

## The Improvement of New Product R & D System in the Scompany Based on the Perspective of Multi-project Management

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**Abstract:** Taking S Company new product research and development project management as the background ,this paper analyzed the problems existing in the process of project management and discussed the approach to improve the way of a new product development project management system. It built the strategic planning to a new product research and development project and its corresponding organization structure model. Finally ,it studied resource management and knowledge management in a new product research and development multi-project.

**Key words:** new product; research and development; multi-project management; organization structure; re-source management; knowledge management

### 1 Introduction

The S Company was founded in 1969 , which is a large and medium-sized transport manufacturing base in China. No.8 aircraft is S Company's major product and it is the biggest producer transport vehicles in our country. Along with the track of the national economic construction and aviation industry development , S Company has also experienced every stage of early creation , trial production , the enterprise construction , difficult to maintain ,winning opportunities ,and rapid development. In the 10<sup>th</sup> and 11<sup>th</sup> Five-year Plan period ,that is to win the opportunities and the rapid development stage ,S Company was developing multiple types of model research tasks and successfully completed a number of national key model tasks. Since 1999 , S Company has successively completed 12 whole projects of the new type and multiple improvement program modification works. It has finished 6 finalized design work of the new model and several improved retrofit projects. With the progress of building models , the company made rapid development

and elevated economic benefit steadily.

In recent years , according to the model ,S Company set up the core project team and carried out the matrix management. Every team takes responsibility of project planning , planning nodes , airborne equipment bidding , implementation and cost. But , looking from the effect over years , due to the design department , engineering department and production units accepting various business enforcement departments management at the same time with limited resources ,it is difficult to implement plans and the actual effect is not ideal.

This article mainly analyzed the problems in multi-project management in the S Company new product research and development and put forward the corresponding strategy. The main content of the research includes S Company new product research and development status quo ,problems in new product research and development ,research and development project process management ,multi-project portfolio management strategy , implementation and monitoring of multi-project portfolio management , and safeguard measures of S Company new product research and de-

velopment.

## 2 Theoretical foundations

### 2.1 Aviation industry theory

According to China's aviation industry development stage , Chinese scholars for the aviation industry research mainly focused in the field of technology , whereas the research on methods and means of management is less. The research on management mainly concentrated on the following aspects: innovation mechanism research , building a financing system , quality process control , cultural cultivation and so on.

Guan Jiancheng and Guo Hong built the system of aviation enterprise technology innovation mode under the general framework of strategic analysis. They thought the leadership of the state or the superior department is the main part of the military technological innovation. But not for civilian aircraft , from decision to market risk , enterprises became a full body of technology innovation<sup>[1]</sup>. Lü Pei divided the aviation industry technology innovation into two levels: head office and subordinate enterprises<sup>[2]</sup>. Liu Daibiao , et al. discussed the issues of technology innovation in aviation scientific research institutes and thought that a traditional scientific research management system for school leadership and technical personnel had a different benefit induction , and it lead to the lack of the mechanisms of the transformation of technological achievements into real productive forces. Current military industry under the planned economic system made the factory separated from the institutes , and was unable to realize the fusion or effective collaboration of scientific research institutes and aviation manufacturing enterprises<sup>[3]</sup>. Yang Guiming , et al. discussed how to build a first-class enterprise for further development relying on technological innovation and advanced market location<sup>[4]</sup>. Yang Yuzhong believed that demand traction and technological innovation would create the brilliance of the 21<sup>st</sup> century world aviation science and technology and industry. It should take structural adjustment and promote technological

and institutional innovation and realize the leap and sustainable development of China's aviation industry<sup>[5]</sup> . Chen Yongzhou , et al. suggested that it should be according to the needs of customers , proceed many varieties of products , and cultivate technology management and innovation systems in aviation manufacturing enterprises under condition of multi-project<sup>[6]</sup> .

### 2.2 Multi-project management theory

Based on the study of the single project management , multi-project management transfers the research emphasis from a single project to multiple projects. It inherited some of project management theory and methods , such as project life cycle , quality , cost , schedule and other core concepts , borrowed from the WBS , CPM , GERT , PERT analysis methods and tools , absorbed content and management procedures such as the project time management , cost management , quality management , human resource management , communication management , risk management , and procurement management. Unlike the single project management , multi-project management emphasizes the coordinated relationship between different projects and between project and organization. The core of multi-project management is how to reasonably distribute limited resources in different projects , including capital , human resources , and so on. It is more difficult and complex than that of general project management. The object of multi-project management is multiple projects; therefore , it is needed to plan , organize , monitor and control many projects at the same time. It increases the difficulty of the project manager to manage the project. In multi-project management , it is necessary for the project manager and department manager to synthesize various factors and then according to the importance of these factors to make a corresponding decision<sup>[7]</sup> .

