

# Dynamic Establishment of Weight of Enterprise’s Internal Function Based on AHP and QFD

Pei HE, Yue-Xiong GONG, Li-Xing ZHANG, Li XIE

China Tobacco Zhejiang Industrial Company Limited, Hangzhou, 310024, China

**Abstract:** Modern enterprise management strives to become effective and pragmatic, usually, KPI is the most essential key indicator for the enterprise examination department. However, because the supporting and bearing roles of KPI for different departments are different, no a rather scientific quantification for the weight between them is available, unbalanced examination weights between indicators and departments usually exists. Here, it is with balanced score card to breakdown enterprise’s key tasks, card the performance indicators supporting enterprise’s key tasks, and utilize AHP and QFD method to dynamically establish a standard for measuring each department’s indicators so as to provide a basis for enterprise’s scientific examination.

## 1.Integral Frame of the Project

Here, with the strategy of Hangzhou Cigarettes Factory as a start point, the key performance indicators of current year on basis of enterprise’s tasks of the said year are carded, the broken-down indicators are sorted with KJ method, and the weight of the key indicators are determined with AHP method. Comparison with industry advanced level is made with key indicators-functional department matrix, and finally the weight supporting each department’s key indicator is obtained. The integral frame is shown in Fig. 1.

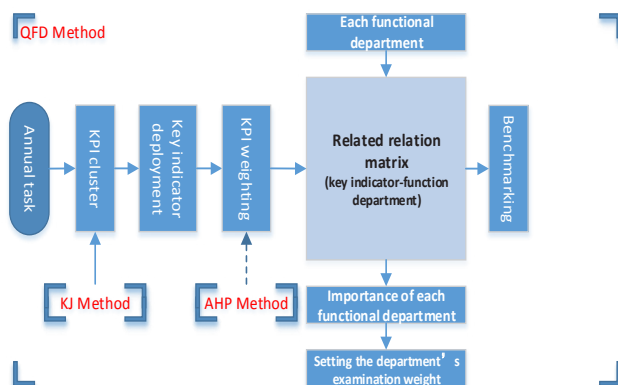


Fig. 1 Diagram of Integral Study Frame

## 2.Breaking Down of Annual Key Performance Indicators

Some enterprise’s annual tasks are rather definite, while some tasks are hidden in the high-level documents or laws or regulations of external origins, usually, the enterprise conducts an overall carding to ensure comprehensiveness of its annual tasks. Generally, an enterprise may be carded from four aspects (finance, customers, internal operation, and learning and growth) of the balanced score card. After breaking down of tasks, each supporting key indicator is re-divided. Taking the carding of year-2015 key performance indicators of Hangzhou Cigarettes Factory as example, the carding of Hangzhou Cigarettes Factory in 2015 in four aspects determines the annual tasks, as shown in Table 1.

Tab. 1 Breaking Down Table of Key Performance Indicators of Hangzhou Cigarettes Factory in 2015

Level-I indicators	Level-II indicators (Balanced Score Card)	Level-III indicators performance
	Finance	Controllable management fee of a single box

Rational setting of enterprise key performance indicators		Cut filler rate	4.1454	Finance	Internal operation	Learning and growth	Customers	wi
		Roll paper consumption of a single box						
		Composite energy consumption of 10000 pieces of cigarette						
	Customers	Consumers' satisfaction on product quality	Finance	1.0000	0.5000	4.0000	0.3333	0.1903
		Satisfaction on inter-department cooperation	Internal operation	2.0000	1.0000	4.0000	0.5000	0.2836
	Internal operation	Mean productivity per on-post employee	Learning and growth	0.2500	0.2500	1.0000	0.2500	0.0759
		Sigma level of production process	Customers	3.0000	2.0000	4.0000	1.0000	0.4503
		Acceptance ratio of random inspection of Level-I and Level-II station						
		Complaint and claiming rate of product quality						

Tab. 3 Distribution of Weight of Level-III Indicators

Scheme	Weight	Scheme	Weight	Scheme	Weight
Consumers' satisfaction on product quality	0.4052	Mean productivity per on-post employee	0.0211	Run efficiency of rolling equipment	0.0297
Composite energy consumption of 10000 pieces of cigarette	0.0432	Sigma level of production process	0.0282	Run efficiency of packing equipment	0.0335
Roll paper consumption of a single box	0.0233	Acceptance ratio of random inspection of Level-I and Level-II station	0.0613	Standard compliance ratio of training hours	0.0379
Cut filler rate	0.0805	Complaint and claiming rate of product quality	0.0842	Ratio of middle/senior technical title	0.0379
Controllable management fee of a single box	0.0432	Outage rate of tobacco primary processing equipment	0.0256	Satisfaction on inter-department cooperation	0.0450

### 3.Ordering of Importance of Key Performance Indicators

After determining the key performance indicators, the project group invites the personnel of functional departments to compare relative importance of level-I, level-II and level-III performance indicators with a pair-wise method, and analyze the data with yaaha analytic hierarchy process software. The calculated coefficient of test of concordance is below 0.1 and meets requirements. Due to limited space, here, merely the ordering and test of concordance of level-II indicators and total weight distribution of level-III indicators are cited, as shown in Table 2 and Table 3.

