Evaluation Index System of Production Planning in Manufacturing Enterprise

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Abstract. This paper expounds the definition of production plan from two aspects of broad sense and narrow sense. What's more, we classify the production plan from time, space, object and resource, and divide the production plan into layers. According to give the function and purpose of production plan, the paper summarizes the influencing factors of production plan and the common reasons why production plan could not be realized, and expounds the process of making production plan, and points out the principles and ideas that establishes the evaluation index system of production plan. On this basis, the evaluation index system of manufacturing enterprise production planning is established.

Keywords: Evaluation index system · Manufacturing enterprise · Principles · Ideas

1 Introduction

With the development of science and technology, customers' demands on manufacturing products are becoming higher and higher. They only rely on improving the quality of their own products and reducing production costs. The upgrade of enterprise's overall production management mode becomes particularly important. In order to upgrade the overall production management model of manufacturing enterprise, we must first make a production plan that conforms to the actual production situation of the enterprise.

2 Definition, Classification and Hierarchy of Production Planning

2.1 The Generalized Definition of Production Planning

Production planning refers to the preparation of activities related to production. Time planning: how to arrange the schedule; space planning: how to plan the site; resource planning: such as the allocation of materials.

C.-F. Chien et al. (Eds.): *IE&EM 2019*, pp. 261–268, 2020.
https://doi.org/10.1007/978-981-15-4530-6_26

2.2 The Narrow Definition of Production Planning

Production planning refers to the production planning of all production workshops centered on the production planning department, which is generally expressed in the form of a form. For example, monthly production plan, weekly production plan, daily production plan, etc. [1].

2.3 Classification of Production Plans

(1) *Time classification*: The annual production plan, the quarterly production plan, the monthly production plan, the weekly production plan, the daily production plan, the production plan per hour, the production plan per minute and the production plan per second.
(2) *Organization classification*: Company production plan; department production plan; section production plan; group production plan; class production plan; line production plan; single machine production plan; single person production plan.
(3) *Object classification*: Order production plan, finished product production plan, component production plan, part production plan, production process plan.
(4) Resource classification: Personnel production plan; equipment production plan; material production plan; industrial production plan; environmental production plan; energy production plan.

2.4 Hierarchical Division of Production Planning

The production plan of manufacturing enterprise can be divided into three levels: strategic plan, tactical plan and job plan. The strategic plan is related to the future development of the whole enterprise. The formulation of the tactical plan defines the objectives to be achieved by the enterprise in production, and the job plan clarifies the working arrangements in the enterprise's production process: schedule, quantity, time, etc. See Table 1.

Table 1. Hierarchical division of production planning

Content	Strategy	Tactic
Time of plan	≥ 5 years	1 year
Range	Enterprise	Factory
Uncertainty	High	Medium
Management	Top	Middle
Trait	Acquirement of resource	The use of resource

3 Function and Purpose of Production Planning

3.1 Function of Production Planning

(1) *Planning function*: Production activities can be organized, organized and organized.
(2) *Prediction function*: The essence of production planning is to predict the production activities and to study and analyze the production activities [2].
(3) *Management function*: Production planning is also a kind of management, a clear objective management of the operation of the enterprise.
(4) *Supervisory function*: The production plan can exert the function of the production plan only by strictly supervising the actual production of the enterprise.
(5) *Coordination function*: The production plan studies and analyzes the problems that appear in the enterprise and resolves the problems.

3.2 Purpose of Production Planning

Improve production, work efficiency; properly reduce inventory; achieve balanced production.

To realize the production planning system with "monthly production plan as the leader and weekly production plan as the guide", and to realize the production plan management mode with "production planning, supervision during production, summary after production"; To realize the production mode of "production department as the center, each workshop comprehensive production", to prepare well before production, to study the external factors affecting production, and to enhance the balance of production.

4 The Influencing Factors and the Causes of Difficulty

4.1 Factors Affecting Production Planning

There are a number of factors that affect production planning, such as markets, resources, targets, warehouses, equipment, production methods, etc., as shown in Table 2.

