

Research on Enterprise Performance Evaluation based on Value Stream Analysis

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Abstract: Based on the analysis of value stream, this research takes source supplier, internal process and customer or market as the starting point, and establishes a number of performance evaluation indexes from 10 aspects such as supplier's supply ability, enterprise's financial status and customer's satisfaction level. According to the hierarchical relationship among the indicators, a hierarchical structure model is constructed, which is solved by the analytic hierarchy process and tested for consistency, obtain the comprehensive weight of each index. This research provides some reference for improving performance evaluation system of lean production.

1. Introduction

After implementing lean, many companies find that traditional performance evaluation indicators do not measure the effect of lean improvement well, and still use traditional accounting methods. Lean benefits are not always obvious [1]. Lean accounting can truly reflect the activities of lean thinking, and when the enterprise changes its accounting model, the performance evaluation indicators based on the traditional accounting model are not completely consistent with the lean requirements. Aghdaei S H [2] pointed out that lean accounting achieves the goal of shortening time by avoiding unnecessary waste in traditional accounting control activities. In lean accounting management activities, value stream is the core of lean accounting, and its objectives are related to performance evaluation. It focuses on continually improving barriers to process work, emphasizing value creation and encouraging companies to continuously improve lean. Frances A. Kennedy [3] pointed out that the change in accounting model leads to a corresponding change in performance evaluation because performance evaluation is not consistent with lean. David Drickhamer [4] demonstrated the difference between the lean accounting method and the standard cost method, and pointed out that the value stream graph can be used to analyze lean accounting and evaluate lean performance on this basis. Beau Keyte [5] and so on elaborated the main content of the value stream, indicating that the production process can be improved through the flow of production data on the value stream, while strengthening the management of suppliers and customers. Maskell B H [6] et al. indicate that performance evaluation should focus on the entire value stream process. Behrouzi F [7] reviewed the performance evaluation of enterprises and proposed that the enterprise performance evaluation based on lean management concept is practical. So lean enterprises can't use traditional evaluation indicators, if the lean operation and traditional evaluation indicators are confused, enterprises can't achieve the purpose of lean transformation.

2. Value Stream Analysis

Based on the analysis of the physical transformation process of products, humans put forward the concept of lean flow, the core of value-based flow, through the study of lean production, which makes humans realize that value flow analyzes and improves the transformation of entities in the production process. Aspects play an important role in achieving lean production. The lean accounting management model changes the traditional enterprise management methods and business operation processes, emphasizing the analysis of value streams to create maximum value for

customers. The value stream integrates the material flow, information flow, capital flow and technology flow in the production process of the product, and integrates the supplier, the internal process of the enterprise, the customer or the market. The value stream is a cyclical process, which means that the company uses the information flow to purchase raw materials from the suppliers according to the customer's order requirements, transforms them into products within the enterprise, and gives them value, and finally delivers all the activities of the customers. Its main components are:

(1) Supplier. Pull-type production is the main feature of lean production methods. Suppliers provide material-based activities based on order-driven, and achieve high-time, accurate and parallel operation according to customer demand orders, ensuring unnecessary waste and cost in the supply process. Achieve flexibility and flexibility in lean supply.

(2) Internal processes. Value stream activities can be divided into three types: non-value-added activities, necessary non-value-added and value-added activities, which focus on value-added activities that create value for customers. Within the company, the materials provided by the supplier are processed together with other input resources to produce products that meet customer needs and realize value.

(3) Customer or market. The value stream is oriented to the market demand to achieve order-based production, to meet the requirements of customers in the market, to create customer value, and to meet the needs of customers to achieve customer service.

3. Selection of Evaluation Indicators

3.1 Supplier Evaluation Indicator Selection

Suppliers are the source of value stream, providing enterprises with the materials needed for production activities. Its performance directly affects the core company's delivery level, product quality, inventory level and customer satisfaction, which in turn affects the performance of the entire value stream. Enterprises must evaluate the performance of suppliers to ensure the quality of materials and improve service levels to ensure that companies choose suppliers correctly. This study will establish supplier evaluation indicators from the following aspects.

(1) Supply capacity. Companies that implement lean manufacturing implement lean management. They must pay attention to time efficiency and pursue the procurement of the required products in the shortest time to ensure that the products needed by the market or the quality services are produced as quickly as possible. Suppliers must deliver on time and at the specified time to avoid delays in delivery or early delivery. Delays in delivery of suppliers result in increased production costs, and early delivery may increase operating costs.