Tab. 2 Distribution of Weight of Level-II Indicators

Setting of key performance indicators : 0.0544: setting of weight of "key performance indicators: 1.0000: $\lambda_{max}$ :
---

### 4.Building of House of Quality of Key Performance Indicators-functional Department

#### Competitive Assessment of Key Performance Indicators

In order to find out the difference between indicators of us and other benchmarking enterprises, our indicators are compared with other enterprise's indicators in five grades (score 1-5) on basis of data on the excellence and standard-compliance of year-2015 cigarette industry, and in combination with features (highlights) of our key performance indicators, their absolute importance is obtained, as shown in Fig. 2.

Quality/Technical characteristics			Competitive assessment		Planned target		Weight		
			Hangzhou Cigarettes Factory	Domestic benchmarking enterprise	Planned quality	Improvement ratio	Product characteristics	Absolute importance	Relative importance
Customers' demands									
Level-I	Level-II	Level-III							
Rational setting of enterprise key performance indicators	Finance	Controllable management fee of a single box	2	5	5	2.50	1.0	10.8	6.666
		Cut filler rate	3	4	5	1.67	1.0	13.4	4.284
	Customers	Roll paper consumption of a single box	2	5	5	2.50	1.0	5.8	1.963
		Composite energy consumption of 10000 pieces of cigarette	2	4	5	2.50	1.2	13.0	4.400
		Consumers' satisfaction on product quality	4	5	5	1.25	1.0	50.7	18.023
	Internal operation	Mean productivity per on-post employee	5	5	5	1	1.0	2.1	0.916
		Sigma level of production process	3	4	5	2	1.0	4.7	2.059
		Acceptance ratio of random inspection of Level-I and Level-II station	4	5	5	1	1.0	7.7	3.428
		Compliant and claiming rate of product quality	3	5	5	1.67	1.2	16.8	7.801
		Outage rate of tobacco primary processing equipment	3	5	5	1.67	1.0	4.3	2.144
		Run efficiency of packing equipment	2	5	5	2.50	1.2	10.1	5.180
	Learning and growth	Run efficiency of rolling equipment	2	5	5	2.50	1.2	8.9	4.833
		Standard compliance ratio of training hours	3	5	5	1.67	1.0	6.3	3.593
			Ratio of middle/senior technical title	3	4	5	2	1.0	7.5

Fig. 2 Competitive Assessment Table of Key Performance Indicators

### 5. Matrix Analysis of Key Technical Indicators-functional Department Relation

After completion of the fore-phase work, the project group determines the matrix of "key performance indicators-each department's function" two-dimensional relation matrix, which is used to express the complex relation between each key performance indicator item and each functional department. Here, figure 6 expresses the "Strong" relation, i.e. the improvement of a key performance is strongly related with the compliance of corresponding functional department; 3 expresses "medium" relation, i.e. the improvement of a key performance is medium related with the compliance of corresponding functional department; 1 expresses the "weak" relation, i.e. the improvement of a key performance is weakly related with the compliance of corresponding functional department; and the blank expresses the no direct relation. When the selected product performance indicators are closely related with the compliance of corresponding functional department, for embodying the correlation, figure 9 is used, as shown in Table 3.

Quality/Technical characteristics			Customers' demands												
			General Office	Production Technology Department	Tobacco Primary Processing Shop	Packing Shop	Power Shop	Tooling Department	Trade Union	Political Education Office	Information Center	Administrative Affairs Department	Supervision Section	Personnel and Labor Department	Technical Reformation Office
Level-I	Level-II	Level-III													
Rational setting of enterprise key performance indicators	Finance	Controllable management fee of a single box	3	3	3										
		Cut filler rate	3	3	3										
	Customers	Roll paper consumption of a single box	3	3	3										
		Composite energy consumption of 10000 pieces of cigarette	1	4	3										
		Consumers' satisfaction on product quality	1	3	3										
	Internal operation	Mean productivity per on-post employee	3	3	3										
		Sigma level of production process	1	4	3										
		Acceptance ratio of random inspection of Level-I and Level-II station	3	4	3										
		Compliant and claiming rate of product quality	1	3	3										
		Outage rate of tobacco primary processing equipment	3	3	3										
		Run efficiency of packing equipment	2	3	3										
	Learning and growth	Run efficiency of rolling equipment	2	3	3										
		Standard compliance ratio of training hours	1	1	3										
			Ratio of middle/senior technical title	1	1	3									

Fig. 3 Matrix Analysis of Key Performance

### Indicators-Functional Department Relation

### 6. Building of House of Quality for Key Performance Indicators and Functional Departments

As per the principle and structure of the house of quality, roof structure should exist, however, which is omitted, as shown in Fig. 4, since the relation between enterprise's functional departments is positive, instead of being negative.