Table 2. Factors affecting production planning

Factor	Content
Market	Demand, variety, price, etc.
Resource	Raw materials, equipment, manpower, etc.
Target	Cost minimization, production maximization, etc.
Depot	Maximize storage capacity, etc.
Equipment	Equipment maintenance cost minimization, etc.
Manufacturing	Single type mass production, multi-type production, etc.

(1) *Consideration of the ability*: According to the production capacity, the production planning problem can be divided into three kinds of production planning problems: no ability constraint, ability constraint and variable capacity. It can be solved by changing labor force, changing overtime time, changing equipment resources, etc. Make the production plan with different production capacity, different characteristics of production costs [3].
(2) *Consideration of energy conservation and environmental protection*: With the continuous development of economy, environmental problems have become increasingly prominent, manufacturing enterprises must abandon the previous economic benefit only the idea, and to consider sustainable development. To achieve the sustainable development of enterprises, mainly to the performance of equipment and production process improvement, reduce waste emissions increase to the same enterprise benefit goal the establishment of a position. The coordination of economy and environment production planning will take waste emissions into consideration.
(3) *Consideration of uncertainty*: When making production plans, enterprises must take into account many uncertain factors, such as market demand, price, production time, raw material supply, equipment problems, operational problems, etc. These uncertainties can affect the normal operation of the enterprise. To deal with these uncertainties, we need to do the following: for uncertain information, use probability distribution to express it. The production plan should be supported by the probability theory, the fuzzy information should be transformed into the quantitative probability theory, the quantitative probability theory should be solved, and the fuzzy information should be expressed by the way of fuzzy number. Fuzzy production planning problem should be solved by fuzzy theory and fuzzy technology.

4.2 Reasons Why the Production Plan Is Difficult to Realize

When the production plan is difficult to realize, there are usually the following reasons: the high level of the enterprise pays less attention to the production plan and thinks that the production plan is not necessary; the enterprise lacks the professional skills to make the production plan, The resulting production plan cannot be implemented; the actual situation is not fully taken into account when the production plan is drawn up, and the production plan does not conform to the actual production of the enterprise. There is not enough coordination and cooperation between the various departments, resulting in production planning could not be carried out.

5 Establishment of Evaluation Index System for Manufacturing Enterprise Production Planning

5.1 The Principle of Setting up an Index System

When an enterprise establishes an index system for production planning, it should consider the actual situation of the enterprise itself, and only establish an index system

that conforms to the conditions of the enterprise itself. The following principles should be followed when establishing the evaluation index system of production plan.

(1) *The principle of qualitative and quantitative interaction*: The implementation of the enterprise production plan will change the original state of the enterprise, and the impact of the implementation of the production plan on the enterprise should be fully considered in the establishment of the index system. Therefore, when establishing the index system, we should not only consider quantitative indicators. Also consider qualitative indicators.
(2) *The level and quantity of indicators should be appropriate*: If there are more index levels and the number of indicators, the evaluation will be more complex, which may lead to the decline of the correct rate of evaluation; if the index level and the number of indicators are too small, the enterprise production plan can't be evaluated completely.
(3) *The establishment of evaluation index should be in accordance with the conditions of the enterprise itself*: To establish an index system of production planning, we should consider the actual situation of the enterprise itself. Only by establishing an index system that conforms to the conditions of the enterprise itself, can the enterprise better realize its strategic objectives [4].
(4) *Combined with production planning*: The establishment of the evaluation index of production planning should not only reflect the current production planning situation of the enterprise, but also reflect the possible changes of the future production plan of the enterprise.
(5) *Operational principle*: The establishment of evaluation index should accord with objective facts, be simple to calculate, and the index data should be defined, otherwise, it may lead to poor maneuverability.
(6) *Having the characteristics of comparison*: The evaluation index should not only show the actual situation of its own enterprise, but also compare the situation of other enterprises and the same industry, and then, through comparison, improve its own enterprise's shortcomings and enhance its competitive power in the industry.
(7) *Principle of integrity*: Because the factors affecting the development of the enterprise include many aspects, the evaluation index system should be comprehensive, complete, and should be considered in many aspects at the same time.

