Improving Production Planning Strategy in Micro Enterprises

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Abstract

Micro enterprise is one of the drivers of the nation's economic growth. There are many micro enterprises that have to provide many various products because of public demand and also industrial competition. Many of the micro enterprise owners run their business ignoring production planning that contributes mostly to the company's profit. We have to improve the micro enterprises production planning methods to get more profit. This paper examines production planning methods in a micro enterprise at Surakarta, Indonesia. The purpose of this paper is to compare the use of planning and scheduling strategy. We explore challenges associated with planning strategies, and lastly, we consider a functional model of developing a planning system.

Keywords
Production Planning, Micro Enterprises, Scheduling, Chase Strategy, Production Cost.

1. Introduction
Development of technology impacts increasing industrial competition. People with their creativity, being innovative to make money. One of the activities is developing their own business and its start from the small or micro scale one. This is why Indonesia has a large number of micro-small-medium enterprises. It also contributes to the value of gross domestic product. Micro-small-medium enterprises have a big impact on national economic growth (Lamazi, 2020). If we can gain a little profit from all micro enterprises, the increase of regional GDP may become quite big.

However, many micro enterprises do not pay attention to production planning because they think their business does not yet need it. In fact, production planning plays a very important role in a business (Sutrisno, 2017). Proper production planning will help companies to implement efficiency. The higher the efficiency, the greater the profit received by the company. The opposite effect can also occur with poor production planning. Low efficiency will cause production costs to swell, thereby eroding profits. It supported by a statement in a journal that there is significant positive effect between production cost and net income (Wulandari et.al., 2016)

Managerial systems in small-micro enterprises are considered good and micro enterprises have minimal skill to organize (Suci, 2017). In some micro enterprises, production planning and inventory control is not one of their concerns. The inventory is mostly in idle condition because inventory tools are not as big as in the big company. Although it has little cost, the income is also little. The order of material usually recorded by general treasure in financial reports. It means, the order material note recorded mixed with another cost beside material. In the other words, most micro enterprises don't use any planning tools in production or inventory management. It leads them to ignore how effective the material is utilized.

To improve this to get more profit, we must have ideal conditions that make efficiency on the production process by improving the method of production planning (Kulikova, 2016). Planning production tools may help the enterprises to control the material and supply the product to customers. Schedule is an output from planning production implementation. From a research before, schedule can increase the value of customer satisfaction (Nurcahyo, 2020)

1.1 Objectives

To make this paper, we research and get data from Glucofeel company. GlucoFeel is a food and beverage micro enterprise that was established in February 2021. The former are students from Universitas Sebelas Maret. The company is located in Surakarta, Central Java. The customer is around Solo and Surakarta. The method to order their product is pre-order method. The inventory is mostly idle condition, and demand is quite stable. The objective of the study is to improve production planning tools to compare improved strategy in micro enterprises. The objective is also to gain more profit in micro enterprises.

2. Literature Review

Planning is the process of developing production plans based on existing constraints (Kapulin, 2020). The purpose of production planning is to satisfy consumer demand at the lowest cost (Valilai, 2017). Production capacity is the ability to produce goods and services and it depends on the efficient use of equipment, labor and financial resources, as well as on the ability to timely receive materials and components from suppliers. A balance between demand and production capacity is achieved through effective planning. Production scheduling model as tools provides the optimal production scheduling solution (Nurcahyo, 2016).

Production planning and control (PPC) deals with logistical problems faced in manufacturing, namely managing details about what and how many products to produce and when, as well as obtaining raw materials, spare parts and resources to produce these products. . PPC solves this logistical problem by managing information. PPC is an integrator in computer integrated manufacturing (Afriansyah, 2019).

The production planning problem has several characteristics, such as time horizon of 12 months is used with periodic updating perhaps every month or quarter, production demand consists of a few product families, demand is fluctuating, plant and equipment are fixed within the time horizon, and a variety of management objectives are set (Arnold, 2008).

2.1 Chase Strategy

Chase strategy is a strategy that tries to reach an output level for each period that meets the predicted demand for that period (Juliantara, 2020). The characteristics of the chase strategy are to match the level of production with the level of demand, increase or decrease labor according to the level of demand and the number of workers is fixed, but working hours are not fixed (Reicita, 2020).

