

An Empirical Analysis of Activity Based Costing in Chinese Enterprises

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Abstract: In recent years, with the rapid development of China's economy, the progress of productive forces and economic system led to the shift from a seller's market to a buyer's market, the single species mass production mode to the varieties and labor intensive industry to technology intensive industry. Therefore, production based on sales have become the norm, once high profits caused capital investment along with the releasing capacity and increasing production, the competition between the enterprises gradually bases on the cost. Therefore, with the needs of business development, a new cost accounting system - activity based costing came into being. Activity based costing is based on the cost driver, which could allocate the indirect manufacturing costs more reasonable, then achieve the purpose of further cost control. In many western developed countries, activity based costing has been used in the enterprise. Although its application scope in Chinese enterprise is not very extensive, it has already got certain attention of many enterprises in China.

Keywords: Activity Based Costing, Cost Driver, Indirect Manufacturing Cost

1. Introduction

In recent years, with the rapid development of Chinese science and technology, economic strength increases rapidly, China's industrialization process have been intensified. In the last century, labor-intensive industry has played a crucial role in promoting Chinese industry. The Labor-intensive industries cost direct manufacturing costs such as raw materials and direct labor primarily. However, with the fast development of the Technology-intensive industry, the prevailing of the computer as well as a series of developed management methods, the method of the industry is gradually transforming from the labor-intensive one to a technology intensive one, besides, the proportion of the indirect manufacturing fees is gradually growing, even surpass that of the direct materials and the direct labors. In this way, the traditional cost method cannot always provide the accurate information for the enterprises to some extent. Thus, under such a fierce and globalized-trend economy society, the traditional cost accounting method has been unprecedented challenged. Then, the Activity Based Costing came into being, its more detailed and accurate cost allocation ability could provide performance management

capabilities which are critical to businesses in the new situation of the development process [1]. Activity Based Costing is based on business activity, allocate resources (such as the raw materials, processing charges) to the business activities through cost drivers accurately, and then assign business activities to the products. As a result, the distribution of cost has become more rational [2]. How cost has happened becomes clear, thus, in the era of the the rapid development of global economy and technology, the reform of the cost method in such a new situation is urgently needed.

This paper will combine the application analysis with empirical study, by collecting related data of implementation content, implementation scale, the implementation history from business groups who are using the ABC System which are mainly located in Northeast Region. The main idea is to reveal the positive impact which ABC System exert on the business groups in the decreasing indirect manufacturing costs, and observe the different impacts of distinguished implementation content, implementation scale, implementation history of each enterprise, then, to reveal how ABC System could fit today's economic development. Make a modest contribution to the reform of the costing method, and thus offer guides to those domestic enterprises who are applying or will

apply the Activity Based Costing System.

With the fast transformation from the labor-intensive industry to the technology-intensive industry, the proportion of the indirect manufacturing fees are taking up more and more amounts of the total costs. Thus, it is unreasonable to allocate the cost to the products merely by the machine hours or labor hours. Therefore, the traditional costing method is facing challenges while the new method-ABC System could make the costs allocation more reasonable. This paper is intending to collect the valid data from samples and use statistics model to provide some practical and constructive advice to the enterprises who are intending to use Activity Based Costing.

2. Literature Review

The theory of ABC system is divided into two parts,

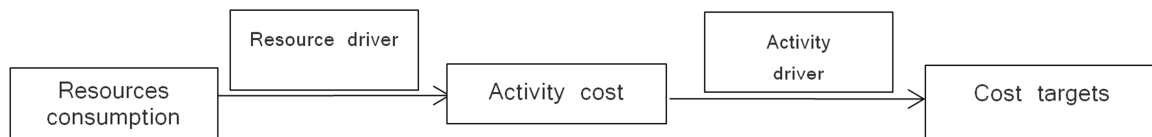


Figure 1. Costing run basic processes.

