
INTERNATIONAL JOURNAL OF SCIENCE ARTS AND COMMERCE

RESEARCH ON EFFICIENCY OPTIMIZATION OF MULTI-PROJECT MANAGEMENT IN IT INDUSTRY

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Abstract

IT companies are currently important high-tech companies in China. These companies have high technology and high added output value. They play an important role in the transformation of China's kinetic energy. For an IT company, the company often does not only undertake one IT-type project, but often multiple projects are carried out at the same time, which will bring about multi-project management problems. Multi-project management is different from the general management process. The multi-project management process is more complicated and has higher standards and requirements. The IT project is a non-traditional technical project, the required resources, risks, and organizational environment are also different from the general project management process. In the process of IT multi-project management, enterprises must not only consider the coordination of resources, but also must control the main progress. For some small and medium-sized IT companies, it is common for an employee to participate in multiple projects at the same time, which puts new requirements on the allocation of resources. At the same time, IT companies have high work intensity, overtime is more common, and staff mobility is often greater, which also brings new challenges to IT multi-project management. So how exactly should IT multi-project management work? What elements should be paid attention to in the specific management process? In the research of this article, four elements including schedule management, basic resources, organizational environment, and risk management are analyzed. Through empirical analysis, we study the relationship between each of the above elements and multi-project management. After verifying whether there is a connection, this article will put forward specific improvement suggestions for these elements to promote the coordination and optimization of the multi-project management process. Based on the questionnaire survey, this article also considers case studies and general studies, and deeply analyzes the impact of each element in IT multi-project management. Through research, this article believes that the final recommendations can provide certain help to Chinese IT companies and promote companies to better balance the speed of project progress and economic benefits.

Keywords: IT multi-project management; schedule management; risk management; organizational environment; basic resources.

Introduction

Research Background

Talking about the origin of project management, it started long before the construction of the ancient Egyptian pyramids and the Great Wall of China. Because of the strict scientific management during the implementation of the project, these great construction projects are successful. But it was not until the 1960s that project management truly ushered in its heyday of development. Project management as a means for organizations to achieve their goals has been widely used in all walks of life. Project management improves the ability of planning, organizing, coordinating, executing and controlling activities in the whole process of project implementation, and provides organizations with effective and reasonable methods of using and allocating resources, and has made important contributions to management practices.

Multi-project management refers to the management of the entire project life cycle for multiple projects that are carried out simultaneously in the organization. It means to manage and coordinate the selection, evaluation, planning, control, execution, and completion of multiple projects at the same time in the enterprise. Balance each project so that the comprehensive execution effect of all projects achieves the best project management method. In the process of parallel implementation of multiple projects in an enterprise, there will inevitably be sharing and conflicts among various projects in terms of funds, time, manpower and other resources. Whether the allocation of these resources is reasonable or not directly determines the implementation progress and quality of each project. The multi-project resource allocation method is quite different from the traditional single-project management. It is necessary to comprehensively consider the allocation of resources and the importance and priority of projects. Perform reasonable and effective resource allocation and scheduling among multiple projects to minimize resource conflicts.

The core and key issue of multi-project management is how to achieve the most reasonable and effective allocation of limited resources to maximize the needs of different projects for resources, and ultimately maximize the benefits of the enterprise organization. In the multi-project resource allocation management, work needs to be carried out in three aspects: firstly, the resource needs of each project need to be identified; secondly, the resource constraints in the project need to be analyzed; and finally, multi-project resource plans need to be formulated. Among them, the basis of resource planning is the accurate identification of project resources and accurate control of resource constraints. And resource planning is the center of resource allocation management. On the premise of meeting and conforming to the strategic goals of the enterprise, the optimal

balance point of meeting resource requirements and reducing resource constraints can be found to realize the optimal allocation of project resources. (Prakash et al., 2020; Chofresh et al., 2020; Rodríguez et al., 2020)

Now more and more companies are implementing multi-project management to varying degrees. The scarcity and value of enterprise resources make various resource conflicts often occur between projects or within projects. For a more mature company, it is impossible for the company to have only one business item in its operation. The coexistence of multiple projects is an important symbol in the development of contemporary enterprises. However, in the face of multiple projects being carried out at the same time, the question of which project has priority for development and which project is the second priority will always cause disputes between business managers and project managers. Therefore, rationally carrying out multi-project management, coordinating the contradictions and conflicts between projects, and fully and effectively allocating the limited resources of the enterprise through active operation is of great significance to the long-term development of the enterprise.