The company produces enough at a time to meet demand exactly. In some industries, this is the only strategy that can be followed. For example, the post office has to process mail during the busy Christmas. The restaurant must serve food when the customer wants it. This industry cannot stockpile or inventory their product or service and must be able to fulfill requests as they occur. In this case, the company must have sufficient capacity to meet these peak demands. Companies have to hire and train people for the peak period and lay off them for the peak period then. Sometimes they have to do extra shifts and overtime. All these changes add cost. The chase strategy has several advantages, among which the inventory can be minimized. Goods are made when demand occurs and are not stockpiled. So, the quite high costs associated with inventory storage is avoided.

2.2 Level Strategy

Production levelling continues to produce numbers equal to average demand. Company calculates their total demand over the span of the plan and, on average, yields enough to fulfill it. Sometimes the demand is less than the quantity produced and supplies are piling up. Other times, the demand is greater and the inventory runs out. Production levelling means the company will use its resources at the level of and produce the same amount every day it operates. The amount produced each month will not be constant because the number of working days varies from month to month.

The advantage of the production leveling strategy is producing smoothness operating level which avoids the cost of changing production levels (Rewers et. al., 2017). The company does not need to have excess capacity to meet peak demand. They don't need to hire and train workers and lay them off at random times. They can build a stable workforce. The disadvantage is that the supply will build up in periods of low demand. This stock will need money to carry.

2.3 Hybrid Strategy

The two strategies discussed so far are pure strategy. Every has its own costs: equipment, hiring / laying off, overtime, inventory, and subcontracting. In fact, there are many possible joint or joint strategies of a company that can be used.

Each will have its own cost characteristics. Production management is responsible for finding strategy combinations that minimize the sum of all the costs involved, provide the required level of service, and fulfill the objectives financial and marketing plans (Arnold, 2008).

3. Methods

Figure 1 shows how micro enterprise's business flows based on interviews with owner. It starts from customer order checking. Customer orders are opened once a week. Customer orders generate order details as a result and then enter to the product stock checking. If there is no stock, continue the producing and delivering process. If there is stock, continue the delivery process. Delivery process is the end of the business process flow chart.
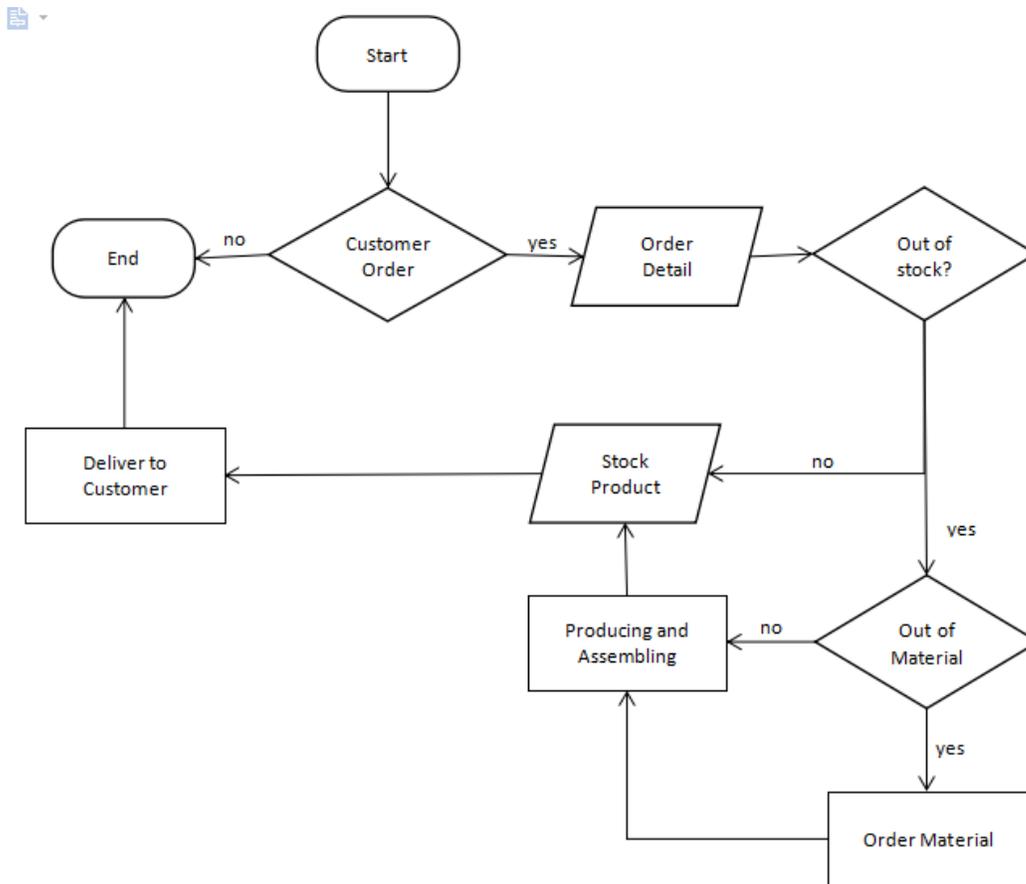

