

Research on Quantitative Value Added of Production Process based on Lean Accounting

Xiaobing Pei, Fangjian Shang*

Tianjin University of Technology, Tianjin 300384, China.

*yingguangjian@126.com

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Abstract: If an enterprise wants to stand out from the fierce competition environment, it is necessary to create greater value for customers at a lower cost, so that products have greater value added. To improve the production and obtain higher value-added, the company must first identify the value added so that it can be improved in a targeted manner. Based on the theory of lean accounting, this paper analyzes the various production links in the value stream from the cost. And the cost accounting is accurate to the level of production links in the value stream, making the cost accounting more specific. Then, the output value of each production link is analyzed, and the distribution method is adopted. By using the output value of each production link minus the cost of the link, the value added of the production link can be quantified. Enterprises can more rationally allocate resources according to quantitative value-added information, make the production improvement of the enterprise more targeted, maintain the competitiveness link, and improve the weak links, thereby improving the value added of the enterprise and helping the enterprise to improve its competitiveness.

1. Introduction

Faced with the dramatic changes in the world market and the intensification of competition, enterprises are increasingly demanding the production sector. Only by creating greater value for customers at a lower cost can we gain a competitive advantage and stand out from today's harsh competitive environment and achieve enduring development. As the demand of customers is getting higher and diversified, large-scale production methods can no longer meet the needs of customers, and lean production methods of many varieties and small batches have emerged. However, when many companies carry out lean improvement There will be many problems. The mismatch between traditional accounting and evaluation methods and lean production methods is the root cause of these problems. In order to adapt to lean production methods, cost accounting methods and performance evaluation methods are in urgent need of change.

The production link of an enterprise is a key link in the value added of an enterprise, and it is crucial to accurately calculate the value added in the production process. The traditional accounting system uses the department as the accounting unit, can only calculate the overall situation of each department, cannot obtain more specific information on each product line, and traditional accounting is post-accounting, unable to provide information in a timely manner. Lean accounting takes value stream as the core, eliminates waste, eliminates non-value-added links, maximizes value added, and better reflects the advantages of lean production methods.

Eliminating non-value-added links and improving lean production must first accurately identify the value added of each production link. This paper attempts to specific the production level and quantify the value added of each production link. Through the analysis of the value added of the production link, it can be more clearly clarified which part of the core competitiveness of the enterprise, which value of the production link has a low value added, and there is a waste situation, which can be improved more targeted. Therefore, using value-added information, maintaining core competitiveness links, maintaining competitive advantage, improving non-value-added links,

eliminating waste, and increasing the value added of weak links, so that enterprise production management can be more targeted.

2. Literature Review

The emergence of the standard cost method solves the problem that the output of the factory is much lower than the rated production capacity. As business operations become more complex, more precise ways are needed to help companies with costing. The generation of the activity-based costing method makes the allocation of indirect costs more reasonable, and plays a very important role in the accurate cost information and the improvement of the business process. The activity-based costing method allocates resources to the job or job center by resource driver, and the job cost is assigned to the product according to the job driver [1]. Compared with the traditional cost accounting method, the activity-based costing method is closer to the process-based management, and the process is reflected in the cost, analysis, and management methods. However, the activity-based costing method is more complicated when the types of services are more complicated, and is not consider unused capacity.

The introduction of the value chain provides a new way of thinking for cost management and value-added analysis. In *Competitive Advantage*, Michael E. Porter pointed out that if a company wants its profits to lead the competition for a long time, the company must have a unique competitive advantage. Porter first proposed the value chain theory in the book. The value chain was originally an accounting analysis method used to distinguish the profit margins of each step in the complex manufacturing process of the enterprise. The purpose is to determine which step can be cut cost or improve the functional characteristics of the product. Porter believes that the analysis of the added value of each step in the accounting analysis should be combined with the analysis of the organizational competitive advantage. Understanding the use and control of enterprise resources must be begin from discovering these independent creative values. Porter divides corporate production activities into basic activities and supporting activities. By considering these individual activities and their interrelationships, the competitive advantage of the enterprise is determined. However, it is not every link that creates value. Only some activities can make value-added. The competitive advantage of enterprises is derived from these production links that can add value to the value chain.