5.2 The Idea of Establishing Index System

(1) *Understanding the necessity of establishing Evaluation Indexes for production Planning*: There are quite obvious differences between production plans in different industries, and the establishment of evaluation indicators will vary widely. The weights of the indicators should be adjusted according to the actual conditions of their own enterprises. Finally, set up a specific evaluation index of production plan in line with their own enterprise.
(2) *The expectations of the evaluation indicators for each aspect of the production plan vary*: When selecting the evaluation index, we should consider and analyze all aspects, and finally choose an evaluation index system which can fully reflect the expectations of the production plan.

(3) *To analyze the degree of difficulty and ease of Evaluation Index*: The more specific the evaluation indicators, the more accurate and reliable the results will be, but the higher the cost of establishing such evaluation indicators, the more effective and cost should be taken into account in the establishment of evaluation indicators, and to establish a reasonable evaluation index system [5].
(4) *Establishment of Evaluation Index should be practical*: The established evaluation index should play an important role in the enterprise's production plan, and the evaluation index should be combined with practice and theory in order to play its greatest role.

5.3 Establishment of Index System

From the aspects of financial management, operation management, customer, product quality, growth and learning, the following evaluation index system is established. See Table 3.

Table 3. Evaluation index system of production planning

First class index	Second class index	Third class index
Financial management	Enterprise manager	Return on assets
		Asset turnover rate
		Profit growth rate
		Sales growth rate
	Enterprise owner	Return on assets
Operation management	Production flexibility	Quantitative flexibility Time flexibility
	Operation process	Rate of sale of marketed goods
		Stock turnover
	Operating cost	Human cost
Customer	Product quality	Bounce rate
		Qualified rate
	Reliability	Rate of on time delivery
		Accurate delivery rate
		Customer complaint rate
		Effective trading rate
		Completion of order rate
Product quality	Product quality	Scrap rate Product rework rate
		One-time qualification rate
Growth learning	Information sharing	Effective rate of information
		Rate of change of information
	Innovation ability	Ratio of new technologies
		R & D investment rate

(1) Consideration of financial management: As far as enterprise managers are concerned, they are usually most concerned about the economic benefits, assets operation, development of enterprises, etc. The following indicators are commonly used to express.

Return on assets = Total profit/Value of assets

Asset turnover = Value of business income/Assets

Profit growth rate = (Current profit − Prior period profit)/Prior period profit

Sales growth rate = (Current sales volume − Prior period sales volume)/Prior period sales volume

Return on assets = 2 * Assets income/(Initial owner's income + Final owner's income)

(2) Consideration of operational management: Quantitative flexibility and time flexibility are utilized to express the manufacturing flexibility.

Quantitative flexibility = Enterprise product amount/Demanded amount from customer

Production and marketing rate = Sales volume/Manufactured volume

Human cost = Direct human cost + Indirect human cost

(3) Consideration of customer: Bounce rate and qualified rate are often taken into consideration when it refers to the product quality.

Bounce rate = Return quantity/Total sales

Qualified rate = Qualified amount/All the product amount

Rate of on time delivery = Times of on time delivery/Times of all the delivery

Accurate delivery rate = Times of accurate delivery/Times of trade

Completion of order rate = Times of completion from customers/Times of trade

Effective trading rate = Times of effective trading/Times of trade

Completed order rate = Completed order amount/All the order amount

(4) Consideration of the quality of the product: Scrap rate, product rework rate and one-time qualification rate are utilized to define the quality of the product.

Scrap rate = Scrap amount/Product amount

Product rework rate = Product rework amount/Product amount

One-time qualification rate = The amount of one-time qualification product/Product amount

(5) Consideration of growth and learning: In the aspect of information sharing, the effective information rate and the information change rate are commonly used.

Effective information rate = Converted information/All the information

The information change rate = (Current information − Prior period information)/All the information

Ratio of new technologies = Benefit from using new technologies/Benefit of the whole enterprise

R & D investment rate = Cost on R & D/Cost of the whole enterprise

Acknowledgment. Project supported by the Science and Technology Panning Project of Guangdong Province of China (2015A030401102).

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