Figure 1. Business Flow Chart of Glucofeel

We will focus on producing and assembling strategy. The data provided shows the number of order details, order material, and stock product in each period. With the data provided, we can illustrate the strategy that the enterprise implemented right now, and estimate total production, inventory and material handling cost. This research uses a quantitative approach. The types of data used in this research are quantitative data. Quantitative data is data in the form of numbers that have a unit of calculation, including product sales data per period, initial inventory data, production capacity data, production costs, subcontracting costs and storage costs.

The data collection method used interviews, data collection by conducting direct question and answer with respondents consisting of company owners. Interviews are conducted in accordance with or based on a list of questions that are expected to get an explanation of relevant matters regarding the data required.

The steps to analyze the data in this study are to calculate the costs incurred by the company with the current production strategy, determine the strategy for production planning according to the company's circumstances, calculate the costs

incurred by the company when implementing the chosen strategy, and compare costs between current strategy with the strategy that we propose.

4. Data Collection

Below these are the supporting data to production planning in Glucofeel Company from February 2021 until April 2021. Data got from the weekly report and annual timeline of the company. Data supporting includes Table of demand and production, table of supply, and graphic of strategies. The data is presented with component period and number of demand, production, or supply. Each period is distinguished by week and each period is already done from february 2021 until April 2021.

4.1 Demand of Product

Table 1 shows the demand of dessert boxes to the industry since February 2021. The data is obtained from order recipes per period. The order recipe notes recorded unofficially in a device. It contains personal information of customers and the details of product order.

Table. 1 Demand of Glucofeel dessert box

Period (Week)	1	2	3	4	5	6
Product demand (per box)	31	14	25	18	18	13

In the first period or after the grand opening, the demand is on the peak. This is caused by the discounts that are offered. This decision was made because the company wanted to introduce their product to the public. In the second period demand decreased because the price was back to normal and the periode date opened at a time not much different. In the third period, demand rose again to number 25. After that they have stable demand at 4-5 period, and down again at 6 period because of the start of fasting month (Table 1).

4.2 Supply of Material

Table 2 shows the supply of dessert box materials since February 2021. The data is obtained from estimating the product can be produced from the material composition in each period. The data counted from the date of purchase of the material and which period it is.

Table. 2 Supply of dessert box material

Period (week)	1	2	3	4	5	6
Product supply (per box)	110	0	0	0	62	4

In the first period, they purchased the raw material to make around 110 pieces of product. In the second until fourth period, they didn't purchase any material because of remaining raw materials after the production before each period. In the fifth period, they purchased raw material for 62 pieces of product, to prevent out of material (Table 2).

4.3 Production Scheduling

Table 3 shows the production scheduling of Glucofeel since February 2021. The data is obtained from the timeline of the company and financial report. This illustrates their production process in each period, the time that they do the production process and the number of output.

Table. 3 Production schedule of Glucofeel

Period (week)	1	2	3	4	5	6
Number of Production	56	45	0	0	31	0

In the first and second period, they produced 101 products in total. In the third and fourth period, they didn't produce but to fulfill the demand in those periods, they used the rest of the unsold product. In the fifth period, the rest of unsold products didn't fulfill the demand, so they produced 31 products. Last, in sixth period they didn't produce again (Table 3).