For the IT industry, the current IT industry is still in its golden stage, and more and more people are beginning to learn IT technology (such as programming, software maintenance, etc.). The rapid development of the Internet has also brought great momentum to the IT industry. However, the amount of business received by current IT companies is often large, and large-scale IT companies often take the form of project teams to complete their respective projects. At this time, how to allocate enterprise resources and allocate resources to each project team reasonably has become the key to ensuring the orderly progress of the project. Due to lack of manpower in small and medium IT companies, team members often overlap in the process of completing different projects. At this time, we must pay more attention to the efficiency of multi-project management, coordinate human resources and funds, to achieve the smooth completion of the project and avoid delays. Therefore, multi-project management is a very necessary management tool for the IT industry. Strengthening multi-project management and improving management efficiency are of positive significance to the development of IT enterprises. (Laine et al, 2020; Hedborg et al., 2020)

Problem Statement

Combining my relevant work experience and related literature, current multi-projects have gradually become the key development issues of enterprise management in the future. For IT companies, especially R&D IT companies, multi-project joint promotion is the norm for companies (Larsson et al., 2020; Kwena, 2020). But in fact, due to the large number of projects and the relatively limited human resources and financial resources, there are often resource competitions between projects, and there are often frictions between project leaders. Many IT companies also feel very troublesome about this type of problem. It is worth pointing out that due to the limited manpower of some small and medium-sized IT companies, when dealing with multiple projects, one person is often required to be responsible for different things in multiple

projects, which causes a huge burden on employees. From the current point of view, the following problems exist in the process of IT enterprise application multi-project management, as shown in Table 1-1:

Table 1-1 Summary of main issues in the multi-project management process

Problem	Brief introduction
Organizational structure	The organizational structure is flawed, which affects the efficiency of multi-project management
Holistic problem	Lack of overall planning, inadequate overall planning capabilities, and failure to treat multiple projects as an organic whole
Balance of interests	There is a difference in the choice of interests between employees and enterprises in project selection
Departmental coordination issues	When multi-departmental linkage, efficiency and smooth communication cannot be effectively guaranteed
Resource allocation problem	Unable to effectively implement resource allocation

Organizational structure

The market environment for IT companies is becoming more and more complex, market competition is becoming more and more fierce, large and small IT companies continue to close down and establish, with the advent of the Internet era, the hot development trend of the IT industry has never faded. However, facing the ever-changing market environment, facing fierce market competition, and facing the pressure of project completion, IT companies must adapt to the trend of the times from the organizational structure. In the process of multi-project management in IT enterprises, there are problems such as large number of projects, technical difficulties, large scale, and complexity. The multi-project system within the organization also has the characteristics of long-term, dynamic change, etc., which puts forward higher requirements on the organizational form of multi-project operation and must have a high coordination ability of internal and external environments. Therefore, it is necessary to design an organizational form that is compatible with the multi-project management of IT enterprises, so as to improve the level and efficiency of multi-project management, thereby ensuring the successful implementation of multi-projects, and ultimately realizing the overall benefits of the enterprise.

Research Problem

Problem: Will the progress management of IT multi-project affect the process of IT multi-project management?

IT multi-project involves more human and material resources. For an IT company, especially some small and medium-sized IT companies, one person often needs to participate in the development process of multiple projects. Then in the actual process of IT multi-project management, the progress of different IT projects is different, and the time node corresponding to each project is also different. For example, when a certain IT project has achieved greater progress, the company will consider whether to coordinate part of the project's resources to other IT projects to ensure the smooth progress of multiple IT projects. Therefore, through the management of the progress of each IT project, will it affect the final effect of IT multi-project management? This is the first question that this article will analyze.

Research Objective

First, this research is devoted to the description of the project-oriented characteristics of IT development organizations, an overview of the actual operation of IT development organizations, and the importance of organization-level project management to IT development organizations. And on this basis, the multi-project management efficiency of IT development organizations is deeply studied from the perspective of system theory, and its capability boundary and capability structure are discussed, and synergy analysis is carried out.

