

# Research on the Priority of BPR Based on Analytic Hierarchy Process

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**Abstract.** The BPR (Business process reengineering) is a kind of management innovation mode for enterprises to cope with the increasingly complex market environment and improve their adaptability and operation ability. It can redesign the business process for oriented to the customer, and make the customer satisfied. The BPR can also help enterprises do better to deal with three forces of customers, competition and changes. At the same time, the BPR is not a simple matter, so there is no enterprise that can simultaneously reengineer all of its business processes. Accordingly, the enterprise must grasp the priority of BPR. This paper takes enterprise H as an example, studies the business process of H according to the process classification framework of APQC (American Productivity and Quality Center), and use the AHP (Analytic Hierarchy Process) method to construct the hierarchical structure model to research the priority of BPR of business process of strategy and operation. This paper hope can be a guidance for successful implementation of BPR. Finally, the effectiveness of the preliminary work of H business process reengineering is analyzed. Then on the base of these, this paper makes a prospect for the research of BPR.

## Introduction

With the rapid development of economy and the continuous improvement of the level of information technology, enterprises are facing more and more intense competition environment, so, some of the original business process has been difficult to adapt to the severe pattern. If the enterprise wants to stand and develop in such a fierce competitive environment, it is necessary to dare to break away from the shackles of the original work mode and the business process [1]. What the enterprise does is Reengineer the core process of the enterprise, that is, BPR.

The management innovation of BPR was first proposed in the book of Reengineering the Corporation in 1990s by Michael hammer and James Champy. In this book, "start" is the meaning of the BPR, the book also made the definition of the BPR of authority. Specifically, the BPR is the basic problem in the business process of reflection, and redesign it completely, So that significant progress has been made in terms of cost, quality, service and speed, which are currently used to measure firm performance [2]. Contrary to the radical view on BPR of hammer and Champy, Davenport claims that the process can be reengineered step by step [3]. With the development of the theory and Practice for many years, people have a clearer and scientific understanding of the BPR, and have a more scientific and profound research on the strategy and method of BPR. Whether it is radical BPR or gradual BPR, it all means that enterprises must improve their competitiveness in order to improve their competitiveness. Chen Guohua, from the strategic point of view, uses the analytic hierarchy process to examine the priority of the process reengineering, and explores the scientific method of reengineering process selection [4]. Lv Wendong and others analysed the advantages of AHP in the BPR, and choose the AHP as the method of selecting the core process in the BPR, then, it made a decision for the enterprise guidance [5]. In the actual operation of the enterprise, BPR is a very high risk management innovation activities, according to incomplete statistics, the failure rate of enterprise reengineering up to 80% [6]. H.James Harrington think there are five reasons for the high failure rate of BPR, one of the reasons is the misuse of methods and goals [7]. Chen Guohua et al (2003) thought that the key reason for the high failure rate of process reengineering lies in the order judgment of the candidate reengineering process. Therefore, how to determine the order of the reengineering process becomes the key factor of the success of the BPR.

## The Introduction of Application of AHP

AHP is a widely used method for decision analysis, it was advanced by T.L.Saaty et al, which is a famous professor and operational research expert of University of Pittsburgh in the middle of the 1970s [8]. It is a combination of quantitative and qualitative method, It can express and deal with the subjective judgment of human. This method has a unique advantage in dealing with complex processes involving many factors. The steps of application of AHP are as follows:

Step1: Establish a stratified structure model and construct the judgment matrix combined with expert opinions.

Step2:Determine the weights of each index by the method of root or others.

Step3:Conduct consistency check to ensure the consistency of judgment matrix.

Step4:Come to conclusion according to the data.

**Establish a Hierarchical Structure Model.** Through the analysis of the research content to determine the target layer, the criterion layer and the program layer. Thus constructing a hierarchical structure model.

**Construction of Judgment Matrix.** Organizing experts to grade for the elements and projects in this evaluation indicator system by using 1-9 scale method [9], and constructing judgment matrix  $A = (a_{ij})_{n \times n}$ , which  $a_{ij}$  is the relative importance ratio of  $A_i$  and  $A_j$ . The judgment matrix as shown in table 1.