ABC System use a large number of cost drivers as the basis of cost allocation, the cost of the indirect cost pool will no longer be allocated through a simple production quantity [4]. Meanwhile, the indirect cost pool become a connection between the enterprise resources and products, which makes the relationship between them become more reasonable. With the development of high-tech companies, the fees of creating new products greatly increased in aspects of a series of pre-production functions, such as the fees of product development or purchase of patents as well as other expenses, the traditional cost methods often regard these costs as period fees which are isolated from the product cost. Thus when the products begin to put into production, the potential reduction of cost is quite low. However, the ABC System put the resource consumption deeply into distinguished activities. Put the whole product's life cycle into analysis system, make up a comprehensive and integrated consideration of the formation of costs. [5]

In 1995, Professor XuYing Yu led the application of activity-based costing into national companies through "Accounting Research", and then continuous disclosed eight thesis in "Contemporary Finance" in 1997, completely exposed the framework of Activity Based Costing and its links with the operational management. Since then opened

namely, activity costing and activity cost management. When ABC System just emerging, people just treat it as an accurate cost consideration method, but with the increasingly widespread use of activity-based costing, people found that the information it provides is no longer confined to the precise measurement of cost, but gradually applied to many financial and non-financial factors of performance management, the production chain and supply chain management. This makes the operating cost theory soon beyond the computational cost area, and gradually developed into a strategic program based on the value chain and a collection of cost management and decision [3].

Basic operational flow Costing is shown below. The essentially difference from a traditional cost method is the extra "converter", the so-called "converter" which is the most central indirect cost pools, also known as operating costs. Shown in Figure 1.

the boom of domestic academic research for Activity Based Costing. Now several large enterprises in China have started using activity-based costing.

Since the 1990s, many large domestic enterprises senior managers have clearly recognized the benefits of Activity-Based Costing: it is not only more accurate in the measurement of product cost, but it can also help enterprises to set reasonable price, provide strategic support to the corporate strategy and business model. A survey shows that a large number of higher competitive firms such as Kelong Group, Midea Group, kangjia Group, Gree Group, Foxconn Group, are now adding Activity Based Costing into the process of the firm functioning method with combining their own internal environment with external environment.

3. Application Cases

In the following, I will refer a real application case to prove the difference between the traditional costing and the Activity Based Costing, then, to expose the importance of the application of the ABC System.

ART company produces three kinds of electronic products, product X, product Y, product Z respectively.

The related information shows in table 1.

Table 1. Fundamental cost information of the enterprises.

	Product X	Product Y	Product Z	Total
yield (piece)	10000	20000	4000	
Direct material (dollar)	500000	1800000	80000	2380000
Direct labor (dollar)	580000	1600000	160000	2360000
Manufacture fees (dollar)				3894000
Direct labor hours (hour)	30000	80000	8000	118000

Under the traditional costing method, the manufacturing fees of ART based on the direct labor hours are show in table 2.

Table 2. The allocation of manufacturing fees.

	Product X	Product Y	Product Z	Total
Direct labor hours	30000	80000	8000	118000
Distribution ratio	3894000/118000=33			
Manufacture fees	990000	2640000	264000	3894000

The information of the products under the traditional costing method shows in table 3.

Table 3. The fundamental information of the products.

	Product X	Product Y	Product Z
Direct material (dollar)	500000	1800000	80000
Direct labor (dollar)	580000	1600000	160000
Manufacture fees (dollar)	990000	2640000	264000
Total	2070000	6040000	504000
Yield (piece)	10000	20000	4000
Cost of per product	207	302	126

The enterprise use 125% of the products cost to set the sale price, it is clear to see the aimed sale price of each product. (in table 4) .

Table 4. The comparison between aimed sale price and actual sale price.

	Product X	Product Y	Product Z
Product cost	207.00	302.00	126.00
Aimed sale price	258.75	377.50	157.50
Actual sale price	258.75	328.00	250.00

The enterprise now is facing some troubles. Due to the facts of the external competition of product Y, product Y could only sale at 328.00/piece. Besides, due to the fact of the limitation of the production of Z, the price of product Z has to be elevated. According to the form, the manager decide to give up the production of Y and increase the production of Z while maintain the production of X. However, it is not accurate to allocate the manufacturing fees just based on the direct labor hours, because the manufacturing fees are not directly proportional to the labor hours. So when it comes to the Activity Based Costing. The result is quite distinguished.