As people's demand for products diversified and demand increased, large-scale production methods were gradually replaced by small-scale production methods, and lean production methods came into being. Lean production emphasizes eliminating all waste and satisfying customers' needs with the fastest response speed [2]. Under the lean production mode, the proportion of science and technology and management methods has risen steadily due to the decline in raw material costs. The standard cost method and lean production methods are no longer compatible. After the transformation of lean production mode, we can't just stay in the change of production mode. Lean improvement requires the strong support of management, and the corresponding changes should be made in the management and finance of the enterprise [3].

Haskin introduces value stream accounting to prove that in some cases, traditional accounting and value stream accounting will lead to different conclusions. Value stream accounting can help companies make correct decisions and is more suitable for lean production [4]. Value stream is the core of lean accounting. The lean accounting concept is designed to better reflect the financial performance of companies implementing lean manufacturing processes. Lean accounting can calculate costs through value streams, and change inventory valuation techniques by using the time value of funds to provide more appropriate information for making correct decisions [5].

The most important task in analyzing the value chain is to identify the value added, which is the result of which links and which factors are added. It is determined that the value-added in each production link can be more targeted to help enterprises to improve production. However, most of the research on the value-added of enterprises is based on the overall level of the enterprise, or from the whole of the value chain, and the research is deeper into the production level is still relatively

less. Moreover, value-added activities and non-value-added activities of value streams are only distinguished from qualitative perspectives, and rarely from a quantitative perspective. Therefore, based on the previous scholars' research, this paper quantifies the value added of each production link on the value stream from the perspective of lean accounting, and helps enterprises to improve production.

3. Quantification of the Value Added of Each Link in the Production Process

3.1 Enterprise Cost Analysis based on Lean Accounting

Under the lean production mode, the demand for accounting information has become higher. In order to adapt to the production demand in weeks or even days, the monthly accounting cycle no longer meets the demand; the continuous improvement of the production process also requires accounting provide more detailed information. In order to adapt to the lean production method, the cost of the product is calculated more accurately and at the same time more detailed.

In the traditional accounting method, the time cost of funds is not included in the cost accounting of products. In order to make the cost accounting more accurate, this paper adds the time cost of funds to the cost accounting of the product. The time cost of joining funds is more in line with the idea of lean production. Lean thinking emphasizes the elimination of various wastes, including overproduction, waiting time, transportation, inventory, etc. These wastes will make the stay of funds longer, and invisibly increase capital cost. In order to better eliminate waste, more accurate cost accounting is needed to confirm which part of the waste is wasted, which part is wasted more, and the production improvement is more effective.

For cost accounting with time value, the capital cost interest rate must first be confirmed. The interest rate of capital cost is the opportunity cost rate of the funds used. It is the weighted average interest rate required by the shareholders and the interest rate of the debt. The necessary rate of return required by shareholders can be measured by the capital asset pricing model. It is the most widely used estimate of the cost of common stock capital. It consists of two parts: risk-free interest rate and risk premium. The formula is:

$$r = r_{RF} + \beta \times (r_m - r_{RF}) \quad (1)$$

Among them, r_{RF} represents risk-free interest rate, β represents stock beta coefficient, r_m represents average risk stock return rate, $(r_m - r_{RF})$ represents market risk premium, and $\beta \times (r_m - r_{RF})$ represents stock risk premium.

Another aspect that affects weighted average capital is the cost of capital for debt. Regardless of the debt capital issuance costs, if the company currently has listed long-term bonds, then the cost of debt can be calculated using the yield to maturity method. According to the bond valuation formula, the yield to maturity is the r that holds the following formula:

$$P_0 = \sum_{t=1}^n \frac{\text{interest}}{(1+r)^t} + \frac{\text{capital}}{(1+r)^t} \quad (2)$$

Among them, P_0 represents the market price of the bond, r represents the yield to maturity, that is, the cost of the pre-tax debt, and n represents the remaining term of the debt, usually expressed in years. The interest rate obtained by this formula is the yield to maturity of the debt.