MHA Hendriks , B Boeten and L Kroep committed to research a human resource optimal allocation model in research and development project organization under the background of a multi-project. They put forward the five element human resource configuration method

that is making long-term, medium-term and short-term resource allocation plan and using PDCA( Plan , Do , Check , Active) feedback information to adjust the allocation in time<sup>[8]</sup>. A P Van Der Merwe studied multi-project management organization structure and control. He put a human resource element in the general matrix organization structure and made it a three-dimensional structure and built a 3D responsibility matrix combined with work breakdown structure<sup>[9]</sup>. Shigeru put forward a model that can not only plan for multi-project but also control the progress<sup>[10]</sup>. Kim and Leachman studied in dynamic multi-project environment , assumed that each project has a specified date of completion and there was a corresponding reward or punishment before and after the project completed and how to solve the problem of minimum total delay cost<sup>[11]</sup>. William East studied in dynamic multi-project environment how to use genetic algorithm to solve the problem of project resource and achieve the optimal configuration and minimize the total cost<sup>[12]</sup>. S M T Fatemi Ghomi built a resource allocation simulation model in a multi-project environment using GPSS simulation language<sup>[13]</sup>. De Maio put forward the framework of product development multi-project management<sup>[14]</sup>.

### **3 The problems in S Company new product research and development multi-project management**

#### **3.1 Lack of research and development project strategy**

Demand is the source of innovation ,and innovation is the soul of a research and development project ,and therefore analyzing the demand of market and users is an important part to make a strategy of research and development project. It is only by estimating the need of market and customers right that the product created by research and development might exist in the target market and enterprises might win the market competitiveness through a research and development project<sup>[15]</sup>. In the process of new product research and

development , the S Company didn't have enough judgment and discernment to the demand of the market. There was a certain blindness. Lack of strategic analysis for a research and development project and the enterprise: own development lead to the fuzzy product development strategy. Especially over years the S Company has established several competitive product direction and if it still keeps an original inertial system , it would be scattered enterprise strength and lead to passive competition.

#### **3.2 Lack of control in the project implementation process**

In resent years , the S Company is facing more and more types of tasks and new product research and development projects increased rapidly. In order to meet the need of national defense and enterprise development needs ,S Company set up a core project team of each model and carried out the matrix management according to the characteristic of each project. Each project team takes responsibility of planning nodes , airborne equipment bidding progress , cost , implementation and other elements. However ,according to the effect over the years ,projects were often delayed progress because of lack of control and monitoring because the design department , engineering department , and production units accepted different management from different project teams.

#### **3.3 Lack of performance evaluation of research and development**

Performance evaluation is evaluating scientifically and objectively the work performance of an individual or an organization in a certain period from the aspects of results , efficiency and effectiveness. Most of S Company's research and development projects are national key research projects , which are pressed for time. Therefore , they often lack necessary performance evaluation and not take the results seriously. Multiple research projects proceeding at the same time lead to lack of coordination between the project teams and overall consideration which means delay on schedule. The commander-in-chief of the system has to readjust the node of the project ,result in delay again. Projects

have failed in finishing on schedule and results in cost increasing and control difficulty. In addition , it is one of the most important causes of research and development project high cost that S Company research and development staff personal performance is not connected with the organization performance.

From the fundamental purpose , performance evaluation is to improve the organization's research and development performance , help the organization to complete many tasks , and achieve a win-win situation between the organization and individual employee. Making effective performance evaluation system of research and development projects is very helpful to reduce the cost of a research and development project.

### **3.4 Resource allocation of new product research and development project management is not reasonable**

On the management of research and development program personnel ,S Company divided staff according to research and development program teams , whereas they did not have clear plan about personnel position between teams , power and responsibility attribution , collaboration , etc. It is easy to cause research and development staff management confusion. Due to the project members involved in the project in the form of department and their work is primarily to meet the requirements of the department , they did not have a pressure of the project ,and did not care about the real purpose of their work and the final success or failure of the project. This situation would lead to widespread lack of work enthusiasm and teamwork spirit , especially in collaboration across different departments. It would also make the work target deviate from the project goals , and internal friction and waste of resources.

