is as follows, and the calculated results are displayed in Table 2.

For Supplier 1 and price range of 1-30 cartons;

$$Q^* = \sqrt{\frac{2(960)(30)}{(0.1)(262.50)}} \qquad TC = \frac{960}{46.84} (30) + \frac{46.84}{2} (262.50) (0.1) + (262.50)(960)$$

$$= 46.84 \qquad \qquad \qquad = \text{RM } 253,229.63$$

Table 2. Calculated results using quantity discount model

Quantity (carton)	Price, P (per carton)	Q* (carton)	TC (RM)
Supplier 1			
1-30	262.50	46.84	253,229.63
31-60	250.35	47.97	241,536.84
More than 60	230.90	49.95	222,817.25
Supplier 2			
1-50	259.80	47.09	250,631.29
51-99	245.55	48.43	236,917.27
More than 100	229.95	50.05	221,902.87
Supplier 3			
1-49	255.90	47.44	246,878.08
50-99	245.90	48.40	237,254.12
More than 100	233.50	49.67	225,319.72

Aggregate Planning

To satisfy the demand from the customers, this bakery needs at least two workers in the workforce. This will increase the production rate of this bakery and it can receive more orders in the future. This can be overcome by adding assistants and setting targets for each worker. Related to this strategy, it is assumed that a worker can make the same quantity of cakes per day. Basically, the duration to order by the customers must be 5 days in advance before the pick-up date. Table 3 below shows the forecasted demand for ABC Bakery products for the next three months, and the number of working days for each month.

Table 3. Forecasted demand for ABC Bakery

Months	November	December	January
Demand (unit)	1500	2000	2200
Working days	24	25	25

One worker can produce 30 cakes per day. So, in November, a worker can produce 720 cakes, and then two workers can produce 1440 cakes. Comparing the forecasted demand in November and actual capacity with the current workforce, 60 cakes are still in demand. The calculation is shown below:

$$1 \text{ worker can produce in a month} = 24 \text{ working days} \times 30 \text{ cake per day} = 720 \text{ cakes}$$

$$2 \text{ workers can produce in a month} = 720 \times 2 = 1440 \text{ cakes}$$

Difference between forecasted demand and current capacity = $1500 - 1440 = 60$ cakes Thus, an additional workforce is required in ABC Bakery in order to fulfill the forecasted demand.

DISCUSSION

Based on the results of the quantity discount model in Table 2, if ABC Bakery purchases more than 60 cartons of butter from Supplier 1, the total cost is RM222,817.25. However, the total cost of Supplier 1 is still high as compared to Supplier 3 with a purchase quantity of more than 100 cartons with only RM225,319.72. It is because the quantity of butter from Supplier 1 is just 61 cartons and above but the quantity of butter from Supplier 3 is 100 cartons and above. Furthermore, comparing the total cost to purchase the same amount of more than 100 cartons of butter from Supplier 2 and Supplier 3 brings to the conclusion that Supplier 2 offers the lowest total cost of RM221,902.87. Therefore, the best option for ABC Bakery to purchase the butter is from Supplier 2 with a quantity of 100 cartons and above. The same methods and calculations can be implemented by ABC Bakery for the other raw materials to assist in purchasing raw materials and taking advantage of discounted prices offered by the suppliers.

The strategy of varying workforce size, which is categorized under the capacity option can help ABC Bakery in fulfilling customers' demands. As shown in this study, adding one new worker makes ABC Bakery produce more. However, this new worker requires training on specific tasks that he or she will carry out. Thus, during the early stages of hiring new workers, ABC Bakery would expect a little issue with quality and productivity since new workers need sometimes to adapt to the working environment and develop certain skills. A study conducted by Sillekens et, al. (2011) has proposed an integrated approach to aggregate planning in the automotive industry. Workforce flexibility and capacity planning are among the considerations in this study.

After a period of time, when the skills are gained and polished, ABC Bakery can target not just to fulfill current demand, but also, to increase upcoming demand by employing an influencing demand strategy. With current technology, social media is the best platform to market products. Additionally, ABC Bakery can opt to join events or open booths to promote the products.

CONCLUSION AND IMPLICATIONS

This study has suggested several production planning and control techniques and methods to assist SMEs in Malaysia in managing their operation. Managing operations requires taking care of the whole business from suppliers to customers. Thus, the first method proposed is related to supplier selection, in which the quantity discount model is employed. This method can be implemented by SMEs to determine which supplier to buy raw materials from that incur the lowest total cost. By the quantity discount model, SMEs do not solely make a purchase based on unit price but also widen the scope to the total cost incurred. Next, aggregate planning introduced varying workforce sizes and influencing demand strategies. For this study, these two strategies can be implemented, otherwise, there are other strategies that can be selected depending on the situation of SMEs. The main purpose of aggregate planning is to fulfill forecasted demand by adjusting internal controllable variables such as workforce, inventory level, and capacity.

In conclusion, awareness and knowledge of operation management need to be conveyed to SMEs to assist them in increasing productivity and sales. Based on the study conducted on ABC Bakery, production planning and control techniques and methods are not only suitable for large organizations but can be implemented in all operations.

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CONFLICT OF INTEREST

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