The weighted average cost of capital of an enterprise is equal to the cost of capital of the stock multiplied by the percentage of capital occupied by the stock plus the cost of debt capital multiplied by the percentage of capital occupied by the debt.

In addition to making cost accounting more accurate, it is also necessary to make cost accounting more detailed. This paper will calculate the cost of each production link in order to determine the value added in each production process. The cost in the production process is divided into two parts: direct cost and indirect cost. Direct costs can be divided into direct material costs and direct labor, which can be directly included in the cost of each production link. Indirect costs need to be collected

and distributed to various production processes. It can be allocated according to the cost drivers such as production hours, workers' wages, machine hours, floor space, and other cost drivers.

Accurately accounting for the cost of each production link in the production process is the first step in the value-added of the accounting value. Only accurate cost can be used to calculate the accurate value-added and help the company to make more targeted production improvement. In addition, cost accounting is no longer constrained by traditional accounting as the accounting cycle, which can provide relevant information for production in a timelier manner, and is more in line with lean thinking.

3.2 Value Added Analysis based on Lean Accounting

Analyzing the process of value formation can help us understand the source of value added more clearly. The value formation process of products is the process of shifting the price of production factors and the creation of new values by labor. The various production factors form the final product through production activities, and the final value of the product is affected by various production factors. But from the perspective of customer perceived value, not all production factors can bring customer perceived value. The perceived value of the customer refers to the customer's perception of the properties of the product or service, and the perception of the use of the product or service that helps the user achieve a certain goal in an environment [6]. The driving factors of customer perceived value include product quality perception, service quality perception, brand value perception and product price perception.

The output value of each production link on the value stream is different from the pricing of the product can be determined by the market. The output of the production process occurs within the enterprise and is difficult to express by the market price. When determining the output value of each production link, the value distribution method can be adopted. The output value of some production links cannot be determined by the perceived value of the customer, according to the principle of cost allocation, the value distribution of each production link can be carried out under the condition that the final output value of the process is determined.

Combining quantitative and qualitative analysis, this paper establishes a distribution standard of "value weight", that is, the importance of realizing the value of the production process in the process is expressed in proportion to the proportion, which can be regarded as the importance of the value of the production link. Sorting is determined by the manager according to the characteristics of the company itself. The factors usually considered are the impact of production links on customer satisfaction, technical complexity, and output quality. They are the value drivers corresponding to the cost drivers, that is, the factors that drive the formation of value. Since the formation of value is the result of the combination of multiple factors, "value weight" can be expressed as a multi-factor function: value weight = F (customer satisfaction, technical complexity, output quality, ...).

The value drivers are identified and the drivers are used as indicators of value distribution. In order to remove factors that cannot be quantified by certain indicators, qualitative indicators should be converted into quantitative indicators before distribution. The fuzzy comprehensive evaluation method can be used to convert qualitative indicators into qualitative indicators. The fuzzy comprehensive evaluation method can improve the accuracy and reliability of the evaluation, and make the scientific and reasonable quantitative evaluation of the ambiguous information. The fuzzy comprehensive evaluation method is to establish an evaluation model to accurately reflect the logical relationship between the various influencing factors and evaluation indicators. After converting the qualitative data into quantitative data, the entropy method is used to determine the weight of the output value distribution. The concept of entropy comes from thermodynamics and was later cited in information theory. Using the entropy method to determine the weight, the greater the degree of dispersion of the data, the smaller the information entropy, the larger the amount of information provided, the greater the impact of the index on the comprehensive evaluation, the greater its weight; otherwise, the difference between the indicators the smaller the information entropy, the smaller the amount of information it provides, and the smaller the impact of the indicator on the evaluation results, the smaller the weight. Using the entropy method to determine the weight can overcome the

subjective and random problem of using subjective weighting method, and can effectively solve the problem of overlapping information between multiple indicator variables.