Table 1 The judgment matrix

$A_K$	$A_1$	$A_2$	...	$A_i$	...	$A_n$
$A_1$	$a_{11}$	$a_{12}$	...	$a_{1i}$	...	$a_{1n}$
$A_2$	$a_{21}$	$a_{22}$	...	$a_{2i}$	...	$a_{2n}$
...	...	...	...	...	...	...
$A_i$	$a_{i3}$	$a_{i2}$	...	$a_{ii}$	...	$a_{in}$
...	...	...	...	...	...	...
$A_n$	$a_{n1}$	$a_{n2}$	...	$a_{ni}$	...	$a_{nn}$

The scale definition of the relative importance listed in Table 2.

Table 2 The scale definition of the relative importance

Scale	Meaning
1	The former element is as important as the latter element
3	The former elements is slightly important than the latter elements
5	The former elements is important than the latter elements
7	The former elements is strongly important than the latter elements
9	The former elements is extremely important than the latter elements
2, 4, 6, 8	Intermediate values between the corresponding values of 1–9 scale
Reciprocal	If the ratio of element i and element j is $a_{ij}$ , so the ratio of element j and element i is $a_{ji} = \frac{1}{a_{ij}}$

**Consistency Test.** In order to make use of the AHP to make decision scientifically, we must check the consistency of the judgment matrix, consistency index (CI) is determined as follows:

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

Among them,  $\lambda_{\max}$  is the largest eigenvalue of the judgment matrix, n is the orders of the judgment matrix. When the value of CI is 0, it means that the judgment matrix is completely consistent. Consistency of Judgment can be evaluated by processing the consistency ratio (CR) of consistency index (CI) with the proper value as given in Table 3.

**Table 3 Random consistency index RI**

Size of Matrix	1	2	3	4	5	6	7	8	9
Random consistency index	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

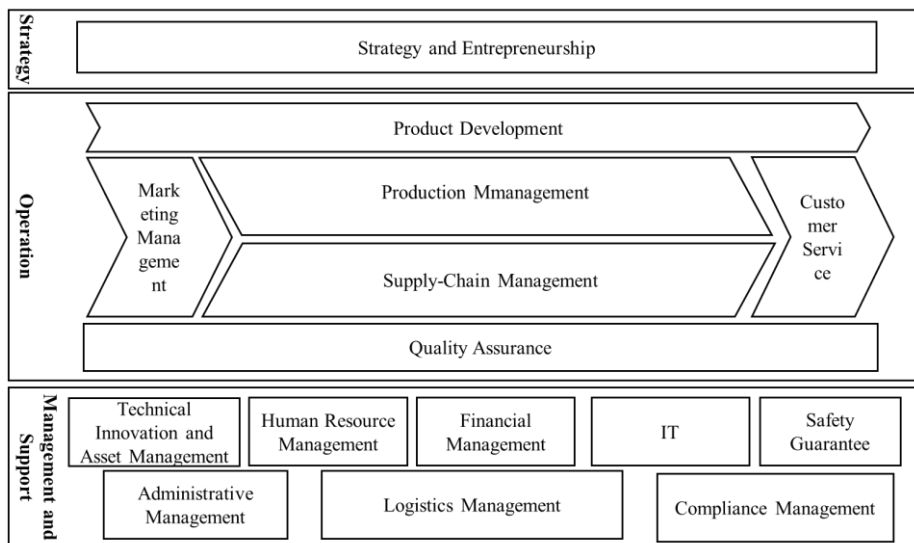
The consistency ratio (CR) is determined as follows:

$$CR = \frac{CI}{RI}$$

When the value of CR is bigger, the consistency is worse, when the  $CR < 0.1$ , it is considered that the judgment matrix satisfies the consistency test, and the weight is valid. When  $CR > 0.1$ , the weight is invalid.

**The H Enterprise Determine the Priority of BPR Based on AHP**

**Brief Introduction of H Company Process.** The process classification framework (PCF) was originally developed as a process classification method for the design of business processes by IBC (International Benchmarking Clearinghouse) of APQC in 1991. Among them, PCF of the aerospace enterprise is also constructed. According to the classification framework and the situation of our country, the aviation and aerospace enterprises will be divided into three categories: Strategic process, operation process, management and support process [10]. So, the top PCF of the enterprise of H can be designed, as shown in Fig. 1.