Table 5. At first we could allocate the manufacturing fees into several homogeneous activity pools. (In table 5, table 6, table 7 separately) Activity pools.

Manufacturing fees	Price (dollar)
Assembling	1212600
Material purchasing	200000
Material handling	600000
Starting preparation	3000
Quality Control	421000
Product packaging	250000
Engineering treatment	700000
Administration	507400
Total	3894000

Table 6. Cost drivers.

Manufacturing fees	Cost drivers	Activity amounts			
		Product X	Product Y	Product Z	Total
Assembling	Machine hours	10000	25000	8000	43000
Material purchasing	Order quantity	1200	4800	14000	20000
Material handling	Material motivation	700	3000	6300	10000
Starting preparation	Preparing times	1000	4000	10000	15000
Quality Control	Test times	4000	8000	8000	20000
Product packaging	Packing times	400	3000	6600	10000
Engineering treatment	Process times	10000	18000	12000	40000
Administration	Direct labor	30000	80000	8000	118000

Table 7. Manufacturing fees of per product.

Manufacturing fees	Cost drivers	manufacture fees	activity amounts	Cost/product
Assembling	Machine hours	1212600	43000	28.2
Material purchasing	Order quantity	200000	20000	10
Material handling	Material motivation	600000	10000	60
Starting preparation	Preparing times	3000	15000	0.2
Quality Control	Test times	421000	20000	21.05
Product packaging	Packing times	250000	10000	25
Engineering treatment	Process times	700000	40000	17.5
Administration	Direct labor	507400	118000	4.3

Put the manufacturing fees to the three products respectively in table 8.

Table 8. Total Manufacturing fees of three products, respectively.

Manufacture fees	Product X		Product Y		Product Z	
	Activity amounts	Real cost	Activity amounts	Real cost	Activity amounts	Real cost
Assembling	10000	282000	25000	705000	8000	225600
Material purchasing	1200	12000	4800	48000	14000	140000
Material handling	700	42000	3000	180000	6300	378000
Starting preparation	1000	200	4000	800	10000	2000
Quality Control	4000	84200	8000	168400	8000	168400
Product packaging	400	10000	3000	75000	6600	165000
Engineering treatment	10000	175000	18000	315000	12000	210000
Administration	30000	129000	80000	344000	8000	34400
Total	-	734400	-	1836200	-	1323400

Assemble all the related costs together to work out the total cost of per product shows in table 9.

Table 9. Total cost of per product.

	Product X	Product Y	Product Z
Direct materials	500000	1800000	80000
Direct labors	580000	1600000	160000
Assembling	282000	705000	225600
Material purchasing	12000	48000	140000
Material handling	42000	180000	378000
Starting preparation	200	800	2000
Quality Control	84200	168400	168400
Product packaging	10000	75000	165000
Engineering treatment	175000	315000	210000
Administration	129000	344000	34400
Assembling	1814400	5236200	1563400
Material purchasing	10000	20000	4000
Cost per product	181.44	261.81	390.85

Calculation of the new aimed price shows in table 10.

Table 10. New aimed price.

	Product X	Product Y	Product Z
Product cost (Traditional costing Method)	209.00	302.00	126.00
Product cost (Activity Based Costing)	181.44	261.81	390.85
Aimed Price	258.75	377.50	157.50
Aimed Price	226.80	327.26	488.56
Real sale price	258.75	328.00	250.00

It is clear to see that the cost of product X is lower than before while the aimed price can be much more higher, therefore, it is potentially profitable. The enterprise should elevate the production of Product X. Besides, there is no need

to give up producing Product Y as its cost is lower than expected. On the contrary, the enterprise should give up producing Product Z because its cost is higher than expected and its aimed sale price is lower than its cost.

