Studies on combined model based on functional objectives of large scale complex engineering

Wang Yuting1,2; Feng Jingchun1,2; Sun Jiabao3
(1Business School, Hohai University, Nanjing Jiangsu, 211100, China; 2Institute of Project Management of Hohai University, Nanjing Jiangsu, 211100, China; 3Mechanical And Electronic Engineering school, Chaohu College, Chaohu Hefei Anhui, 238000, China)

corresponding author’s e-mail: wangyuting2017@163.com

Abstract: As various functions were included in large scale complex engineering, and each function would be conducted with completion of one or more projects, combined projects affecting their functions should be located. Based on the types of project portfolio, the relationship of projects and their functional objectives were analyzed. On that premise, portfolio projects-technics based on their functional objectives were introduced, then we studied and raised the principles of portfolio projects-technics based on the functional objectives of projects. In addition, The processes of combined projects were also constructed. With the help of portfolio projects-technics based on the functional objectives of projects, our research findings laid a good foundation for management of large scale complex engineering portfolio management.

1. Introduction
Large and complex engineering projects include strategic goals, functional goals and control objectives. Strategic goals determine large-scale complex engineering projects, while large-scale complex engineering projects guarantee the realization of functional goals. To this end, two aspects need to pay attention: one is the project portfolio based on the functional goals of large and complex engineering projects; the other is the project portfolio based on the tactical level of large complex engineering, in other words, in order to improve the management efficiency of large and complex engineering projects and facilitate project management. By using project portfolio techniques based on project similarity and relevance, project portfolio is formed from the correlation and similarity indicators between projects[1-4]. Functional goals usually have multiple sub-functional goals, and how to achieve functional goals effectively is an important task for the large and complex engineering project management. There is a correspondence between the components of a large and complex engineering project and the functional objectives. For this purpose, according to every functional goal, it needs (sub-functional goal) to find out the constituent part that affects each functional goal (sub-functional goal) and form the portfolio project that affects the functional goal (sub-functional goal). This article is based on the functional objectives of the project to launch the research of project combination technology.

2. Project Combination Principle
The strategic goal determines the necessity of the implementation of the large and complex engineering projects, and the large and complex engineering projects is an important means to achieve
the strategic goal. The success or failure of the project is directly related to the realization degree of the function target of the project, while, the control goal is the key criterion to measure the success or failure of the project. Every project and every constituent part of the project has certain functions. In order to ensure the success of the project, we need to control the quality, schedule and cost effectively. To this end, large and complex engineering project management needs to implement two kinds combination: one is to combine projects with common objectives combine to form the project group; the other is to have a combination of similar projects to form portfolio projects. The first combination of two combinations is divided into three types, which is based on the project portfolio of the strategy target, based on the project portfolio of functional objectives and based on the project portfolio of control[5-9].

The relationship between functional goals and engineering projects is more complex, there may be four kinds of relationship: the first one is a functional goal corresponding to a project; the second is a functional goal corresponding to several projects; the third is a number of functional goals corresponding to multiple projects; the fourth is multiple functional goals corresponding to a project. For functional goals, there are two combinations to be achieved based on the relationship between functions and projects: one is to combine projects of the same level and the other is to combine projects of different levels. Therefore, according to the function decomposition structure, project decomposition structure and the relationship between function and project, it needs to build corresponding project groups through project portfolio method. The combination principle based on functional goal is shown in the following diagram[10-12].

3. Project Combination Process

According to the relationship between functional goals and projects, the project Portfolio based on functional goals has two salient features: one is the relationship between functional goals and projects is more complex, so the project portfolio between multi-function goals and multi-projects needs to be solved; the other is the need to consider the needs of engineering construction management. Even
though one functional goal corresponds to one project, but in general the project is not the lowest level item in the work breakdown structure, that is to say, The project needs to be further decomposed into sub projects, while, these sub projects belong to different levels in the work breakdown structure. Therefore, there is a need to solve the problem of correspondence between functional goals and project decomposition structures. To this end, the work decomposition structure (WBS) and the value engineering theory can be introduced.

3.1 Functional Target Decomposition

The function of the project generally includes the total function goal and the sub-function goal, the two levels. As large projects generally need to be implemented in stages, the staging function targets can be increased according to management needs, as shown in Figure 2.

![Figure 2 function target decomposition](image)

3.2 Project Decomposition

According to the principle of work breakdown structure and the need of project management, we decompose the project from top to bottom into a staging engineering, a individual engineering, a unit engineering, a partitioned engineering and a sub engineering.

3.3 The Conversion Between Functional Goals and Projects

According to the relationship between the function goal and the project, the transformation model between the function target and the project is set up so as to get the project group. According to the relationship between the functional goal and the project and the needs of the project management, there are four relationships between the project and the functional goal.

(1) Functional goals are related to individual engineering. The conditions of the project portfolio: the first is the correlation between the individual project and the functional goal; the other is a individual engineering belonging to the same engineering project.

(2) Functional goals are related to unit engineering. The condition of the project combination: the first one is the correlation between the unit project and the function goal; the other is the partitioned engineering that belongs to the same unit engineering.

(3) The functional goals are related to partitioned engineering. The condition of the project portfolio: the first is the correlation between the partitioned engineering and the functional goal; the other is the partitioned engineering that belongs to the same unit engineering.