**Figure 1. Finite The top PCF of the enterprise of H**

At present, facing the increasingly fierce competitive environment, the original business process of H has become increasingly difficult to support the long-term development of enterprise, so H enterprise must conduct BPR. This paper focuses on the core process of H enterprise, which is the business process of strategy and value chain, and combined with the factors that influence the BPR. On this basis, determine the priority of the BPR by AHP. Therefore, the priority of BPR will be defined as the decision objective Q. Strategy and Entrepreneurship, Marketing Management, Product Development, Production Management, Customer Service, Supply-chain Management and Quality Assurance are classified into 7 layer elements, are marked as b1, b2, b3, b4, b5, b6, b7 in proper order. The 6 main factors that affect the decision-making objectives are personnel, capital, equipment, technology, customer, performance, and then successively marked as a1, a2, a3, a4, a5, a6.

**Analysis by AHP.** Through questionnaire survey and interviews with relevant experts,

Combined with 6 factors such as personnel, we can get the judgment matrix as follows:

$$A = \begin{pmatrix} 1 & \frac{1}{3} & \frac{1}{2} & \frac{1}{2} & \frac{1}{4} & \frac{1}{2} \\ 3 & 1 & 3 & 2 & \frac{1}{3} & 1 \\ 2 & \frac{1}{3} & 1 & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ 2 & \frac{1}{2} & 3 & 1 & \frac{1}{2} & \frac{1}{2} \\ 4 & 3 & 4 & 2 & 1 & \frac{1}{3} \\ 2 & 1 & 5 & 2 & 3 & 1 \end{pmatrix}$$

$\lambda_{\max} = 6.5660$ ,  $CR = 0.0898$ ,  $CR < 0.10$ , consistent with the consistency test.

Personnel matrix

$$B_1 = \begin{pmatrix} 1 & 3 & 1 & 2 & 3 & 1 & 2 \\ \frac{1}{3} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{3} & 3 & 2 \\ 1 & 2 & 1 & 1 & \frac{1}{2} & 2 & 3 \\ \frac{1}{2} & 2 & 1 & 1 & \frac{1}{2} & 2 & 3 \\ \frac{1}{3} & 3 & 2 & 2 & 1 & 3 & 4 \\ 1 & \frac{1}{3} & \frac{1}{2} & \frac{1}{2} & \frac{1}{3} & 1 & 2 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{3} & \frac{1}{3} & \frac{1}{4} & \frac{1}{2} & 1 \end{pmatrix}$$

$\lambda_{\max} = 7.6877$ ,  $CR = 0.0843$ ,  $CR < 0.10$ , consistent with the consistency test.

Capital matrix

$$B_2 = \begin{pmatrix} 1 & 2 & 2 & \frac{1}{2} & \frac{1}{2} & 4 & 2 \\ \frac{1}{2} & 1 & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & 2 & 3 \\ \frac{1}{2} & 3 & 1 & \frac{1}{4} & \frac{1}{3} & 4 & 2 \\ 2 & 4 & 4 & 1 & 2 & 3 & 3 \\ 2 & 5 & 3 & \frac{1}{2} & 1 & 4 & 2 \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{4} & \frac{1}{3} & \frac{1}{4} & 1 & 3 \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{2} & \frac{1}{3} & \frac{1}{2} & \frac{1}{3} & 1 \end{pmatrix}$$

$\lambda_{\max} = 7.8064$ ,  $CR = 0.0988$ ,  $CR < 0.10$ , consistent with the consistency test.

Equipment matrix

$$B_3 = \begin{pmatrix} 1 & 2 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 2 & \frac{1}{2} \\ \frac{1}{2} & 1 & \frac{1}{4} & \frac{1}{4} & \frac{1}{3} & \frac{1}{3} & \frac{1}{2} \\ 2 & 4 & 1 & 1 & 3 & 2 & 2 \\ 2 & 4 & 1 & 1 & 4 & 2 & 3 \\ 2 & 3 & \frac{1}{3} & \frac{1}{4} & 1 & 1 & \frac{1}{2} \\ \frac{1}{2} & 3 & \frac{1}{2} & \frac{1}{2} & 1 & 1 & \frac{1}{2} \\ 2 & 2 & \frac{1}{2} & \frac{1}{3} & 2 & 2 & 1 \end{pmatrix}$$

$\lambda_{\max} = 7.3784$ ,  $CR = 0.0464$ ,  $CR < 0.10$ , consistent with the consistency test.