4. Empirical Analysis

4.1. Research Framework

According to the research goal, the frame of the article is shown in figure. Take the Northeast enterprises applying to the Activity Based Costing as example. Observing the

relation between the implementation scale, implementation content, implementation motivation and the indirect manufacturing fees as well as the distinguished impacts which the differences of those three factors made on the businesses manufacturing costs. (In Figure 2)

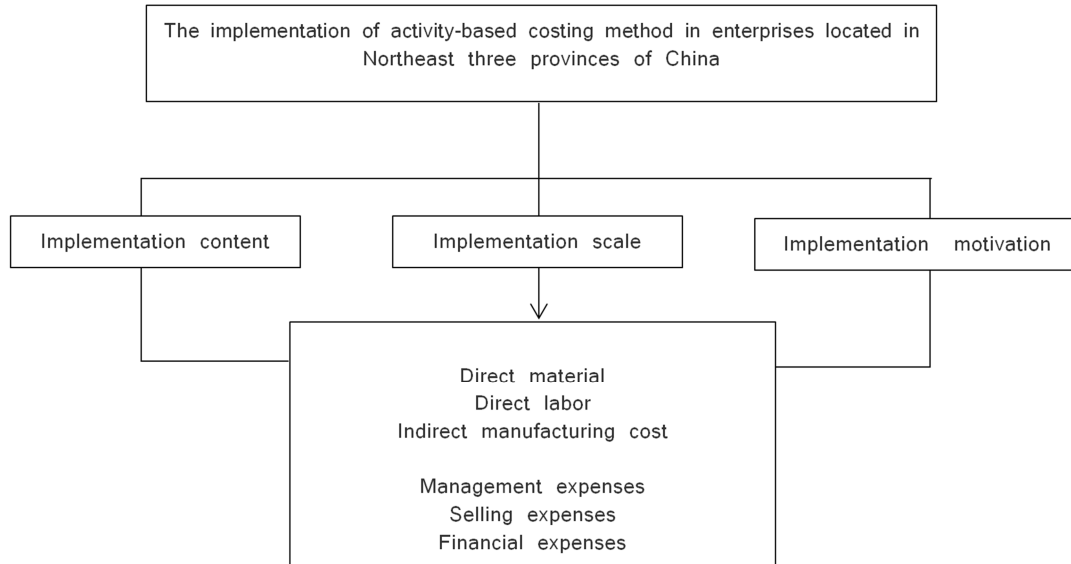


Figure 2. Empirical Analysis Framework.

4.2. Research Subjects

This article intends to sort 12 Northeast enterprises that are applying the Activity Based Costing, constructs model to make empirical analysis and modeling research by using those three factors.

4.3. Research Variables

This paper takes the ABC system applied enterprises located in the Northeast region as samples. identify implementation content, implementation scale, and the implementation length of time as the independent variables, indirect costs as the dependent variable.

4.3.1. The Implementation Content of the Enterprise Applying Activity-Based Costing

For implementation content, this article will focus on the numbers of the used cost drivers. Because the Activity Based Costing is based on the activity driver. In the same time, Professor Cooper also said, we must consider the numbers of the cost drivers as well as the issues of cost-effectiveness and so on; Therefore, we could use the numbers of the cost drivers to justify the applying extent of Activity Based

Costing in the enterprise.

4.3.2. The Implementation Scale of the Enterprise Applying Activity-Based Costing

Aiming at the implementation scale, the article will analyze the application of ABC system by using four factors, numbers of applying department, turnover, number of employees and amount of capital. Intend to measure the size of the enterprise implementation of ABC system from the financial and non-financial dimensions.

4.3.3. The Implementation History of the Enterprise Applying Activity-Based Costing

For the implementation history, this article aims to analyze such a factor by using the implementation length of time, intends to analyze how different lengths of time could make distinguished impacts on businesses manufacturing fees.

5. Research Hypothesis

This paper intends to make four hypothesis through the three factors, namely, the implementation content, implementation scale, implementation history. (In table 11)

Table 11. Empirical analysis of the four assumptions.