On the research and development project funds management ,cost control is often neglected in the S Company. Due to the long running in Planned Command Economy ,S Company paid most intention to the implementation of result instead of cost control. Developers need a great deal of support from the lab and e-

quipment and strict control of planning would limit the flexibility and creativity of research and develop personnel; nevertheless ,excessive cost would be in conflict with the limited resources of projects. In addition ,many project teams have repeat technology because of the intersection of different research and development projects; however ,it is difficult to parallel processing ,and eventually the cost increased.

### **3.5 Analysis of the causes of problems**

#### **1) Conservative thought**

The S Company is one of the core members of China aviation aircraft companies. Their research and development investment are totally dependent on national investment. This thought is disconnected with the market economy and it is hard to adapt to market economy development. Employees have widespread egalitarianism thinking under a Planned Command Economy and they are short of competition consciousness and the understanding about the company's overall development ,which leads to personal interests deviating from the interests of the company.

#### **2) Lag in management technology**

Leaders pay much attention to technology ,but far less to the management. They don't think management can quickly bring apparent benefits for an enterprise ,thus ,management technology development greatly lagged behind the development of scientific research and technology. New management technology has been doubted in S Company. They have less contact with a professional management team and lack necessary technical training to management personnel.

#### **3) Lack of construction of the project team**

Research and development project technical complexity requires a project team would be made up of employees which have complementary ability and knowledge to participate in the task oriented and autonomous units of work. The S Company uses a linear function type organizational structure. Although later use of an matrix organization structure because of many projects ,team members are always responsible

for straight linear functional department leaders. Linear functional department leaders hold power to the project team performance appraisal , etc. The project managers have less necessary power to team members. When the problems such as resource allocation conflict between different project teams occurred , each team fought mutually for their own benefits. It eventually lead to low efficiency and high costs in S Company new product research and development projects.

#### **4 Approach to a perfect research and development multi-project management system**

There is an important difference between enterprise project management( EPM) and single project management( PM) and where the focus of EPM is concerning all the achievements of projects in the enterprise. There may be many projects at the same time that need to be done in an enterprise. How to manage all the projects economically and effectively at the same time is the core of enterprise project management<sup>[16]</sup>. At present , the problem such as poor communication between departments was solved by using a project team system in the research and development projects in S Company. However , it brought project management resource conflict problems because of

more and more research and development type projects and limited resources. Enterprise research and development resource mainly includes three parts , human resource , capital and knowledge.

##### **4.1 Organization structure of multi-project**

S Company set up project core teams for various aircraft development and production , and their current organization structure is a matrix structure. Matrix organization structure is helpful to solve poor communication problems in a traditional linear structure. However , there still are some problems such as organization coordination , dual leadership and dissymmetry between leadership and responsibility in a matrix structure. In view of the above problems , the linear organization structure has been replaced by a process oriented organization structure. The process is a combination of a series of related activities which convert the input into useful output to customers<sup>[17]</sup>. S Company research and development projects can be seen as processes. The process oriented organization completely broke the traditional division of labor theory of ideology based on this consideration. It emphasized that establishing a process guide instead of a function oriented form of organization. The specific organization structure is shown in Figure 1.