(2) Quality level. The quality of the materials delivered by the supplier shall comply with the production technical requirements, which is directly related to the results of the production and operation of the enterprise. The enterprise shall pay attention to the quality of the supplier's supply. If the quality of purchased materials can be steadily improved, the procurement cost and production cost will be reduced, thereby ensuring the production of stable and durable high-quality products and strengthening their competitiveness. Therefore, controlling the quality level of suppliers is a key factor in the results of enterprise procurement.

(3) Collaboration ability. The rapid development of social economy has enabled more and more enterprises to focus on their partners in the process of strategic development and improve their competitiveness in the market through overall strategic cooperation. The increase of communication and communication between suppliers and enterprises is conducive to the establishment of a good friendship and cooperation relationship, and the formation of incentives for suppliers to improve their comprehensive service capabilities, to meet the customer's customized needs at the fastest speed.

Specific indicators in various aspects are shown in Table 1.

Table 1. Supplier performance evaluation index

Primary indicator	Secondary indicators	Three-level indicator
Supplier(B ₁)	Supply Capacity(C ₁)	On-time delivery rate(D ₁) Competitive price advantage(D ₂) Just in time service(D ₃)
	Quality level(C ₂)	Rate of qualified products(D ₄) Product return rate(D ₅)
	Collaboration(C ₃)	Strategic goal consistency(D ₆) Information sharing(D ₇)

3.2 Internal Process Evaluation Indicator Selection

In the internal process activities of the enterprise, all kinds of input resources, such as materials, equipment, energy, manpower, information, capital, space and time, must be fully utilized in the process of value flow, and ultimately by satisfying customers. The products that the market needs to realize its value. Conduct internal process performance evaluation, measure the utilization of various resources, and find that defects in the process are improved to improve lean performance. This study will establish internal process evaluation indicators from the following aspects.

(1) Financial status. First choose financial status as a measure of internal process performance. Enterprise performance evaluation indicators are constantly updated, but financial indicators are still in a dominant position in performance evaluation. The financial situation is an important part of the internal operation of the enterprise. The investigation and familiarity with the financial situation are conducive to the enterprise to strengthen the management of funds, promote the rational circulation of capital flow, and provide effective guarantee for the turnover of corporate funds.

(2) Efficiency level. In internal processes, efficiency refers to an evaluation method that uses resources most efficiently to meet set desires and needs given conditions such as inputs and technologies. The internal process activities of the value stream focus on the efficiency impact, including overall equipment efficiency, per-capita sales and other productivity, value-added operating rate and other operational efficiencies, from a holistic perspective to analyze the entire life cycle of the company's products, avoiding only the production part Optimal without producing an overall optimality.

(3) Value creation. The internal process of value stream emphasizes value creation ability, production meets the target customer's products and provides satisfactory service, which is essentially the process of value creation. The value stream focuses on the various factors that influence value creation, and starts to enhance the value creation ability of each link from all aspects of value creation. EVA (Economic Value Added) is a measure of value creation, and its idea comes from residual income. Given that EVA is a good measure of value creation, this study selects EVA-related indicators to measure value creation.

(4) Personnel development. Human development indicators reflect the key role that stakeholders play in business success. As a strategic resource of modern enterprises, human resources have exclusiveness and increases the connection between employees and enterprises. It is a key factor in the development of enterprises. Enterprises must satisfy the interests of employees and fully mobilize the enthusiasm of employees. The positive psychological state will often enable them to better serve the enterprise, and at the same time pass the enthusiasm, sincerity and quality service to the customers, resulting in higher customer satisfaction. At the same time, employees with innovative thinking are the magic weapon for enterprises to compete and win, and it is of great practical significance to continuously improve the production process.

Specific indicators in various aspects are shown in Table 2.