Hypothesis 1:	The change of Manufacturing fees are most significant.
Hypothesis 2:	Implementation content, implementation scale, the implementation history are each independent from another
Hypothesis 3:	Changes of the indirect manufacturing fees are obviously related with the three factors, namely, implementation content, implementation scale, implementation history
Hypothesis 4:	The implementation content exerts the most significant impact on the enterprises indirect manufacturing fees

6. Construction of the Model

6.1. Cost Assessment

This article intends to explore the influence that ABC system exert on indirect cost, therefore this section will first discuss whether the indirect cost of the enterprises that are

applying Activity Based Costing change significantly. The test results will directly affect the discussions of the relations between the following factors in the thesis with the indirect cost. This section will list six business-related cost items, using hypothesis testing method in SPSS to analyze the test results. (In table 12)

Table 12. Hypothesis Testing.

Measure dimensions	α	$Z_{\alpha/2}$	Z	P
Direct materials	0.05	1.96	2.11	0.922
Direct labor	0.05	1.96	3.57	0.946
Manufacturing overhead	0.05	1.96	4.21	0.003
Management costs	0.05	1.96	2.73	0.022
sales expense	0.05	1.96	1.44	0.136
Financial expenses	0.05	1.96	1.32	0.357

The empirical results:

Assumption 1: For the enterprises that are applying ABC system. The sales expense as well as the financial expense are not changing significantly while the other factors are changing significantly, among which the indirect manufacturing cost is the most significant one. It can be determined, it is sensible to use the indirect manufacturing fees to justify the influence that the Activity Based Costing exert on the enterprises.

6.2. The Analysis of Implementation Content, the Implementation Scale, Implementation History

This section is intending to explore relationship among implementation content, implementation scale, and implementation history of the enterprises that are applying the Activity Based Costing, using Chi-square Independence Test to determine whether the three factors are independent from each other, thus exclude the impact of the relationship among the three factors, make the following research which focus on the influence which the three factors exert on the indirect cost more clearly.

6.2.1. The Relationship Between the Implementation Content and the Implementation Scale

Table 13. The relationship between the implementation content and the implementation scale.

content /scale	Numbers of cost drivers	
	Chi-square value	P value
Turnover	14.325	0.047
Capital	42.661	0.003
Number of departments	14.838	0.005
Number of employees	3.772	0.438

It is clear to see that the P value of Turnover, capital and number of departments is less than 0.05 respectively, therefore, reject null hypothesis, those three factors are independent from the implementation content. Thus, the implementation scale is independent from the implementation content. (In table 13)

6.2.2. The Relationship Between the Implementation History and the Implementation Scale

Table 14. The relationship between the implementation history and the implementation scale.

History/ scale	The implementation length of time	
	Chi-square value	P value
Turnover	14.174	0.007
Capital	11.652	0.012
Number of departments	11.438	0.003
Number of employees	4.286	0.117

It is clear to see that the P value of Turnover, capital and number of departments less than 0.05 respectively, therefore, reject null hypothesis, those three factors are independent from the implementation scale. (In table 14)

6.2.3. The Relationship Between the Implementation Content and the Implementation History

Table 15. The relationship between the implementation content and the implementation history.

content /history	Numbers of cost drivers	
	Chi-square value	P value
The implementation length of time	11.262	0.006

It is clear to see that the P value of Turnover, capital and number of departments less than 0.05 respectively, therefore, reject null hypothesis, those three factors are independent from the implementation history. (In table 15)

The empirical results:

Assumption 2: For the enterprises who are applying the Activity based Costing Method, the interactional influence among the three factors are not significant. Those three factors are independent from one of each other. Thus, reject the null hypothesis.

6.3. The Analysis of the Project-Related Business Costs

This section is intending to explore the relationship between the three factors and the cost items. Therefore, this

section will use Spearman Correlation Analysis Model to determine the degree of association as well as the direction of association between those six related cost items and the one of each three factors.

6.3.1. The Relationship Between Implementation Content and the Cost of the Project

Table 16. The relationship between the implementation content and the cost of the project.