5. Results and Discussion
5.1 Graphical of Current Production System
From the data above, we visualize the demand and production of products from February 2021 until April 2021 into graph in Figure 1. It shows the current production strategy of Glucofeel since February 2021 until April 2021.
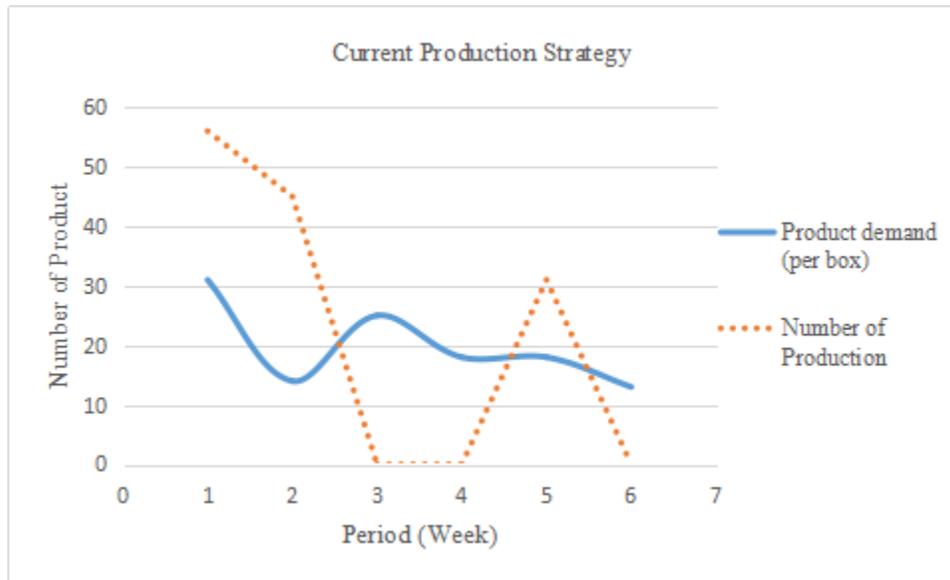

Figure 2. Current Production Strategy Graph

The graphic shows the strategy that they implemented doesn't have a pattern (Figure 2). The gap between production and demand in some periods is too far. There are 2 periods that don't do production activity, they are in the third and fourth period. The inventory is in almost full capacity in period 2 and the cost is increasing. The maximum of inventory is 60 based on interview. If the inventory is not quite accommodating anymore, they must rent another inventory that has a bigger cost. To optimized it, we need to implement the production strategy to press the production and inventory cost.

Table 4. Calculation Current Production Cost

Production Cost per unit	Rp11.695,45					
Period	1	2	3	4	5	6
Production	56	45	0	0	31	0
Production cost	Rp654.945,45	Rp526.295,45	Rp0,00	Rp0,00	Rp362.559,09	Rp0,00
Total Production Cost	Rp1.543.800,00					

5.2 Current Cost Calculation

Below is the calculation of production cost before implementing production planning strategy. The cost includes production cost per unit, inventory cost, and material handling cost. Production cost is obtained from multiplying production cost per unit with the number of production each period. Production cost per unit is formed by the cost of each material with a considering ratio. The material includes ingredients and packaging of one product. So, the total production cost is from additional producing cost each period.

We got Rp1.543.800,00 for total production (Table 4). According to what has been mentioned in the previous chapter, there is inventory to keep the rest of products that are not sold. Inventory is the storage for products that exceed because the demand is less than production. Inventory cost appears from rent cost inventory tools. The tools are a fridge and food container. The minimum inventory cost is Rp10.000,00 or minimum inventory is around 9 units. More than that, it imposes a variable cost Rp1.363,64 for a unit. So, the inventory cost got from multiplying inventory cost per unit with inventory. Number of inventory is formed by the subtraction of production and inventory in that period with demand in the same period.

