The decision making of scientific research direction of construction enterprise

Ye Luo12*, Geng Peng2, ZhiWen Luo3, YunXing Shi1, Zhen Tian 1, YongXi Zhao1, YuXiang Luo1, YanFang Liang1

1China state construction technical center, Beijing, 101300, china
2University of Chinese Academy of Sciences, Beijing, 100049, china
3China construction first group corporation limited, Beijing, 100161, china
*Corresponding author’s e-mail: luoye@cseec.com

Abstract. The determination of research direction is a complicated process, especially in the case of architectural research projects. General research projects, especially engineering projects, usually have several characteristics: first, large amount of capital. Second, the work cycle is long. Third, the return is unknown. Therefore, it is particularly important to establish an evaluation system for engineering research projects. This paper analyzes the literature on the civil engineering. The original index factors were extracted and the final index was determined by expert group discussion. Analytic hierarchical analysis (AHP), computer calculation (MATLAB) and hand calculation are used to determine the weight factor. In this paper, real cases are introduced to help leaders of Z enterprise to make decisions on scientific research projects. Based on this case, it can provide reference for other civil engineering research projects.

1.Introduction

Engineering scientific research projects usually cover a relatively large system, and when approached from different perspectives or evaluated by people from different backgrounds, the result is often "a mountain is seen horizontally and a peak is seen on the other side". As the judgment process is very complex, the accuracy of subjective judgment in the decision-making process will be greatly reduced, and there may even be such a case that different speakers on the same project and the same content will produce different results. Therefore, it is necessary to introduce a method that can depress the subjectivity of the judge or strip away the essential idea that the judge is least affected by the environmental factors.

2.Necessity of analytic hierarchy process

Analytic Hierarchy Process (AHP) is a scientific mathematical method that divides the judgment of a problem into several levels and then makes judgments respectively [1]-[3]. It can get a more objective and scientific result in the subjective choice through the comparison and judgment of layers of indicators. Theoretically speaking, the finer the indicators are, the more levels they are, the more objective the results will be, and the closer they are to the real idea of the judge. In this case, the judge's knowledge reserve can be brought into full play. Nowadays, the establishment of scientific research projects in enterprises is usually a procedure of report by the project owner, expert discussion and decision by the leader. In this process, the judgment of participants is influenced not only by their
own state but also by environmental factors. Therefore, the introduction of analytic hierarchy process (AHP) and the use of experts with rich knowledge reserves in this field at different levels to establish and score indicators will greatly improve the accuracy of judgment. This will also make the end result more reasonable.

3. Principles of index establishment
In order to solve the real problems in construction enterprises, the author combines the research field with the current situation of the enterprise. Firstly, through literature analysis and oriented by research trends, the research focuses on several directional contents of current mainstream research in the market, and selects several most representative system research directions that are highly concerned by both domestic policies and large construction enterprises in the market [4]-[6]. Secondly, through the comparison of the existing analysis of this research direction at home and abroad to find out its similarities and differences, from the cost of economy, social policy, environmental impact, use safety, practicability and other aspects of consideration, the preliminary extraction of market correlation indicators, for the final determination of the complete index content to provide a foundation and support.

In the research process, the basic situation of Z Construction Company was deeply understood, that is, the challenges faced by the civil industry and the current situation of Z Company's civil laboratory. Which focus on practical considerations in the process of research and development of Z company laboratory factors and resource usage are analyzed, and combined with the rest of the typical building corporate laboratories and laboratory of colleges and universities, from the experiment of artificial, experiment artifacts, demolition, difficulty, staff continuity, experiments, covers an area of experimental period, experimental machine takes up several aspects, such as consideration, preliminary fitness correlation index to refine the research. This will pave the way for the further study of the complete index.

4. The expert selection and the use of expert evaluation
Selection of experts. As for the selection of civil scientific research projects, it needs the participation of managers or experts from different enterprises to make an index weight suitable for most enterprises. Therefore, the author selected a number of relevant managers and technicians from several influential enterprises for communication, index discussion and written scoring.

The use of expert evaluation. In this paper, experts are divided into two categories, one is management and the other is technology. The use of experts is divided into two parts, one is the final determination of indicators, and the other is the scoring of indicators. First for final indicators, this article is based on the study of the shape index through, and scientific research enterprise decision makers and managers (management experts) to establish a general evaluation system, after discussion with management experts for the overall grasp and development of the enterprise more macroscopic situation, so in setting up the index mainly rely on such expert judgment. Final grade index after determine stratified index, according to the different evaluation index item needs to invite familiar or experienced experts in this field, personnel (technical experts) layered evaluation score, which is not let each expert to evaluate all indicators, thus can make the expert evaluation of advantage to the largest, at the same time avoid the existence of the field experts in other fields caused by lack of experience of evaluation is not enough professional or miscalculation.