LITERATURE REVIEW

Dependent Variable: IT Multi-Project Management

First, this article must further explain the multi-project management based on the previous article. This article has pointed out in the first chapter that there are obvious differences between multi-project management and general single-project management. This article will use Table 2-1 to make a comprehensive comparison between multi-project management and traditional single-project management. (Drăgan et al., 2020; Delisle, 2020)

Table 2-1 Difference between multi-project management and single-project management

Differences	Single project management	Multi-project management
Management object	Specific item	All projects in the entire organization
Management goals	Submit the project to the	Achieve corporate

	owner as planned	strategic goals
Management perspective	Relatively micro	Relatively macro
Management level	Executive layer	The overall strategic level of the organization
Management method	Project management	Strategic management, resource management, etc.
Manage content	Time, cost, scope and risk	Strategy and project consistency

For multiple projects in the organization, multi-project management can be classified into the following types according to the degree of relevance between the projects: project group management, project portfolio management and project group management.

(1) Project group management Project group management is to group some similar projects together for management. These projects with certain similarities do not have a common relationship in goals, but the projects themselves are similar. There are similarities in work implementation methods, project scales, technical solutions, etc., and multiple projects can be cross-referenced. This management model can form economies of scale and improve work efficiency.

(2) Program management the program is the link between the project and the company's strategy. To promote the realization of corporate strategic goals, the special project is designed to include a combination of some projects. Sending some projects alone for management cannot achieve benefits, but coordinated and unified management can achieve the strategic goals of enterprises and organizations. Project group management is to coordinate and manage a group of interrelated projects according to the environment and strategic goals of the enterprise and organization, so as to realize the goal that cannot be achieved by managing only a single project.

(3) Project portfolio management The American Project Management Institute PMI's definition of project portfolio is the aggregation of projects or program groups and other tasks, through effective management to meet corporate strategic goals. Project portfolio management is the portfolio management of multiple projects, under the overall strategic guidance of the enterprise and the support of internal and external resources, the selection and portfolio management of multiple projects or program groups. Project portfolio refers to the combination of projects, program groups, and other work that are combined to facilitate effective management and achieve strategic business goals. The projects or program groups in the project portfolio do not necessarily have similarities, and it is difficult to refer to each other. However, by combining these projects for unified management, the resources and production factors in enterprises and organizations can be used and configured scientifically and efficiently, thereby enhancing the

efficiency and economic benefits of resource utilization of enterprises and organizations. Therefore, project portfolio management is management oriented to enterprise organizations. To achieve specific strategic goals, multiple projects are optimally selected and combined, and the limited internal and external resources and technologies of the enterprise are effectively utilized to maximize the value and overall benefits of the enterprise.

The relationship among project group management, program management, project portfolio management, and single project management is shown in Figure 2-1:

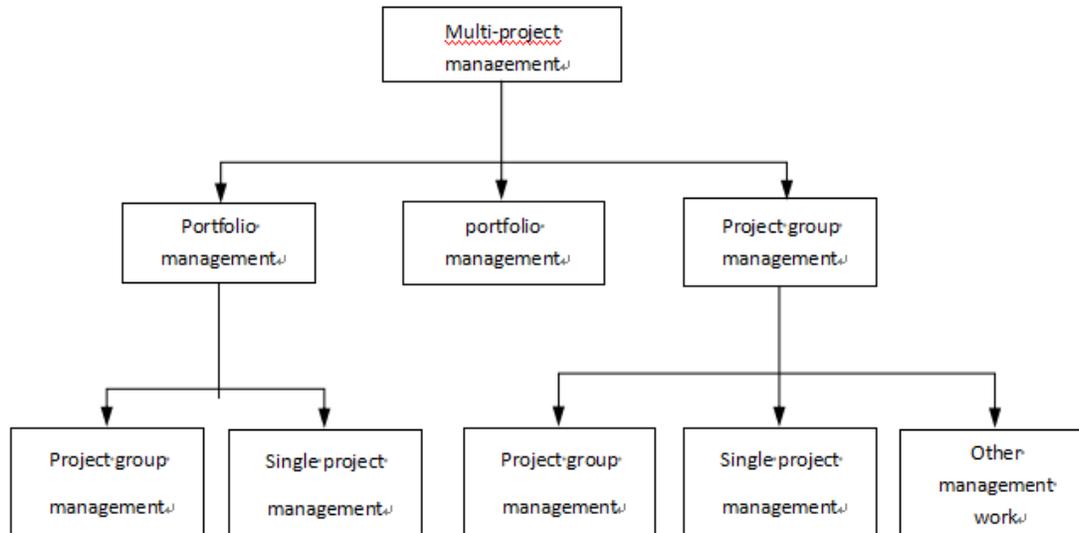


Figure 2-1 Multi-project management classification diagram

Based on these analyses, multi-project management has the following characteristics:

(1) Overall strategy. Multi-project management considers the selection, evaluation, planning, implementation, and control of projects on the overall strategic level of the organization and has an overall strategic nature. As a new management field different from single project management, multi-project management needs to ensure that all projects within the organization are consistent with the overall development strategy of the organization. As the carrier of the organization's strategic goals, only by ensuring the overall success of the project can the organization's strategic goals be achieved. Therefore, multi-project management requires organizations to look at and build multi-projects from a holistic and systematic perspective.

The overall strategy of multi-project management requires companies to first formulate their development strategies based on their own corporate missions and corporate goals, and then select multiple projects based on the corporate strategy, and prioritize multiple projects, and then the implementation of the projects. When the implementation of multiple projects at the same time is blocked, the order of implementation of the projects or processes should be determined according to the priority of the multiple projects or the priority of the process, and finally the

strategic goal is achieved through the success of the project. Figure 2-2 shows the overall strategic characteristics of enterprise multi-project management.

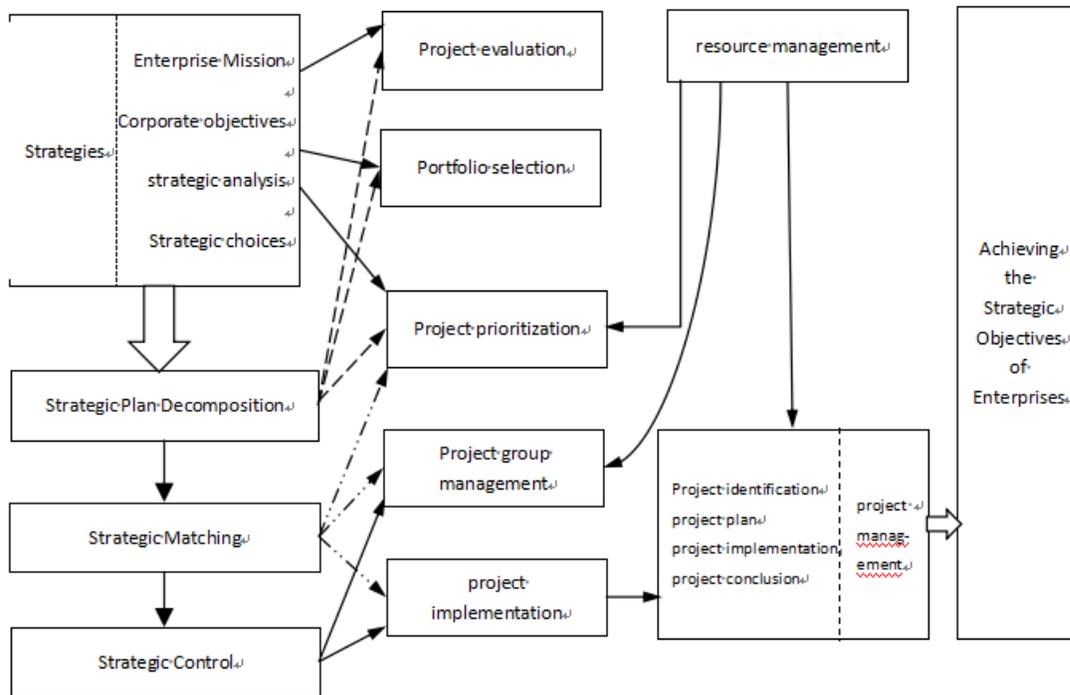


Figure 2-2 Schematic diagram of multi-project strategic management

(2) Integration. On the one hand, multi-project management embodies integration in management tools and methods, integrating the ideas of project management, strategic management, system management, and resource management. Combine and improve the relevant theoretical knowledge in these research fields, and comprehensively use its advantages to solve multi-project management problems. On the other hand, multi-project management embodies the integration in content, and needs to coordinate and control multiple projects within the organization at the same time. This feature can enhance the mutual connection between projects, facilitate the effective allocation of resources, and improve the organization and management capabilities.