Measure dimensions	n	r_s^a	r_s
Direct materials	12	0.587	-0.07
Direct labor	12	0.587	-0.17
Manufacturing fees	12	0.587	-0.82
Management costs	12	0.587	0.26
Sales expense	12	0.587	0.28
Financial expenses	12	0.587	0.19

It is clear to see that direct materials as well as the direct labors are rarely related with the implementation content. On the contrary, the indirect manufacturing fees are nearly proportionally negative correlated with implementation content. (In table 16)

6.3.2. The Relationship Between Implementation Scale and the Cost of the Project

Table 17. The relationship between the implementation scale and the cost of the project.

Measure dimensions	n	r_s^a	r_s
Direct materials	12	0.587	-0.27
Direct labor	12	0.587	-0.13
Manufacturing fees	12	0.587	-0.76
Management costs	12	0.587	0.67
Sales expense	12	0.587	0.21
Financial expenses	12	0.587	-0.23

It is clear to see that direct materials as well as the direct labors are rarely related with the implementation scale. On the contrary, the indirect manufacturing fees are nearly proportionally negative correlated with implementation scale.

6.4.1. Decision-Making Analysis Chart

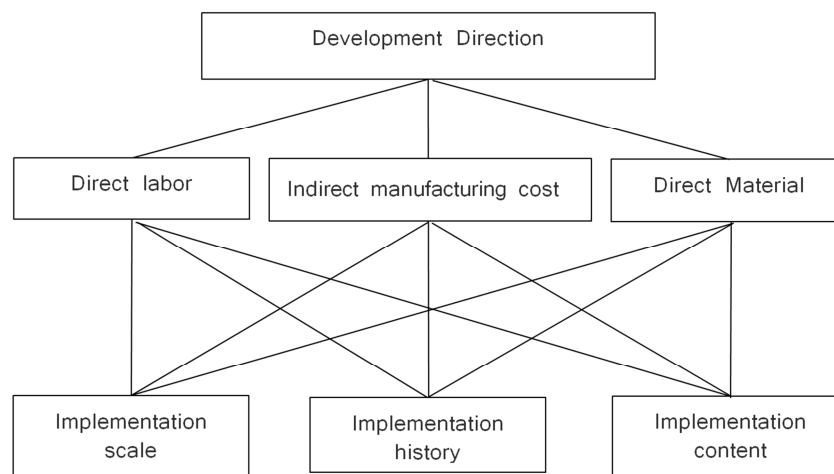


Figure 3. Decision-making analysis chart.

(In table 17)

6.3.3. The Relationship Between Implementation History and the Cost of the Project

Table 18. The relationship between the implementation history and the cost of the project.

Measure dimensions	n	r_s^a	r_s
Direct materials	12	0.587	-0.71
Direct labor	12	0.587	-0.62
Manufacturing fees	12	0.587	-0.77
Management costs	12	0.587	0.31
sales expense	12	0.587	-0.22
Financial expenses	12	0.587	-0.37

It is clear to see that direct materials as well as the direct labors are rarely related with the implementation history. On the contrary, the indirect manufacturing fees are nearly proportionally negative correlated with implementation scale. (In table 18)

The empirical results:

Assumption 3: Based on the above, it is clear to see that the three factors have negative correlation with most of the cost items. Observing from r_s^a and r_s , we could see that those three factors are highly correlated with direct material, direct labor and indirect manufacturing fees, the most significant one is the indirect manufacturing fees. Thus, we can reject the null hypothesis H_0 .

6.4. AHP Analytical Work

After the empirical analysis, the paper intends to use the AHP to set the three factors above, namely, the implementation scale, the implementation history, the implementation content as the program level, and the most significant cost items, namely, direct materials, direct labor, indirect manufacturing fees rule level, then rank the program layer according to the priority, designing to provide the preferential choices for the enterprises that are applying the Activity Based Costing Method.

At the beginning of AHP Analysis. We are supposed to set the program level and the rule level for all the possible choices. As shown in the figure above, the program level contains three factors which have been referred in the paper before, namely, the implementation scale, the implementation history, and the implementation. The rule level contains the three most significant cost items of the enterprises, namely, direct labor, direct material and indirect manufacturing fees. Shown in figure 3.

