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Manufacturing and Production Collaborative Customers Preference

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Abstract. Modern manufacturing involved many productions' constraints and corporation's objectives. This study tries to considering manufacturing process with customer preference modification; beside, takes convenience stores producing thawing and heating prepared (THP) food for an example. The study constructed a THP diversity with customer preference selection model. Two distribution data of customer behavior were introduced to design parameters of customer preference indicators. Through computer system simulations, the results showed it would increase the profits if manufacturing process considering customers preference. However, it may result in different profits if some of the assumptions are revised. Future research suggests applying this model to others industries.

Introduction

Modern manufacturing involved many productions' constraints and corporation's objectives. Products manufacturing have to consider customers' preference. Take I-phone5 for an example, the product through continues revised and it would be a popular product using in daily life. Modern people's life is compact and fast moving. Frozen food is the trend of first choice when life schedule is tight. Everywhere is filled with convenience stores in Taiwan. When people think of dining, convenience stores offer hot food and delicious thawing and heating prepared (THP) food; and it solve the hungry in tight schedule lifestyle. This study tries to considering manufacturing process with customer preference modification; beside, takes convenience stores producing thawing and heating prepared (THP) food for an example. A THP food would be heated to original cooked well food, that is, if we heat the food, it would reach the original favor and taste. Based on the classification of THP food by the Association of Chinese Agricultural Products [1], THP food would be divided into 11 categories. These are frozen dumpling, frozen noodle, frozen rice, frozen mentioned food, frozen meatloaf, frozen aquatic refined food, frozen meat refined food, frozen Chinese dishes, frozen barbecue food, frozen hot pot raw food and frozen vegetable foods. Based on the Statistical Yearbook of the Ministry of the Interior, Accounting and Statistics, Executive Yuan [2], it stated that due to single, ethnic or small families groups moving toward a rising trend of quantity, THP foods showed strong need in daily life. Small packaging and high-priced commodities are features of these THP foods. There are some consumers who think small packaged foods can help control calorie intake, and even require low temperature to store and transport frozen foods [3-6]. THP food includes storage and conditioning facilities, diverse tastes and easy access , etc. advantages. In THP food's 11 categories, each of them has a different production process and manufacturing approaches. In the following sections, it would state and analyze these processes in more detail.

Problem Formulation

This research adapts maximization of THP diversity and a space utilization of a convience store (Such as 7-11) to serve as an indicator to service customers in a certain time. Dynamic order selection model [4,5] helps this study construct a more precise problem formulation. In Ho [4], j denoted order number; n denoted number of orders at t stage; p_j denoted profit from order j; x_j denoted a binary decision variable, if order j is selected, then equal to 1; otherwise equal to 0; w_j denoted weight of order j ; Cap denoted stock constraint. In this study, previous research was extended, let y_j denote a binary decision variable, if order j is selected, then equal to 1; otherwise equal to 0. It represents a customer preference indicator at a certain stage and similar to x_j. Without y_j, the algorithm would find an optimal x_j, however, it's not authentic due to diversity of customer preference vibrations. Usually a questionnaire survey can be involved, and parameters in the algorithm of dynamic order selection model would improve the authenticity to real world problems [4]. Based on survey results, a future resercher would apply this model and assume distribution of y_j to solve more complex THP diversity and a space utilization problem. The survey is expressed in the next two sections. It showed as follows:

$$y_j = \left\{ \begin{array}{ll} 1, & \text{if order } j \text{ is selected} \\ 0, & otherwise \end{array} \right\}$$

The MINLP (Mixed interger non-linear programming) model to maximize THP diversity and a space utilization is as follows:

$$\textbf{Max} \quad RP = \sum_{j=1}^{n} p_j x_j y_j \tag{1}$$

s.t.

$$\sum_{j=1}^{n} w_j x_j \le Cap \tag{2}$$

$$x_j, y_j \in \{0,1\} \tag{3}$$

The objective (1) is to find a maximum THP diversity and a space utilization. In Eq. (2), these are space constraints. Eq. (3) declares artificial binary *decision* variable constraints.

Production Process

In recent global trends of THP food, customers always change their preferences and interests. In formulation (1), y_j is a decision variable, however, it simulates the customers' behavior, thus it may revise due to real world customer preference. The following production process describes the difference of these THP foods.