(3) Dynamic variability. The external environment in which multiple projects operate at the same time is complex and changeable, with dynamic characteristics. Multiple projects managed by an organization can be regarded as a multi-project management system. As the duration, requirements, and goals of each project in the organization are not the same, some projects will exit the multi-project management system as the project is successfully completed. At the same time, the organization will discover new opportunities, and new projects will be added to the multi-project management system. The nature of these dynamic changes also requires the organization to dynamically adjust the overall strategic plan of the organization in time as the project implementation environment changes.

METHODOLOGY

Research Design

The research of this article is mainly based on empirical analysis and uses data processing software such as SPSS to perform auxiliary analysis. To understand the actual situation of enterprise IT multi-project management, to obtain real data, this article will take a questionnaire survey. Questionnaires were issued to IT-type enterprises in Shenzhen, combined with a five-level evaluation scale, to score related questions, and finally summarized for data analysis. At the same time, in order to verify the role of schedule management, this paper will adopt the method of genetic algorithm to simulate the final results of enterprise IT multi-project management under different schedule management states, so as to judge the connection between the two. As shown in Figure 3-1 below, the schematic diagram of the research design:

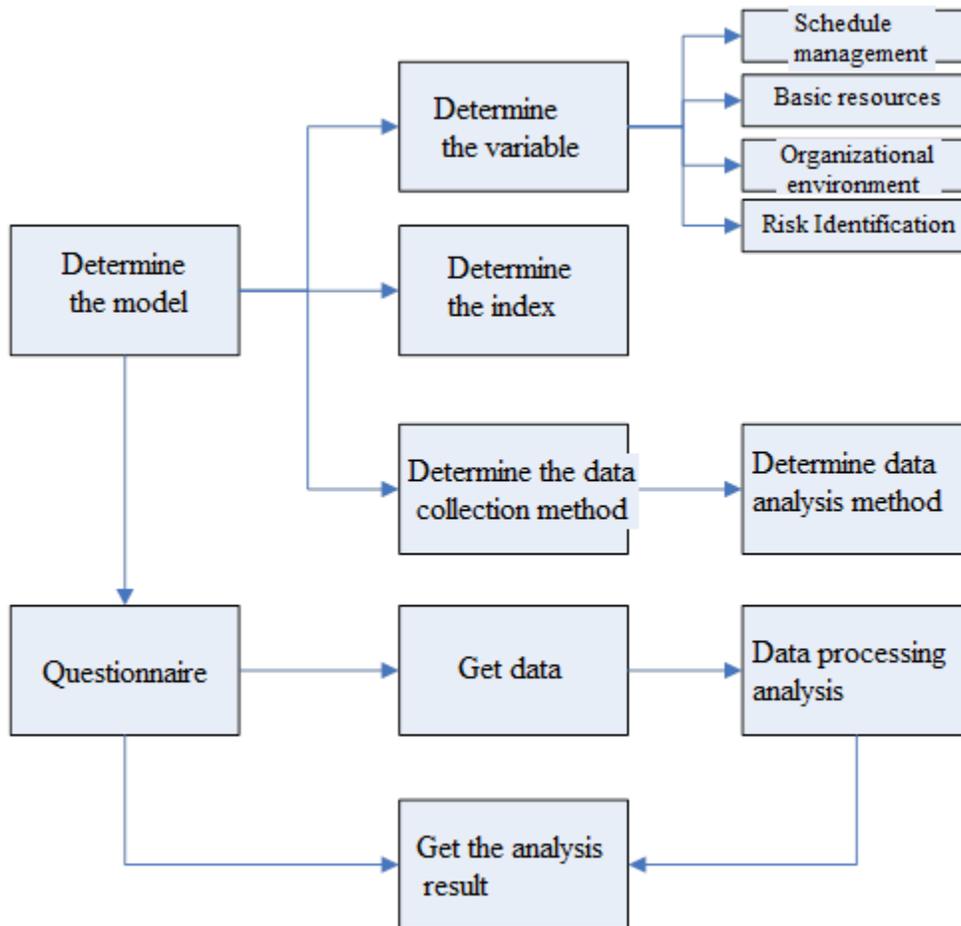


Figure 3-1 Schematic diagram of research design

Population/Sampling/Unit of Analysis

To verify and analyze the hypotheses proposed in this article, this article needs to determine the appropriate sample range and sample size. This article takes Chinese IT companies as the research object, so project personnel from these companies are selected for research. This questionnaire survey mainly used electronic questionnaires, which were mainly distributed in Shenzhen, and contact work was carried out before distribution. Among the 400 questionnaires that have been distributed, 355 were recovered, 29 incomplete questionnaires and invalid questionnaires were eliminated, and 326 valid questionnaires were formed. Obtained 326 valid data records, the effective questionnaire recovery rate was 91.83%, and the questionnaire content is detailed in the appendix.

Analytical Scale

On the one hand, from the perspective of traditional influencing factors, this article uses three factors to describe this level, namely resource base, schedule management quality, and organizational environmental quality. Each factor is composed of several indicators, and there are 14 measurement indicators at this level. On the other hand, from the perspective of the efficiency of IT multi-project risk control management, this article uses two factors to describe this level, namely the basic operation ability of risk control and the ability of coordinated risk control, which contains a total of 10 measurement indicators. The details are shown in the following table:

Table 3-1 Related elements and index statistics

	Impact factor	Index