6.4.2. Judgment Matrix

Use the 1-9 ranking method to structure the matrix, there are four matrix totally, one for the rule level, three for the program level.

i. Judgment matrix A-B

A	B1	B2	B3
B1	1	3	5
B2	1/3	1	3
B3	1/5	1/3	1

ii. Judgment matrix B1—C

B1	C1	C2	C3
C1	1	1/3	1/5
C2	3	1	1/3
C3	5	3	1

iii. Judgment matrix B2—C

B2	C1	C2	C3
C1	1	3	3
C2	1/3	1	1
C3	1/3	1	1

iv. Judgment matrix B3—C

B3	C1	C2	C3
C1	1	3	6
C2	1/3	1	4
C3	1/6	1/4	1

6.4.3. Eigenvector with the Largest Characteristic Root

Table 19. Eigenvector and the maximum characteristic root.

Stratum	Judgment matrix	Eigenvectors	The maximum characteristic root
Rule Layer	A-B	W= (0.389 0.153 0.069) T	$\lambda_{\max}=4.044$
Program layer	B1-C	W= (0.106 0.260 0.633) T	$\lambda_{\max}=3.092$
Program layer	B2-C	W= (0.600 0.200 0.200) T	$\lambda_{\max}=3.001$
Program layer	B3-C	W= (0.639 0.247 0.087) T	$\lambda_{\max}=3.051$

Based on the above steps, we could obtain the Eigenvectors of both rule layer and program layers, the production of the two Eigenvectors will be the Hierarchical total ranking, before which a consistency check is needed. Shown in table 19.

6.4.4. Consistency Check

Table 20. Consistency check.

matrix	CI	RI	CR
Judgment matrix A-B	0.015	0.58	0.025
Judgment matrix B1-C	0.027	0.58	0.047
Judgment matrix B2-C	0.019	0.58	0.033
Judgment matrix B3-C	0.027	0.58	0.047

It is clear to see all figures of CR are less than 0.1, therefore, both the rule layer and the program layer will pass the consistency check. Shown in table 20.

6.4.5. Hierarchical Total Ranking

Table 21. Hierarchical total ranking.

0.106	0.600	0.639	0.389	C1	0.067
0.260	0.200	0.274	0.153	C2	0.052
0.633	0.200	0.087	0.069	C3	0.061

Based on the table above, it can be clearly seen that the merits of the three programs are sorted $C1 > C3 > C2$,

therefore, for the enterprises who are using or intending to use the Activity Based Costing Method, C1 should be given the priority, namely, the implementation content. Shown in table 21.

7. Conclusion

The indirect manufacturing fees of the enterprises that own more extensive cost drivers decrease more significantly than those of the enterprises that own narrow cost drivers. It is clear to see that companies are supposed to input more and more resource drivers as well as the activity resources. Include all every step of the of the enterprises into the calculating of the business-related costs.

The enterprises that are applying the ABC System for longer time will have a more significant decrease in the indirect manufacturing fees, but the effect is lower than those who own more extensive cost drivers. Thus, it is clear to see that there are a large number of enterprises having a low efficiency rate of functioning the ABC System. Even functioning with a longer time, they don't go hand in hand with business trends due to various objective factors such as the lack of support from management layer, the determination of the reform and so on.

The enterprises that have a larger scale of the implementation of ABC System show a more dramatic decrease in the indirect manufacturing fees. It can be seen

that the implementation scale is one of the most important factors of success. At the same time, the reform of the cost of running business should be strictly in accordance with the development trend of the business scale.

According to the three factors in the thesis, namely, implementation contents, implementation scale and the implementation history, the most significant factor related to the indirect manufacturing fees is the implementation content. Thus, enterprises that are applying or intending to apply the ABC System could focus on more detailed cost drivers division.

Eventually, through this thesis, the enterprises who are applying the Activity Based Costing Method, universally have lower amount of cost items. Especially the indirect manufacturing fees.

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