Table 2. Internal process performance evaluation indicator

Primary indicator	Secondary indicators	Three-level indicator
Internal Process(B ₂)	Financial status(C ₄)	Total asset turnover(D ₈)
		Inventory turnover(D ₉)
		Return on total assets(D ₁₀)
		Sales cash flow ratio(D ₁₁)
	Efficiency level(C ₅)	Cash flow liability ratio(D ₁₂)
		Overall equipment efficiency(D ₁₃)
		Operating safety rate(D ₁₄)
Value Creation(C ₆)	Per capita sales(D ₁₅)	
	Value-added operation rate(D ₁₆)	
	Value-added operation cost rate(D ₁₇)	
Personnel development(C ₇)	EVA rate(D ₁₈)	
	Equity EVA rate(D ₁₉)	
	EVA per share(D ₂₀)	
	Job Training(D ₂₁)	
		Labor mobility(D ₂₂)
		Health and safety(D ₂₃)
		Accident rate(D ₂₄)

3.3 Customer or Market Evaluation Indicator Selection

Value stream activities are carried out around customers in the market. They are the reason for the existence of the company and the key to realizing its value. As market competition intensifies, the status of customers as the ultimate consumers in the market is clearly rising. Market performance is an important part of corporate performance. Only when the company's market performance level is improved, can the company's profit be continuously developed. This study will establish customer or market evaluation indicators from the following aspects.

(1) Satisfaction level. Customer satisfaction is the decisive factor for enterprises to increase market share, in order to further obtain better economic efficiency and business performance. Research shows that customer satisfaction and loyalty are key to a company's dynamic and sustainable competitive advantage. Enterprises must always put the needs of customers first, enhance the trust and persistence of customers to the company, and avoid the loss of existing customers.

(2) Marketing ability. The market competitiveness is intensifying, and the survival and development of enterprises depends to some extent on their market share, and the market share ultimately depends on customer satisfaction. Enterprises should deeply embed marketing concepts into their daily work, and promote enterprises to better integrate into the market and improve their comprehensive competitiveness in the market.

(3) Development capacity. The growth rate of an enterprise depends on its ability to develop. The level of development ability determines whether the company can maintain high-speed and stable development in a long period of time, and whether it can enhance its competitive advantage in the market. In the fierce market competition, enterprises can still maintain a good growth rate and trend, and the market share of their products has also increased, and the development of new markets, new products, new customers, etc. have witnessed the effective growth of enterprises.

Specific indicators in various aspects are shown in Table 3.

Table 3. Customer or market performance indicator

Primary indicator	Secondary indicators	Three-level indicator
Customer or market (B ₃)	Satisfaction level(C ₈)	Customer retention rate(D ₂₅) Customer complaint rate(D ₂₆)
	Marketing ability(C ₉)	Market share(D ₂₇) Average sales rate(D ₂₈) New product sales rate(D ₂₉)
	Development ability(C ₁₀)	Market share growth rate(D ₃₀) New market development capabilities(D ₃₁) New product development capability(D ₃₂) New customer development capabilities(D ₃₃)

4. Enterprise Performance Evaluation based on AHP

4.1 Building a Hierarchical Model

According to the analytic hierarchy process, the above-mentioned Table 1, Table 2, and Table 3 can be used to obtain the hierarchical structure model of enterprise performance evaluation index based on value stream analysis, as shown in Figure 1.