Traditional influence factors	Basic resources	Material resources, technical human resources, management human resources, information resources
	Organizational environment	Customer performance, partner company performance, project management technology, IT development technology
	Schedule management	Corporate strategy, organizational structure, project development process, corporate culture, project management information system, organizational learning atmosphere
Risk control ability factors	Basic operation capability of risk control	Multi-project start-up management ability, multi-project planning ability, multi-project basic control ability, risk response and early warning ability, multi-project performance evaluation ability
	Cooperative	Resource allocation collaborative risk control ability,

risk control capability	organization and management ability, project knowledge project culture environment	collaborative risk control collaborative risk control collaborative risk control collaborative risk control
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The entire questionnaire is composed of 5 subscales and a total of 24 measurement items. It includes a subscale of influencing factors described by three exogenous latent variables: ① Resource base subscale, including 4 indicators; ② Organize the environmental quality subscale, including 4 indicators; ③ The progress management quality subscale, including 6 indicators. And the subscale of organizational multi-project management efficiency described by two endogenous latent variables: ① The risk control basic operational capability subscale, including 5 indicators; ② The collaborative risk control capability subscale contains 5 indicators. The questionnaire uses the more popular Likert 5-point scale. Answers “strongly agree” get 5 points, “agree” get 4 points, “neither agree nor disagree” get 3 points, “disagree” get 2 points, and “strongly disagree” get 1 point. See the appendix for the questionnaire.

FINDINGS AND DISCUSSIONS

Respondents Summary

Among the issued questionnaires, 255 were collected, of which 226 were valid questionnaires, with an effective rate of 88%. First, conduct a frequency analysis of the working years of the surveyed personnel, and the results of the analysis by SPSS software are shown in Table 4-1:

Table 4-1 Frequency distribution of working years

		Frequency	Percent	Valid Percent	Cumulative Percent
valid	1.00	59	26.1	26.1	26.1
	2.00	127	56.2	56.2	82.3
	3.00	36	15.9	15.9	98.2
	4.00	4	1.8	1.8	100.0
	Total	226	100.0	100.0	

It can be seen from Table 4-1 that among the IT employees who participated in this questionnaire survey, none of them have worked for more than 10 years, and most of them are in the range of

1-3 years. This is also in line with one of the main characteristics of IT-based enterprises, that is, the mobility of human resources within the organization is strong. Secondly, conduct frequency analysis on the job roles of the investigators. In Table 4-2, 1 is a system analyst, 2 is a programmer, 3 is a tester, 4 is a general manager in the team, and 5 is a project manager. The analysis results by SPSS software are shown in Table 4-2 below. It can be seen from Table 4.7 that more than half of the IT employees who participated in the questionnaire survey were programmers. The general manager and project manager in the team, that is, the manager role only accounted for 16.4%.