Technology matrix

$$B_4 = \begin{pmatrix} 1 & 3 & 2 & 1 & 3 & 2 & 1 \\ \frac{1}{3} & 1 & \frac{1}{3} & \frac{1}{3} & \frac{1}{2} & 2 & \frac{1}{2} \\ \frac{1}{2} & 3 & 1 & 2 & 2 & 3 & 3 \\ 1 & 3 & \frac{1}{2} & 1 & \frac{1}{2} & 2 & 2 \\ \frac{1}{3} & 2 & \frac{1}{2} & 2 & 1 & 3 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{3} & \frac{1}{2} & \frac{1}{3} & 1 & \frac{1}{2} \\ 1 & 2 & \frac{1}{3} & \frac{1}{2} & 2 & 2 & 1 \end{pmatrix}$$

$\lambda_{\max} = 7.6142$ ,  $CR = 0.0753$ ,  $CR < 0.10$ , consistent with the consistency test.

Customer matrix

$$B_5 = \begin{pmatrix} 1 & \frac{1}{2} & 2 & 2 & \frac{1}{3} & \frac{1}{2} & \frac{1}{2} \\ 2 & 1 & 4 & 3 & 2 & 1 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{4} & 1 & 2 & \frac{1}{2} & \frac{1}{3} & 1 \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{5} \\ 3 & \frac{1}{2} & 2 & 2 & 1 & \frac{1}{3} & 2 \\ 2 & 1 & 3 & 2 & 3 & 1 & 2 \\ 2 & 2 & 1 & 5 & \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix}$$

$\lambda_{\max} = 7.7039$ ,  $CR = 0.0863$ ,  $CR < 0.10$ , consistent with the consistency test.

Performance matrix

$$B_6 = \begin{pmatrix} 1 & 4 & 3 & 2 & 2 & 3 & 3 \\ \frac{1}{4} & 1 & 2 & \frac{1}{2} & 2 & \frac{1}{2} & 3 \\ \frac{1}{3} & \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{3} & 1 & \frac{1}{2} \\ \frac{1}{2} & 2 & 2 & 1 & 3 & 2 & 3 \\ \frac{1}{2} & \frac{1}{2} & 3 & \frac{1}{3} & 1 & 3 & 2 \\ \frac{1}{3} & 2 & 1 & \frac{1}{2} & \frac{1}{3} & 1 & 2 \\ \frac{1}{3} & \frac{1}{3} & 2 & \frac{1}{3} & \frac{1}{2} & \frac{1}{2} & 1 \end{pmatrix}$$

$\lambda_{\max} = 7.6817$ ,  $CR = 0.0835$ ,  $CR < 0.10$ , consistent with the consistency test.

Further operation, the weight sorting table of the elements in the program layer are calculated as shown in table 4.

Table 4 Weight sorting

Project	Weight
Strategy and Entrepreneurship	0.1895
Production Management	0.1751
Supply-chain Management	0.1650
Customer Service	0.1242
Marketing Management	0.1226
Product Development	0.1174
Quality Assurance	0.1061

From the analysis above, it can be seen that the first process of BPR is Strategy and Entrepreneurship, and then Production Management, Supply-chain Management, Customer Service, Marketing Management, Product Development, Quality Assurance.

## Conclusion

The BPR is not a simple thing for enterprises. In the process of the development of the enterprise, the BPR will be an indispensable mode of management innovation. Successful business process reengineering can bring huge profits to enterprises. At the same time, the business process of each enterprise is various. Therefore, under the condition of limited manpower, material resources and so on, it is very difficult for the enterprises to rebuild each process. So, how to choose the order of process reengineering is the key to the success of BPR. Only in this way, enterprises can successfully implement the BPR. This paper determine the priority of BPR Based on Analytic Hierarchy Process. It provides the scientific guidance for the selection of process to be reengineered. It also hope to provide some help for the future research on the BPR.

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