Research on the Performance Evaluation of Integrated Project Management Based on PBS

Wang Yanweia,b, Wang Songjianga, Huang Yia,c, Wang Weid, a*

aCollege of management and Economics, Kunming University of Science and Technology, kunming 650201,China
bYunnan Agricultural University, kunming 650093,China
cYunnan Bureau of Statistics, kunming 650051,China
dCollege of Civil Engineering, Beijing University of Technology, Beijing 100124, China

Abstract

On the basis of Hall’s three-dimensional model system, and according to project management practices, the paper sets up the integrated model of project management based on the PBS, and the integrated model includes three dimensionalities, i.e. elements integrated, process integrated and stakeholders integrated. In order to test the model, the paper established the integrated project management evaluation model according to general evaluation principles and system reconstruction theories. Utilizing the integrated method, the model divided the performance of project management into three dimensionalities that is time, space, and benefit, and achieved the combination of qualitative and quantitative performance evaluation of integrated project management.

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1. Introduction

With the modern project especially the engineering project becoming larger and more complex, project theories and practice have gradually integrated. Most management modes of the former project management are single, isolated, but now, the project involves more stakeholders, and how to maximize the interests of the stakeholders becomes the hotspot of the current project management.

* Corresponding author: Wang Yanwei. Tel.: +86-871-5227647
E-mail address: ziyu19800626@126.com;63418231@qq.com
Wang Qiankun (2006) put forward construction project integration management, organization integration, process integration, information integration three dimensions structure system, and built construction project integration management new system on the analysis of three dimension system[1]. Huangqian (2007) adopted an active optimization process to build and combine, and that quickly, better, more effective to realize the aim of construction project[2]. Liu Yinsheng (2008) analyzed the connotation of construction engineering project integration management and put forward the development strategy of engineering project integration management from three sides[3]. Qi Anbang (2010) put forward integrated management system of large construction project group based on strategic goal [4].

2. Project integration management model based on PBS

At present, the most disadvantages of project management are mainly too much benefit related parties, the project life cycle is so long, there are so many sub-objects that we need to realize under the overall objects, and the stakeholders consider problem on their own way because of their different views, and do not consider the system as a organic whole so that do not achieve the whole optimization. The three dimensions structure model of Hall inspire us that we treat the project as a organization system, consider the object or elements (cost management, schedule management, quality management, contract management, resource management, risk management, safety management, human resource management, stock management) that project management related, each related stakeholders (owner, design company, construction company, supervision company, consultant company, national construction bureau, layout bureau, soil bureau, contractor, material supplier, operator, user, environment protect department, city planning department). Through the above research, we can found that if we manage the project detail excessively not only lead to expend so much cost but also not benefit for grasp the whole of the project and easily indulged in the exact details and things because the scale of the project especially the engineering project is so big. And PBS is the best tool of project macro control and the ligament of the micro control, not only the basis of marking bid of the project, is also the tool of realizing project system breakdown. So PBS is the basis of project synthesis integration control, build the project integration management model based on PBS.

Fig.1. Multi-dimensional Model based on PBS

Each project can be divided into many related and independent package according to some breakdown rule. Each package included some time information, space information and elements information, that is, object, process and stakeholders. Many project packages consist of the whole project, controlled each project package equal to realized the synthesis integration control of the whole project; at the same time, because realize the integration from the view of system integration, and that can achieved the whole system optimization, that is, project optimization.

3. The performance evaluation of project integration management
3.1 The synopsis of performance evaluation model

The performance evaluation of project integration management is a very complex system, and difficult to evaluate quantitatively, and gained the detailed benefit data. However, we can qualitatively build a three dimension evaluation model of project integration management, and then use the system restructure theory of synthesis integration[5-6] to quantitatively evaluate the time dimension, space dimension and efficiency dimension of the three model so that achieved the purpose of project synthesis integration from qualitative to quantitative method. Time dimension is consist of decision phase, implementation phase, operation phase according to the operation sequence of the project; space dimension is consist of owner, design company, construction company, supervision company, consult company, government department, contractor, material supplier, operator, user and so on according to stakeholders; the benefit dimension is consist of social benefit, economic benefit and environment benefit according to the benefit that the project can produce. The three dimensions contact together, and commonly consist of performance evaluation model of project integration management.

Fig.2. Three-dimension performance evaluation mode of project integrated management

3.2 The evaluation method

Synthesis integration method is put forward by Qian Xueshen professor in 1980s, it is a scientific method to deal the complex giant system, and lately through the specialist’s researches, Shu Guangfu put forward a synthesis integration method of system restructure analysis on the basis of researches[7]. Project integration management itself is a complex system; the effective management of the project is the key figure if the project can be done successfully. The involved stakeholders of project integration management are so many, and need to consider the inner and outer complex environment at the same time; therefore, the system restructure theory of synthesis integration method quite fit the performance evaluation research of project integration management.