Table 5. Calculation Current Inventory Cost

Inventory Cost per unit	Rp1.363,64					
Period	1	2	3	4	5	6
Demand	31	14	25	18	18	13
Inventory	25	56	31	13	26	13
Inventory Cost	Rp34.090,91	Rp76.363,64	Rp42.272,73	Rp17.727,27	Rp35.454,55	Rp17.727,27
Total Inventory Cost	Rp223.636,36					

Table 6. Material Handling Current Cost

Material Handling cost per unit	Rp1.000,00					
Period	1	2	3	4	5	6
Material Supply	110	0	0	0	62	4
Material on hand	54	9	9	9	40	44
MH cost	Rp54.000,00	Rp9.000,00	Rp9.000,00	Rp9.000,00	Rp40.000,00	Rp44.000,00
Total MH Cost	Rp165.000,00					

We got Rp223.636,36 for inventory cost (Table 5). Beside the inventory cost, we must consider material handling cost. Material handling caused by the excess of material. Some material isn't used in production activity because of consideration. During the other material processed, the other one has to be kept wisely to be used in the next production. In this case, material handling is quite cheap because the treatment to keep material is not too hard. To get

material handling cost is multiplying material handling cost per unit with the number of material on hand. Material on hand is obtained from subtraction material supply with the number of production.

We got Rp165.000,00 in material handling cost. In summary the table above, we need Rp1.543.800,00 for production cost, Rp223.636,36 for inventory cost, and Rp165.000,00 for material cost (Table 6). So, the calculation of total cost is Rp1.932.436,36.

5.3 Proposed Improvements
Currently, the company has not implemented a production strategy, thus allowing business processes to not run efficiently and have high costs. Therefore, we propose a chase strategy production plan, a production planning strategy based on customer demand for each period (Table 7). Based on the demand data, we develop a production plan as shown in the table below.

Table 7. Proposed production plan

Demand	31	14	25	18	18	13
Planned Production	31	14	25	18	18	13

We chose a chase strategy to implement in this case because the number of demand or production is not too big. So, it's important to reduce inventory cost and we expect it can lower the production cost in total. The chase strategy also known as the zero inventory strategy. The chase strategy production plan can be illustrated by the graph below.

Figure 3. Proposed strategy graph

The graph shows that in chase strategy, there is a same pattern between demand and production plan (Figure 3). The advantage of chase strategy is that inventory can be minimized. Goods are made when demand occurs and are not stockpiled. So, the cost associated with inventory storage is avoided. In this case, we are only improving the production scheduling. Supply and demand is assumed to be the same with historical data.

5.4 Validation
To validate our proposed improvement, we calculate the costs incurred if the company implements a chase strategy. The method of calculation is the same with current cost calculation. Proposed improvement in demand will multiply with production cost per unit.

Table 8. Improved Production Cost

Production Cost per Unit	Rp11.695,45					
Planned Production	31	14	25	18	18	13
Production Cost	Rp362.559,09	Rp163.736,36	Rp292.386,36	Rp210.518,18	Rp210.518,18	Rp152.040,91
Total	Rp1.391.759,09					

We got Rp1.391.759,09 for improved production cost (Table 8). Different with the current one, this strategy doesn't have inventory cost, because the number of production and demand is same. However, the material supply is same, and it causes material handling costs. Material handling cost formed by material handling cost per unit multiplied by material on hand that obtained from subtracting material supply with production.

From the calculation, we get Rp1.391.759,09 as the total production cost and Rp329.000,00 as the total of material handling cost (Table 9), so that the total costs incurred by the company if applying chase strategy is Rp1.720.759,09. These results indicate that the strategy we propose has a positive impact, marked by a 10,95% reduction in costs from the costs incurred by the company in the current strategy.

Table 9. Improved Material Handling Cost

Material Handling Cost per Unit	Rp1.000,00					
Planned Production	31	14	25	18	18	13
Material Supply	110	0	0	0	62	4
Material on hand	79	65	40	22	66	57
MH cost	Rp79.000,00	Rp65.000,00	Rp40.000,00	Rp22.000,00	Rp66.000,00	Rp57.000,00