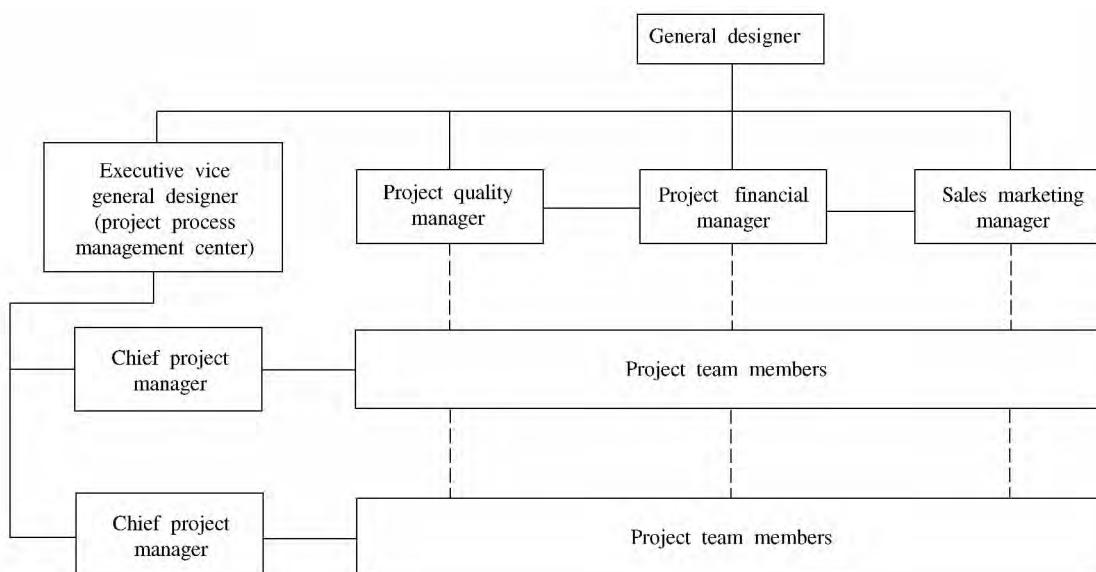


Figure 1 Process oriented organization structure

In Figure 1 , the solid line shows the direct leadership , the dashed line shows the indirect leadership. The original function personnel constitute different project teams according to the project division led directly by a chief project manager , and adding the executive vice general designer whose main effect is similar to the project process management center to plan all of the projects and solve the coordination problems between different projects. The vice general designer in the process oriented organization performs two functions: coordinating all processes in the enterprise and authorizing and monitoring each process manager. The original project quality manager , project financial manager and sales marketing manager no longer lead the project team members directly , but

help to assist the projects.

#### 4.2 Resource management of a multi-project

In order to use the limited funds efficiently , it is necessary to confirm the source of funds according to the categories of research and development projects. After a project is started , the chief project manager must control the cost during the process and afterwards according to the initial cost plan. In a multi-project , the impendency degree to funds of each project is evaluated and weighed by the general designer of the research and development project. The general designer allocates the funds with the help of the project financial manager. The specific process is shown in Figure 2.

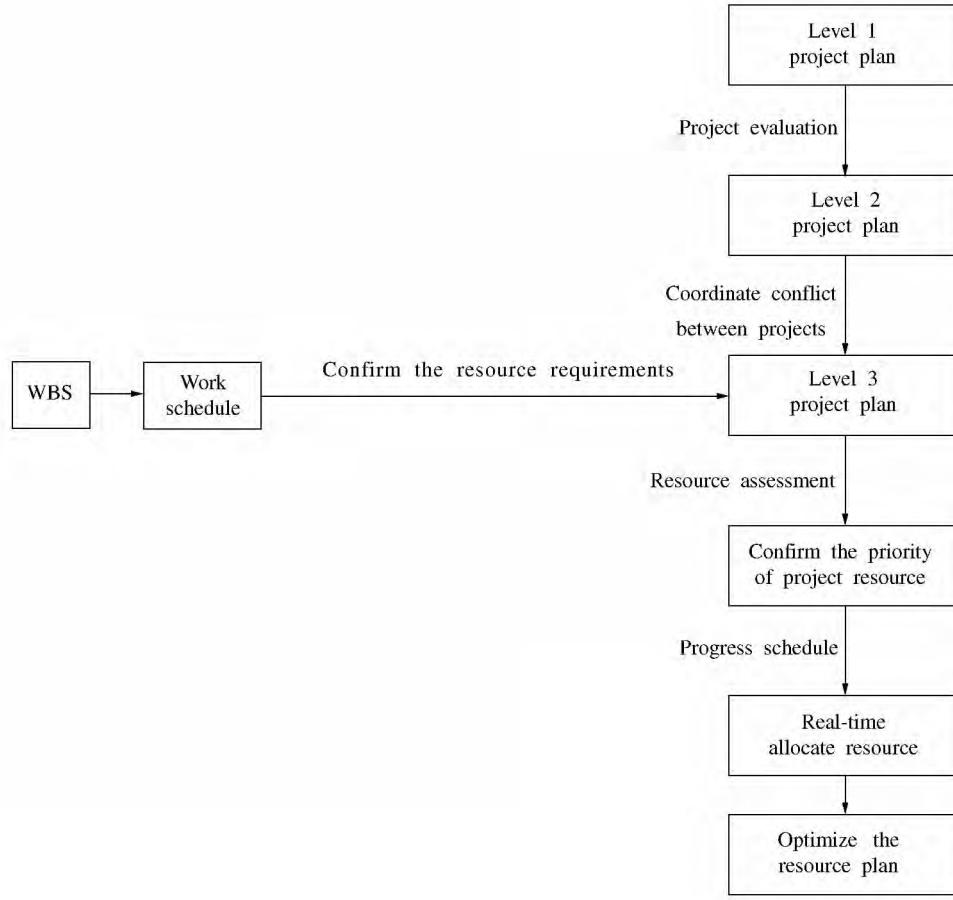


Figure 2 Resource management process

Use WBS to break down several research and development projects and make 3 levels of project progress