3.3 The mathematic model of evaluation

The system restructure theory of synthesis integration firstly divides the complex giant system into a small system, this avail to analyze problem, and find the key problem. The performance evaluation of project integration management is divided into three dimensions based on this: time dimension, space dimension, benefit dimension. And give the math formula of the three dimensions as follows.

3.3.1 Time dimension

The weight of time dimension $\omega_t$, represent the weight of each phase of the project through subjective and objective weight ways in each phase of the operation phase.
The performance function of the time dimension is:

\[ E_T = \sum_{i=1}^{m} \sum_{j=1}^{l} P_k \cdot o_{e_i} \]  

3.3.2 Space dimension

The weight of space dimension \( o_{S_j} \) represents the weight of stakeholders owned.

\[ \sum_{j=1}^{n} S_j = S_1 + S_2 + \cdots + S_n = 1, j = 1, 2, \ldots, n. \]

The performance function of space dimension is:

\[ E_r = \sum_{i=1}^{m} \sum_{j=1}^{n} P_k \cdot o_{s_j} \]  

3.3.3 Efficiency dimension

The weight of efficiency dimension \( o_{B_k} \) represents the weight of economic efficiency, social efficiency and environment efficiency of the project.

\[ \sum_{k=1}^{l} B_k = B_1 + B_2 + \cdots + B_k = 1, k = 1, 2, \ldots, l. \]

The performance function of efficiency is:

\[ E_B = \sum_{i=1}^{m} \sum_{k=1}^{l} P_k \cdot o_{b_k} \]  

3.3.4 Synthesis performance

Project integration management should add the outer element parameter \( O(x) \) of the project when consider the outer elements, here, synthesis performance function can be represented:

\[ E = (T, S, B, o, O(x)) = f(E_T, E_S, E_B, O(x)) \]

Thereinto, \( T = T(t_1, t_2, t_3, \ldots), S = S(s_1, s_2, s_3, \ldots), B = B(b_1, b_2, b_3, \ldots), \omega = o(\omega_T, \omega_S, \omega_B) \)

Thereinto, \( T \) represents the time parameter (decision phase \( t_1 \), implementation phase \( t_2 \), operation phase \( t_3 \)), \( S \) represents space parameter (government department \( s_1 \), owner \( s_2 \), contractor \( s_3 \), consultant company \( s_4 \), material supplier \( s_5 \)), \( B \) represents efficiency parameter (social efficiency \( b_1 \), economic efficiency \( b_2 \), environment efficiency \( b_3 \)).

When predigest the relation between parameters into linear relation, the above function can be represented as follows:

\[ E = \sum_{i=1}^{m} \sum_{j=1}^{n} \sum_{k=1}^{l} o_{e_i} \cdot o_{s_j} \cdot o_{b_k} \cdot P_k + O(x) \]  

There into:

\[ \sum_{i=1}^{m} T_i = \alpha + \beta + \gamma + \lambda + \zeta + \cdots = 1, i = 1, 2, 3, 4, 5, \ldots, m. \]
\[ \sum s_j = s_1 + s_2 + \cdots + s_n, \quad j = 1,2,\ldots,n. \]
\[ \sum b_k = b_1 + b_2 + \cdots + b_k, \quad k = 1,2,\ldots,l. \]

Formula 5 represents that the performance of project integration management expresses the effect of project integration management mode on the basis of considering the inner and outer elements and opinion of the specialist, that is, the sum of the small cuboid’s cubage.

4. Case study

The paper takes Wukun freeway for example and assured the weight and score of each dimension through specialist investigation as follows: The score in decision phase are: Social performance (60, 65, 55, 50, 70, 75, 60, 40); Economic performance (90, 85, 90, 85, 88, 80, 92, 90); Environment performance (85, 70, 75, 72, 78, 80, 76, 73). The score in implementation phase are: Social performance (70, 55, 60, 70, 72, 58, 65, 76); Economic performance (95, 90, 83, 92, 90, 88, 86); Environment performance (80, 75, 78, 75, 74, 72, 65). The score in operation phase are: Social performance (70, 55, 60, 70, 72, 58, 65, 76); Economic performance (85, 80, 89, 90, 87, 78, 86, 83); Environment performance (80, 75, 78, 82, 71, 68, 80, 72). Therefore, the synthesis performance of Wu Kung freeway integration management is: 80.62. The score of Wu Kung freeway synthesis performance evaluation is 80.62 (the full mark is 100), it explains that the level of this project’s synthesis performance lies in the high level, and achieved the expected object.

5. Conclusion

The paper builds the performance evaluation model based on synthesis integration system restructure theory, and realizes the qualitative analysis of project performance evaluation, but because the outer elements are more complex and difficult to quantity, so did not consider the outer elements’ effect in this case application, how to better realize the quantitative analysis is worthy to further research.

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