The steps to determine the weight using the entropy method are as follows:

1. Establish a matrix of raw data X_{ij} :

$$X_{ij} = \begin{bmatrix} x_{11} & \cdots & x_{1m} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nm} \end{bmatrix}$$

2. Dimension the indicators:

Since the units of the indicators selected are not the same, in order to eliminate the impact of these differences, these indicators need to be dimensionless. Commonly used linear dimensionless methods include standard processing methods, extreme value processing methods, and power factor methods. From the empirical analysis, the data obtained by the extremum method using the extremum method is better than other methods. It can be seen from the selected indicators that some of the indicators are as large as possible, such as productivity, product qualification rate, basic quality of employees, etc.; some indicators are as small as possible, such as equipment failure rate, quantity of inventory, in order to unify standards, this article Select the extremum method to quantify the data without any criteria. The specific processing method is as follows:

If the evaluation index X_j is a positive indicator, then

$$y_{ij} = \frac{X_{ij}-m_j}{M_j-m_j} \quad (i = 1,2, \dots, n; j = 1,2, \dots, m) \quad (3)$$

If the evaluation index X_j is a negative indicator, then

$$y_{ij} = \frac{M_j-X_{ij}}{M_j-m_j} \quad (i = 1,2, \dots, n; j = 1,2, \dots, m) \quad (4)$$

among them, $M_j=\max\{X_{ij}\};m_j=\min\{X_{ij}\}$.

After the dimensionless processing, some data may be negative or zero, which will cause the next step to be meaningless when calculating the logarithm, and also need to translate the data, $y'_{ij} = y_{ij} + d$, where d is an integer slightly larger than $\left| (y_{ij})_{\min} \right|$.

3. Calculate the proportion of the j -th indicator under the i -th scheme:

$$p_{ij} = \frac{y'_{ij}}{\sum_{i=1}^n y'_{ij}} \quad (5)$$

4. Calculate the index entropy value e_j of the j -th indicator:

$$e_j = -k \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (6)$$

among them, $k=\frac{1}{\ln(n)} > 0$

5. Calculate the difference coefficient of the j -th indicator:

$$g_j = 1 - e_j \quad (7)$$

6. Calculate the weight of the j -th indicator:

$$w_j = \frac{g_j}{\sum_{j=1}^m g_j} \quad (8)$$

7. Calculate the composite score of the i -th link being evaluated:

$$s_i = \sum_{j=1}^m w_j p_{ij} \quad (9)$$

The entropy method is used to calculate the comprehensive score of each production link. The comprehensive score represents the relationship between each production link and the output value. The more the production points, the greater the contribution to the output value. The value of the output should be greater. The price determined by the contradiction between supply and demand is the final value of the product produced by the enterprise. Since the quantification is the value added in each production process, it is necessary to eliminate the influence of the input of the initial raw materials, and subtract the raw materials of the initial one-time input from the final value, and the sum of the output values of the various production links can be obtained. By using the comprehensive score as the weight and distributing the output value to each production link, the output value at each production link can be obtained.

By using the output value at each link and subtracting the cost of each production link obtained by the introduction method, the value added on each production link can be quantified.

Considering the time cost of funds and quantifying the value added of various production links on the value stream, it can help enterprises to analyze more accurately and detail, find the most competitive links and weak links, improve weak links, and maintain competitiveness links. Enterprises make improvements in production and gain greater value added.

4. Summary

More and more enterprises adopt lean production methods to meet people's diverse needs. Lean production methods need to be changed from thinking. It is not only to improve lean in the production department, but also to cooperate with all employees in other departments. Only in this way can we succeed to lean improvement. This paper provides an idea for the value-added of production links to improve the production of enterprises. Enterprises also need to select the influencing factors suitable for the value added of enterprises according to the characteristics of the industry as the basis for the distribution of output value, in order to make the quantification of value-added more precise, and thus more targeted production improvement.

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