(1) Frozen dumpling

The process is flour skin through fermentation, heating and then rapidly freezing. In this catogory, frozen buns, frozen bread, frozen dumplings, or frozen pizza are more often seen.

(2) Frozen noodle

The main are raw material noodles or macaroni. After fried roasted, baked or water heated, the process is rapid freezing. The products are frozen fried noodles, frozen noodles, frozen macaroni, etc.

(3) Frozen rice

Rice is the main material. Pre-treatment, minced dehydrated, or fried baking, baking, cooking and other processing are often seen. The products are frozen fried rice, frozen lunch, frozen rice balls, frozen kway teow, etc.

(4) Freezing mentioned food

Batter material coated food. After frying, the process lead to rapid freezing. The products are frozen fried vagetables, frozen fried meat, frozen fried sea water food, etc.

(5) Frozen meatloaf

Meat is minced, adding vice materials or seasonings, then stir molding and rapid freezing. The products are Burgers, pork pie, chicken pie, fish patties, shrimp pie, etc.

(6) Frozen aquatic refined food

Aquatic refined food means fish or other sea water animal uniform mashed, thermoform and rapid freezing. The products are frozen fish balls, frozen squid balls, frozen shrimp balls, etc. These foods should store at low (-18 ℃) temperatures.

(7) Frozen meat refined food

Meat refined food means meat is uniform mashed, thermoform and rapid freezing. The products are frozen meat balls, frozen chicken balls, frozen duck balls, etc. These foods should also store at low (-18 ℃) temperatures.

(8) Frozen Chinese dishes

The well cooked Chinese dishes are frozen. Frozen braised beef, frozen Kung Pao chicken, etc.

(9) Frozen barbecue food

The barbecue food are rapid frozen. The products are frozen roasted eel, smoked eel, grilled chicken wings (legs), smoked chicken wings, sausage, etc.

(10) Frozen hot pot raw food

Hot pot is very popular in Chinese, Korean, or Japanese society. Frozen shrimp dumplings, fish dumplings, egg dumplings, fish plates and crab sticks are often seen.

(11) Frozen vegetable foods

Vegetables are cooked well and then rapid frozen. The products are frozen vegetarian dishes, vegetarian hot pot ingredients, vegetarian ham, vegetarian sausages, vegetarian dumplings, etc.

Sampling Approach

The experiments of the proposed approach was proceeded on the basis of questionnaire survey. In the questionnaire, the subject were general customers whom had experience of purchasing THP food in Taiwan; the 400 questionnaire copies were returned. There were two dimensions in this questionnaire survey, one is customer preference of choosing frozen food, and the other is customer purchase location.

Results and Discussion

This study analyzed the results of the returned 400 questionnaire copies and listed in basic descriptive statistics as shown in table 1 and 2. In table 1, the top three choices of frozen food were frozen noodle, frozen dumpling and frozen rice. It showed that basic nutrition requirement was the first reason when they purchased THP food. In table 2, the top three customer purchase locations were convenience store, supermarket and hypermarket. It showed convenience was the important issue over other reasons. These two distribution data converted to computer system to simulation [4]. Then it got the relative maximize THP diversity and a space utilization.

Conclusion

Manufacturing and production collaborative customers preference is an interesting topic. How customers select their preference and add to improve the production process is a useful technique to distribution companies. In this study, two distribution data of customer behavior were introduced to manufacturing design. Through questionnaire survey and computer system simulation, the results also found that basic nutrition requirement and convenience issue were the main reasons when customers purchased these THP foods. However, it may result in different profits if some of the assumptions are revised.

Table 1 Customer preferrence of choosing freezing food

Categories of frozen food	Number of samples	Percentage
Frozen noodle	295	24.3
Frozen dumpling	255	21.0
Frozen rice	226	18.6
Frozen mentioned food	181	14.9
Frozen barbecue food	105	8.7
Frozen Chinese dishes	88	7.3
Frozen vegetable foods	52	4.3
Others	11	0.9
Total	400	100

Table 2 Customer purchase location

Purchase location	Number of samples	Percentage
Convenience Store	303	36.7
Supermarket	172	20.8
Hypermarket	232	28.1
Military and government welfare clubs	68	8.2
Department store	34	4.1
Direct market from web	11	1.3
Others	6	0.7
Total	400	100

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