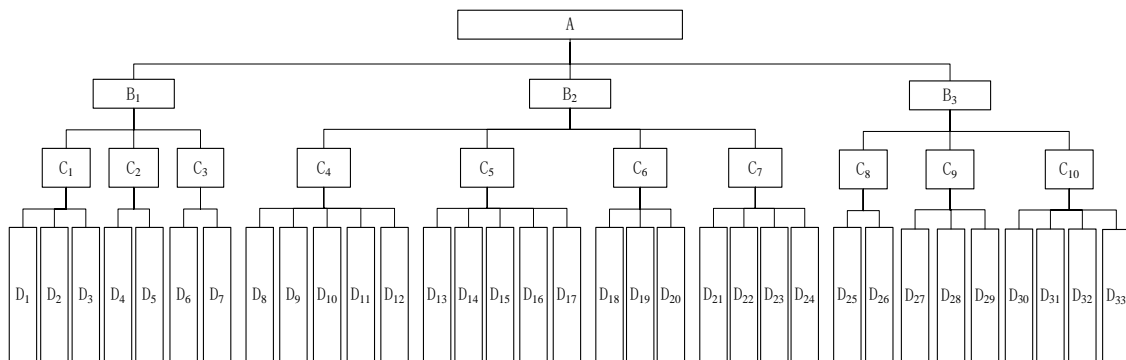


Figure 1. Performance evaluation index hierarchy model

4.2 Index Weight Judgment and Consistency Test

Invite Lean experts, management personnel in the implementation of lean production, and professionals in performance evaluation to form an expert group to conduct in-depth discussions. Based on the principle of comparing two elements and two elements, assign values to each element using the evaluation scale of 1-9. 1, 3, 5, 7, and 9, respectively, represent one element that is "equal importance", "slightly important", "quite important", "significantly important", and "absolutely important", 2, 4, 6 And 8 is the compromise between other values. Combined with the hierarchical structure model of Figure 2 and the evaluation scale according to 1-9, the expert group has set a comparison value for each element of each two layers from top to bottom. The comparison values between the elements are shown in Table 4.

Table 4. Comparison of the two elements of each layer

Elemen t	Contras t value	Elemen t	Contras t value	Elemen t	Contras t value	Elemen t	Contras t value	Elemen t	Contras t value
B ₁ /B ₂	1/5	C ₈ /C ₉	3	D ₉ /D ₁₀	1	D ₁₄ /D ₁	3	D ₂₃ /D ₂	2
						7		4	
B ₁ /B ₃	1/3	C ₈ /C ₁₀	5	D ₉ /D ₁₁	2	D ₁₅ /D ₁	2	D ₂₅ /D ₂	2
						6		6	
B ₂ /B ₃	3	C ₉ /C ₁₀	3	D ₉ /D ₁₂	3	D ₁₅ /D ₁	5	D ₂₇ /D ₂	5
						7		8	
C ₁ /C ₂	1	D ₁ /D ₂	3	D ₁₀ /D ₁	3	D ₁₆ /D ₁	1	D ₂₇ /D ₂	7
				1		7		9	
C ₁ /C ₃	1	D ₁ /D ₃	4	D ₁₀ /D ₁	3	D ₁₈ /D ₁	1/2	D ₂₈ /D ₂	5
				2		9		9	
C ₂ /C ₃	3	D ₂ /D ₃	2	D ₁₁ /D ₁	2	D ₁₈ /D ₂	3	D ₃₀ /D ₃	3
				2		0		1	
C ₄ /C ₅	5	D ₄ /D ₅	5	D ₁₃ /D ₁	1	D ₁₉ /D ₂	5	D ₃₀ /D ₃	3
				4		0		2	
C ₄ /C ₆	3	D ₆ /D ₇	3	D ₁₃ /D ₁	2	D ₂₁ /D ₂	1/3	D ₃₀ /D ₃	5
				5		2		3	
C ₄ /C ₇	7	D ₈ /D ₉	3	D ₁₃ /D ₁	1	D ₂₁ /D ₂	2	D ₃₁ /D ₃	5
				6		3		2	
C ₅ /C ₆	1/3	D ₈ /D ₁₀	3	D ₁₃ /D ₁	2	D ₂₁ /D ₂	2	D ₃₁ /D ₃	5
				7		4		3	
C ₅ /C ₇	3	D ₈ /D ₁₁	4	D ₁₄ /D ₁	1/2	D ₂₂ /D ₂	2	D ₃₂ /D ₃	1
				5		3		3	
C ₆ /C ₇	3	D ₈ /D ₁₂	5	D ₁₄ /D ₁	2	D ₂₂ /D ₂	4		
				6		4			

According to the comparison values between the two elements set by the expert group in Table 4, the corresponding judgment matrix is constructed, and the consistency test is performed. The calculated consistency evaluation index CR (Consistence Ratio) is less than 0.1, the judgment matrix has consistency, and the determined weight value of each element is valid; if the CR is greater than 0.1, the expert group once again discusses setting the comparison value until the test is passed. This study takes the judgment matrix (represented by A-B) composed of two layers A and B as an example. By solving the matrix A-B, the weighting values of the B layer elements B1, B2, and B3

and the consistency evaluation index of the matrix A-B under the total target A can be obtained, as shown in Table 5.

Table 5. A-B Judgment matrix and consistency test

A	B ₁	B ₂	B ₃	Weights	Consistency test
B ₁	1	1/5	1/3	0.1061	C.R.=0.032
B ₂	5	1	3	0.6334	
B ₃	3	1/3	1	0.2605	

It can be seen from Table 5 that the consistency evaluation index C.R. of the judgment matrix A-B is 0.032 less than 0.1, and the judgment matrix A-B composed of the comparison values set by the expert group is consistent. In the same way, according to the same steps, the judgment matrices constructed by the two layers B and C and C and D are solved and the consistency test is performed. The results show that the CR values of each judgment matrix are less than 0.1, and the proofs are consistent. The weight value of the element is also valid.