5.5 Statistical Result

The result tested by minitab to find is there a significant result when the solution is implemented. We use paired t tests between current strategy cost and chase strategy cost with Minitab. Paired t-test, is statistical tools to examine the same object when different conditions have significant differences or not. To do the t-test, the assumption must be fulfilled. The assumptions are the data has normal distribution, Object of the test is the same with different conditions. Below is the normality test of data results to fulfill the normality assumptions (Figure 4).
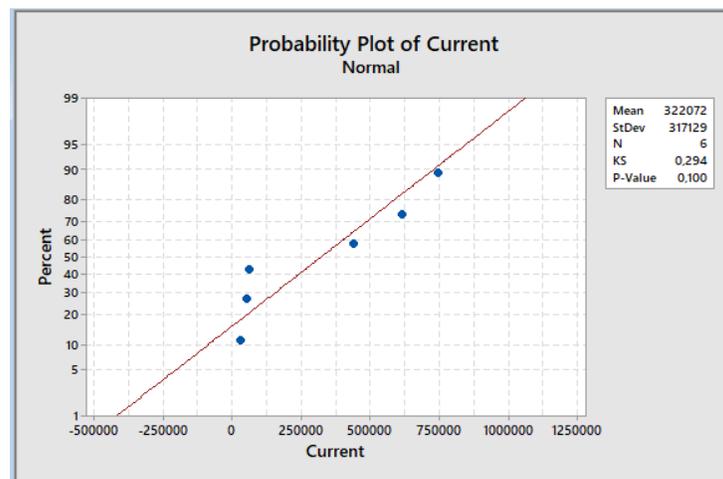

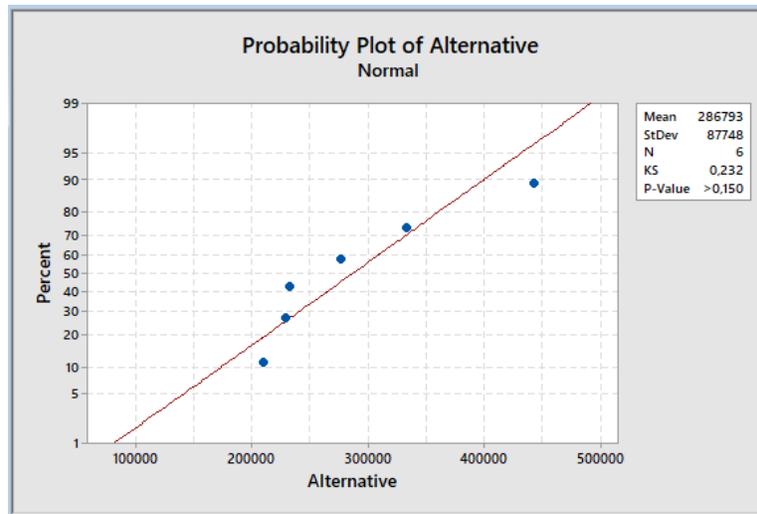Figure 4. Normality Test of Current Data

Figure 5. Normality Test of Chase Data

The P-value that we got is more than 0,05 (Figure 5). So, we can conclude that the normality assumption is fulfilled. The object of the test is same and the different conditions are already implemented. All the assumptions are fulfilled, so the t-test can be done. There are 2 hypotheses when doing paired t-test. Null hypothesis is that there is no significant difference between 2 conditions (H0: $\mu1 - \mu2 = 0$) and the alternative hypothesis is that there is a significant difference between 2 conditions (H1: $\mu1 - \mu2 \neq 0$) with a confidence interval 95%. The descriptive statistic of current and alternative sample and estimation for paired difference shows in a table below (Table 10).

Table 10. Descriptive Statistic of Current and Alternative and Estimation

Sample	N	Mean	StDev	SE Mean
Current	6	322072	317129	129467
Alternative	6	286793	87748	35823
Difference		35280	282562	115356
Estimation, 95% CI			(-261251: 331810)	

From the calculation on table 10, we got 0,772 for P-Value. We know that P-Value is bigger than 0,05. So, do not reject H0. It means there isn't a big difference between total cost of current strategy and improvement strategy.

6. Conclusion

Micro enterprises are one of the drivers of the nation's economic growth but many of the micro enterprises owners run their business with ordinary people point of view or without helicopter view methods. They ignore production planning. In fact, production planning plays a very important role in a business. Proper production planning will help companies to implement efficiency. The higher the efficiency, the greater the profit received by the company.

The objective of the study is to improve the method of production planning and implementing tools to compare each strategy in micro enterprises. The objective is also to gain more profit in micro enterprises. We contribute by providing a proposed improvement of production planning for the company, chase strategy. Even though in the statistical test results there was no significant difference between the current system and the improvements we proposed, in the

results of calculating costs, the improvements we proposed showed that the cost was 10% lower than the current system. This means that the improvements we propose have a positive impact when implemented in the company.

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