plan. Level 1 project resource plan is mainly established by the general designer who is responsible for

project decision and evaluation. Level 1 plan is the focus of the project resource management system. It should be strictly controlled. Meanwhile the whole project critical path is composed of the level 1 project plan; therefore it is also the focus of resource conservation. Level 2 project resource plan is established by an executive vice general designer who pays close attention to coordinate resources and make specifications. Level 2 resource plan is used to mediate the conflicts in the process of project implementation. It would ensure that each project is completed smoothly. Meanwhile , each functional department also can adjust the level 2 plan according to their own resource requirement. Level 3 project resource plan is established by a chief project manager. It mainly includes organizing each single project and executing level 1 and level 2 resource plans. It guarantees the project resource plan. It eventually formed an entire resource plan to all projects via monitoring and adjusting the process of project implementation. It would allocate limited resources reasonably and avoid resource conflicts.

#### **4.3 Knowledge management of multi-project**

There are two types of knowledge in a research and development organization: explicit knowledge and implicit knowledge. Explicit knowledge is information on the surface from research and development organization personnel and external technical surveys. It could be expressed and communicated by formal and systematic language. It includes product appearance , files , databases , manuals , formulas and computer programs , etc. Implicit knowledge is the foundation of personal skills. It is a personal style formed in the cycle of experimenting , making mistakes and correcting. It usually includes experience , impression , skill knack , organization culture and custom<sup>[18]</sup> .

For explicit knowledge , it should establish a project

management information system( PMIS) . The basis of establishment of PMIS under the condition of a multi-project includes the following steps. Building an enterprise project management organization system and resource database is the first step. It should have a perfect economic accounting foundation to provide accurate and complete raw data. It makes the management work stylized and the report file unified. Managers need to know clearly and definitely what kind of resource that the enterprise has and classify these resources and establish the corresponding database. Managing projects requires cooperation between different departments , so enterprises must establish their own human resource system to evaluate the skills their employees have. The importance of this system is that they can select the project managers and members efficiently and make a powerful project team. The second step is to sum up and establish a standard project process. It means to clear up various working procedures in the process of product development and eventually form a standard work process. It includes project selection process , implementing project work process , allocating project resources and so on. The third step is to set up effective and fast information communication channels. It should result in transferring files electronically and using software to monitor projects. In project communication management , it should make a reasonable communication plan according to the actual situation of the project and emphasize process communication and manage conflicts efficiently.

For implicit knowledge , it needs to achieve a win-win situation relied on the project team construction. Individuals are the basis of a team. They should have full respect. If team members' pride were wounded , they would generate negative emotions and their sense of belonging would be reduced greatly. Team members

would feel to be trusted and expected when they are authorized properly and fully. They would give more enthusiasm and potential to their work. On the premise of respect and trust , it should be established that working mechanisms of a research and development team help to communicate information , clear responsibility and coordinate progress. Working mechanisms include a formal mechanism ( such as team meeting) and informal mechanism ( such as random exchange) . Furthermore , project team culture is a part of the whole enterprise culture , so the project team culture has shared characteristics in the whole enterprise culture and its own unique requirements , such as innovativeness and cooperativeness. Good team culture can make team members generate a strong sense of belonging and responsibility. It would help to share knowledge and alleviate contradiction. It ultimately would achieve the goal of project management by means of completing project tasks smoothly.

## 5 Conclusions

From the perspective of multi-project management , this article proposed ways to improve new product development project management in the view of problems in S Company research and development projects. This article analyzed the problems in S Company new product research and development: lack of project strategy planning and control of the implementation process , high cost of research and development because of the lack of performance evaluation and the allocation of resources is not good enough. This article put forward an approach to a perfect research and development multi-project management system. It constructed strategy planning for new product research and development projects and the organization structure model for S Company. It studied the resource allocation in a multi-project situation and proposed ad-

vices such as formulating a resource plan reasonably , deciding the priority of each project and paying more attention to research and development project team culture.

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