(4) The functional goals are related to the sub engineering. The conditions of the project portfolio: one is the correlation between the sub engineering and the partitioned goal; the other is a sub engineering belonging to the same partitioned engineering.
3.4 The important degree coefficient of function \( (F) \)
There are two methods to calculate the important degree coefficient of function: one is the 01 evaluation method, and the other is the expert scoring method. The two methods are introduced in this paper.

(1) 01 evaluation method. By comparing the every two functions, the order of function importance can be determined, and the function importance coefficient can be obtained accordingly. The steps are as follows: first, according to the importance of function, one to one comparison is made. One important party gets one point, the minor side records zero score, gets the score of each function and the order of importance of every function; The next is each function score divided by the value of the overall system, getting the important degree coefficient of each function refer to table 1.

| Order number | function | function 1 | function 2 | … | function R | score | order | coefficient |
|--------------|----------|------------|------------|---|------------|-------|-------|------------|
| 1            | function 1 | —          | —          |   |            |       |       |            |
| 2            | function 2 | —          | —          |   |            |       |       |            |
| 3            | …         | …          | …          |   |            |       |       |            |
| 4            | function R | —          | —          |   |            |       |       |            |

(2) expert scoring method. The steps include: first, the experts score each function according to the importance of each function by percentile system; the next is to accumulate every function score; then is to divide every function score by the total score of all functions and get the importance coefficient of the function. See Table 2.

| Order number | function | expert | score | coefficient |
|--------------|----------|--------|-------|-------------|
| 1            | function 1 | 1      |       |             |
| 2            | function 2 | 2      |       |             |
| …            | function R | …      |       |             |
|              | Total score |       | 1.00  |             |

3.5 Project portfolio
Two factors should be considered in the project portfolio: one is the level of the work breakdown structure, the other is the correlation between the project and the function. The type of project portfolio includes:

(1) a individual engineering portfolio based on a functional target.
(2) a unit engineering portfolio belonging to the same individual engineering based on a functional target.
(3) a partitioned engineering portfolio belonging to the same unit engineering based on a functional target.
(4) a sub engineering portfolio belonging to the same partitioned engineering based on a functional target.

4 The formation process of the project portfolio

4.1 Individual engineering portfolio
The formation of individual engineering portfolio based on the relationship between each individual project and its functions, the important degree coefficient of function and so on. A individual project related to a certain function is a program.
Target name: a program based on functional goal m at a individual project level.
Program: \( \{ P_{1.i} \mid A_{m1.i} > 0, \ i_1 = 1, 2, \ldots \} \);
\( A_{m1.i} \) is the \( P_{1.i} \)'s weight of the corresponding project in the functional m.

### 4.2 Unit engineering portfolio belonging to the same individual engineering

The formation of unit engineering portfolio based on the relationship between each unit project and the function, the important degree coefficient of function and so on. A unit project related to a certain function and belongs to the same individual project is a program.

Target name: the program of unit project belonging with the same individual project based on the function target m.
Program: \( \{ P_{1.i1.i2} \mid A_{m1.i1.i2} > 0, \ i_1 = 1, 2, \ldots, i_2 = 1, 2, \ldots \} \);
\( A_{m1.i1.i2} \) is the \( P_{1.i1.i2} \)'s weight of the corresponding project in the functional m.

### 4.3 Partitioned engineering portfolio belonging to the same unit engineering

The formation of partitioned engineering portfolio based on the relationship between each partitioned project and the function, the important degree coefficient of function and so on. A partitioned project related to a certain function and belongs to the same unit project is a program.

Target name: the program of partitioned project belonging with the same unit project based on the function target m.
Program: \( \{ P_{1.i1.i2.i3} \mid A_{m1.i1.i2.i3} > 0, \ i_1 = 1, 2, \ldots, i_2 = 1, 2, \ldots, i_3 = 1, 2, \ldots \} \);
\( A_{m1.i1.i2.i3} \) is the \( P_{1.i1.i2.i3} \)'s weight of the corresponding project in the functional m.

### 4.4 Sub engineering portfolio belonging to the same partitioned engineering

The formation of sub engineering portfolio based on the relationship between each sub project and the function, the important degree coefficient of function and so on. A sub project related to a certain function and belongs to the same partitioned project is a program.

Target name: the program of sub project belonging with the same partitioned project based on the function target m.
Program: \( \{ P_{1.i1.i2.i3.i4} \mid A_{m1.i1.i2.i3.i4} > 0, \ i_1 = 1, 2, \ldots, i_2 = 1, 2, \ldots, i_3 = 1, 2, \ldots, i_4 = 1, 2, \ldots \} \);
\( A_{m1.i1.i2.i3.i4} \) is the \( P_{1.i1.i2.i3.i4} \)'s weight of the corresponding project in the functional m.

### 5 Conclusion

(1) By decomposing functional objectives of the project and project function itself, so as to find out the relationship between the project functional objectives and the different levels of the project. On this basis, composing the portfolio project based on the different project function objectives. The result lays the foundation for the realization of project portfolio management.

(2) When using portfolio technology based on functional goals, through the analysis of the relationship between function and cost, we make the best use of the total cost of the whole life cycle of the project that try best to achieve the lowest cost. Also construction projects can fully meet the requirements of the owners in function so that obtain the greatest economic benefit. Since the portfolio is a set of projects with a common functional goal, therefore, this paper research on project function and cost by project portfolio can overcome the shortcomings effectively which analysis the single project function and cost. More economic benefits can be gained.

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