It can be seen from Fig. 1 that the representative letters of the top to bottom layers are A, B, C, and D, respectively, and the weight of the i ($i = 1, 2, \dots, 33$) elements of the D layer for the corresponding C layer is D_i ; the m ($m=1, 2, \dots, 10$) elements of the corresponding C layer are C_m for the corresponding B layer; meanwhile, the n ($n=1, 2, 3$) elements of the corresponding B layer are the weight of the A layer is B_n , and the weight of the i element of the D layer corresponding to the A layer is $D_i \times C_m \times B_n$, that is, the integrated weight value of the lowest layer for the highest layer is set to D'_i . For example, from the hierarchical model, the comprehensive weight value D'_{16} of the 16th element value-added operation rate of the D layer is $D'_{16} = D_{16} \times C_5 \times B_2$. The weight value of each element and the combined weight value of the lowest layer element are shown in Table 6.

Table 6. Comprehensive weight value

	B	B _n	C	C _m	D	D _i	D' _i		
A	B ₁	0.1061	C ₁	0.4286	D ₁	0.6232	0.0283		
					D ₂	0.2395	0.0109		
					D ₃	0.1373	0.0062		
			C ₂	0.4286	D ₄	0.8333	0.0379		
					D ₅	0.1667	0.0076		
					D ₆	0.7500	0.0114		
	B ₂	0.6334	C ₃	0.1428	D ₇	0.2500	0.0038		
					C ₄	0.5688	D ₈	0.4743	0.1709
							D ₉	0.1740	0.0627
							D ₁₀	0.1978	0.0713
							D ₁₁	0.0894	0.0322
	C ₅	0.1281	D ₁₂	D ₁₂	0.0645	0.0232			
				D ₁₃	0.2458	0.0199			
				D ₁₄	0.2322	0.0188			
				D ₁₅	0.2958	0.0240			
						D ₁₆	0.1304	0.0106	
						D ₁₇	0.0958	0.0078	

			C ₆	0.2372	D ₁₈	0.3091	0.0464	
					D ₁₉	0.5813	0.0873	
					D ₂₀	0.1096	0.0165	
		B ₃	0.2605	C ₇	0.0659	D ₂₁	0.2365	0.0099
					D ₂₂	0.4720	0.0197	
					D ₂₃	0.1860	0.0078	
					D ₂₄	0.1055	0.0044	
		B ₃	0.2605	C ₈	0.6334	D ₂₅	0.6667	0.1100
					D ₂₆	0.3333	0.0550	
					D ₂₇	0.6966	0.0193	
	B ₃	0.2605	C ₉	0.1061	D ₂₈	0.2316	0.0064	
				D ₂₉	0.0718	0.0020		
				D ₃₀	0.4836	0.0328		
				D ₃₁	0.3306	0.0224		
	B ₃	0.2605	C ₁₀	0.2605	D ₃₂	0.1018	0.0069	
				D ₃₃	0.0840	0.0057		

5. Conclusion and Outlook

This study establishes an evaluation index system based on value stream analysis for the problem of performance evaluation indicators that enterprises that implement lean production need to adapt to them, and uses AHP to calculate the weight value of each indicator. This study illustrates that companies should not only focus on the internals of the company when conducting performance evaluation, but should also evaluate supplier performance and market performance from a holistic perspective. In the process of operation, the company actively promotes lean thinking to improve customer satisfaction and enhance the market competitiveness of the company. It uses the indicators established in this study to objectively evaluate lean activities and help enterprises identify in lean promotion and operation. Existing obstacles, so that enterprises can overcome obstacles, better implement lean production, improve the overall operational efficiency and efficiency of the enterprise, and promote the continuous success of domestic lean production.

However, all walks of life have their own unique value streams. The enterprise performance evaluation index system based on value stream analysis constructed in this paper is not very effective for every enterprise. In the future study and work practice, we will continue to conduct in-depth research on different types of value streams, continue to improve, and better serve the performance evaluation of lean manufacturing enterprises.

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