Quality/Technical characteristics			Customers' demands											Weight				
			General Office	Production Technology Department	Tobacco Primary Processing Shop	Packing Shop	Power Shop	Tooling Department	Trade Union	Political Education Office	Information Center	Administrative Affairs Department	Supervision Section	Personnel and Labor Department	Technical Reformation Office	Safety and Security Section	Absolute importance	Relative importance
Level-I	Level-II	Level-III																
Rational setting of enterprise key performance indicators	Finance	Controllable management fee of a single box	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1.8	0.667
		Cut filler rate	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1.8	0.667
	Customers	Roll paper consumption of a single box	1	4	3	3	3	3	3	3	3	3	3	3	3	3	5.8	1.963
		Composite energy consumption of 10000 pieces of cigarette	1	3	3	3	3	3	3	3	3	3	3	3	3	3	13.0	4.400
		Consumers' satisfaction on product quality	1	3	3	3	3	3	3	3	3	3	3	3	3	3	50.7	18.023
	Internal operation	Mean productivity per on-post employee	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2.1	0.916
		Sigma level of production process	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4.7	2.059
		Acceptance ratio of random inspection of Level-I and Level-II station	3	3	3	3	3	3	3	3	3	3	3	3	3	3	7.7	3.428
		Compliant and claiming rate of product quality	3	3	3	3	3	3	3	3	3	3	3	3	3	3	16.8	7.801
		Outage rate of tobacco primary processing equipment	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4.3	2.144
		Run efficiency of packing equipment	3	3	3	3	3	3	3	3	3	3	3	3	3	3	10.1	5.180
	Learning and growth	Run efficiency of rolling equipment	3	3	3	3	3	3	3	3	3	3	3	3	3	3	8.9	4.833
		Standard compliance ratio of training hours	1	1	3	3	3	3	3	3	3	3	3	3	3	3	6.3	3.593
			Ratio of middle/senior technical title	1	1	3	3	3	3	3	3	3	3	3	3	3	7.5	4.425
Importance of quality/technical characteristics			0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	100.0	0

Fig. 4 House of Quality for Key Performance Indicators and Functional Departments

From the above-mentioned analysis of house of quality, we concluded that if type I department is scored above 600, type II department is scored 100-599, and type III department is scored below 99, the Packing Shop and Tobacco Primary Processing Shop are type I department, the Tooling Department, Production and Technology Department, Power Shop, Information Center, and Personnel and Labor Department are type II department, and the General Office, Trade Union, Political Education Office, Supervision Section, Technical Reformation Office, and Safety And Security Section are type III department.

### 7. Conclusion

The enterprise's work tasks of current year are carded from its strategy, the key performance indicators of the current year are broken down through comprehensive consideration with balanced score card mode, the supporting and contribution of each functional department to the key performance indicators is transformed with QFD method, and finally the types of various departments are scientifically decided, which provides the support to examine each enterprise department's weight and the objective data basis to set each department's basic wage and bonus. Dynamic adjustment with this method will dynamically set the weight of each department's function.

### References

- [1] Xiong Wei, Quality Innovation-QFD-Based System Method [M]. China Zhijian Publishing House, 2015: 47-89
- [2] Xiong Wei, Quality-Function-Development [M]. Beijing: Chemical Industry Press, 2005: 43-95
- [3] Chen Honggen, Liang Gongqian Quality Assurance Model of QFD-based Postgraduate Culture [J]. Academic Degrees and Graduate Education, 2007 (2): 14- 1 [6]
- [4] Sun Yuanyuan, Liu Fei, Li Li, Determination of Attribute Final Importance for Personalized Product Development Using Kano Model and QFD Integration Method [J]. Computer Integrated Manufacturing Systems, 2014, 20 (11): 2697-2703
- [5] Jin Gang, Li Ming, Analysis and Research of Customer's Requirement Based on Quality Function Configuration, [J]. Manufacturing Technology & Machine Tool, 2009 (8): 116 -126
- [6] Wang Shuang, Yin Guofu, He Zhongxiu, Research on Customer Requirements' Target System Based on Kano Model [J] Packaging Engineering, 2006, 27 (4): 209-213