5. Determination of final indicators
Through the development of the construction industry and civil science research projects research and development laboratory application of the actual situation. According to the preliminary indicators and the existing data and research as a reference, experts at each analysis level are invited to jointly discuss the indicators and determine the final indicators, which are as follows:
Table 1. The weight and ranking of evaluation system factors for civil research

| Rule layer | Index layer | Final indicator layer |
|------------|-------------|-----------------------|
| Study fitness B¹ | Experimental economic index C¹¹ | Experiment labor cost D¹¹ |
| | | Experimental component cost D¹² |
| | | Experimental demolition cost D¹³ |
| | Technical index C¹² | Experiment difficulty D²¹ |
| | | Personnel integrity D²² |
| | | The laboratory covers an area of D²³ |
| | | Laboratory occupancy period D²⁴ |
| | | Laboratory machinery occupancy rate D²⁵ |
| Marketing degree B² | Cost economic index C²¹ | Production cost D³¹ |
| | | maintenance cost D³² |
| | Social indicator C²² | Reusability D³³ |
| | | Recognition D⁴¹ |
| | | public praise D⁴² |
| | | Policy environment D⁴³ |
| | Environmental indicator C²³ | Degree of resource consumption D⁵¹ |
| | | Influence of the construction on the surrounding D⁵² |
| | Safety index C²⁴ | Accessibility D⁶¹ |
| | | durability D⁶² |
| | | Security D⁶³ |
| | Application index C²⁵ | Technology maturity D⁷¹ |
| | | generalization D⁷² |

6. Weight calculation results
The results calculated according to MATLAB are shown in the following table

Table 2. The result of Weight calculation

| |  |
|------------------|------------------|
| Experiment labor cost D¹¹ | 0.01 |
| Experimental component cost D¹² | 0.05 |
| Experimental demolition cost D¹³ | 0.01 |
| Experiment difficulty D²¹ | 0.12 |
| Personnel integrity D²² | 0.06 |
| The laboratory covers an area of D²³ | 0.04 |
| Laboratory occupancy period D²⁴ | 0.03 |
| Laboratory machinery occupancy rate D²⁵ | 0.02 |
| Production cost D³¹ | 0.20 |
| maintenance cost D³² | 0.06 |
| Reusability D³³ | 0.03 |
| Recognition D⁴¹ | 0.01 |
| public praise D⁴² | 0.01 |
| Policy environment D⁴³ | 0.05 |
| Degree of resource consumption D⁵¹ | 0.01 |
| Influence of the construction on the surrounding D⁵² | 0.04 |
7. Application analysis of actual cases of Z Company's scientific research projects

Table 3. Actual project table of Z Company

| Serial number | Name of Scientific Research Project | The project properties | Project type            | Project cycle |
|---------------|-------------------------------------|------------------------|-------------------------|---------------|
| 1             | Intelligent concrete grouting sleeve research project | Enterprise Level Topic | The experimental project | 2 years       |
| 2             | Research project of building damping and isolation bearing | Provincial and ministerial level projects | The experimental project | 3 years       |
| 3             | Space steel structure demolition research project | Provincial and ministerial level projects | The experimental project | 2 years       |

8. Data analysis and result analysis

According to the scoring results, the total weighted score is 1. The scientific research project of intelligent concrete grouting sleeve is 6.87 points. 2. The research project of building damping and isolation bearing is 7.72 points. 3. Research projects of dismantling space steel structures score 7.3.

Therefore, according to the ranking result of the index evaluation system, the priority order is as follows: Research project of building damping and isolation bearing > Space steel structure demolition research project > Intelligent concrete grouting sleeve research project. From the scoring situation, the front-line staff of the laboratory are more optimistic about the scientific research project of intelligent concrete grouting sleeve, while from the scoring situation of leaders and experts, they are more inclined to the Space steel structure demolition research project. However, through the calculation of the evaluation system, it is precisely obtained that the scientific research project of building vibration isolation bearing should be given the highest priority. Therefore, the above cases have proved the necessity of the evaluation system from the side, and the subjective judgment is described more scientifically as the result, which greatly reduces the possibility of mistakes in the selection of scientific research projects by the company.

9. Conclusion

The importance of scientific research is becoming more and more prominent for the development of enterprises. Nowadays, large central and state-owned enterprises hold overwhelming market shares in some traditional sectors. Although they have a lot of resources, they lack the impetus to promote industrial innovation, which leads to the slow development of the industry. The root cause is essentially related to the quality of scientific research projects. In the market economy environment, not only private enterprises, central enterprises, state-owned enterprises also face the challenge of survival of the fittest. To become bigger and stronger, enterprises must seek changes, which are increasingly inseparable from the choice of scientific research direction and the quality of scientific research projects. At present, many enterprises choose the project through the way of defense. The problem with this approach is that it is a decision-oriented approach or respondent oriented approach rather than a project-oriented approach, and its judgment is likely to be biased. In addition to factors
such as information asymmetry, it is not conducive to selecting better scientific research projects under the premise of evaluating the priority of scientific research projects. Therefore, it is necessary to introduce a method that can depress the subjectivity of the judge or strip away the essential idea that the judge is least affected by the environmental factors. The study in this paper can provide reference for this kind of situation.

Reference
[1] Samiha Tahseen, BryanKarney. Opportunities for increased hydropower diversion at Niagara. An SWOT analysis[J]. Renewable Energy, 2017, 101.
[2] Qian S D. Operations research [M]. BeiJing: Tsinghua University Press, 2012-9.
[3] Peng G, Lv Y. Research on pricing strategy of bike-sharing platform [J]. The practice and understanding of mathematics, 2019, 49(10): 11-21.
[4] Xiao X W, Tian W. Application of 3D printing technology in the field of architecture [J]. The construction technology, 2015, 44 (10): 79-83.
[5] Zhang H, Huang H R. Design and evaluation system of steel structure construction system [J]. Industrial building, 2019, 39(S1): 1062-1065.
[6] Yang Y, Zhao W S. Study on the comprehensive benefits of prefabricated buildings [D]. AnHui: Anhui Jianzhu University, 2018.