Table 4-2 Frequency distribution of job roles

		Frequency	Percent	Valid Percent	Cumulative Percent
valid	1.00	14	6.2	6.2	6.2
	2.00	120	53.1	53.1	59.3
	3.00	55	24.3	24.3	83.6
	4.00	21	9.3	9.3	92.9
	5.00	16	7.1	7.1	100.0
	Total	226	100.0	100.0	

Research Objective 1: Schedule Management and Multi-Project Management Efficiency

4.2.1.1 Steps of progress management

The essence of schedule management is the management process of rationally deploying resources according to the development stage of each project, according to the contract and project plan. Progress management in multi-project management can be divided into the following steps:

- ① Through the work breakdown structure, multiple projects can be divided into several tasks, and the connections and constraints between these tasks are represented by a single-code network diagram. By adding dummy tasks at the beginning and end of each project, the multiple projects are integrated into a whole project, and then the overall objective function of the multiple projects is established to control the implementation of the multiple projects to achieve better results.
- ② The resources required by the project can be updated, that is, the project tasks occupy resources when they are implemented, and the resources are released when the project tasks are

completed. Assuming that the implemented multi-projects are geographically close, the time and cost of resource transfer between projects are ignored.

③ The duration of the project task and the resources required for the task can be estimated based on past project experience, that is, the duration and resource consumption of the task are considered to be known. At the same time, it is assumed that the type of resource demand and the quantity consumed are fixed during the time period when the task is occupying resources, and the type and quantity of supply of resources are also fixed by the enterprise.

④ Each project has a construction period requirement when signing the contract, and the project will receive corresponding rewards in advance; project delays will be correspondingly punished. In order to ensure the quality of the project, there is a maximum limit on the reward for early completion of the project; Similarly, there is a limit to the penalty for project delay. It is impossible to be punished all the time when the project cannot be completed, limiting a delay time. After this time limit, the project contract will be terminated and the project undertaking enterprise will be brought forward to deal with breach of contract and demand compensation.

⑤ Enterprises can determine the expected rate of return of the project for different projects, so according to the contract price when the project is contracted and the expected rate of return of the project, the value of the return that can be obtained when the project is completed can be determined.

CONCLUSION

Multi-project management is one of the hot topics in the current project management community, and the introduction of related theories into China has been relatively short. Although Chinese IT companies have project-oriented characteristics, how to effectively manage multiple projects is still in the exploratory stage. This article attempts to innovate based on previous studies, hoping to start with management capabilities and other aspects, in-depth analysis of relevant factors affecting IT multi-project management. (Dotsenko et al., 2020; Guo et al., 2019) Through research, the main research conclusions obtained in this article are as follows:

1. In terms of schedule management, IT multi-project management has a special place. IT projects are different from physical projects. As a technical project, IT projects contain different stages. There are certain differences in the human resources required at each stage, so it is necessary to pay attention to the control of the project schedule in the schedule management process. Adjust the personnel involved in a single project in a timely manner, reasonably arrange the responsible work of each personnel, and at the same time comprehensively consider issues such as cost and default.

2. Construct a conceptual model of the factors affecting the efficiency of the organization's multi-project management from the three dimensions of resource base, organizational environment

quality, and schedule management quality, and design a questionnaire entitled "Factors affecting the efficiency of IT enterprise multi-project management". Through the results of questionnaire feedback from IT company personnel, statistical analysis software is used to analyze and sort the data, and to draw quantitative research conclusions. Among them, the resource base has a significant impact on the basic operation ability of risk control and the ability of coordinated risk control; The environmental quality of the organization has a significant impact on the basic operation capability of risk control; The impact on the collaborative risk control capability is not significant; The quality of schedule management has a significant impact on the basic operational capabilities of risk control and collaborative risk control capabilities; The basic operation ability of risk control has a significant impact on the ability of collaborative risk control.

3. In terms of risk response, the risk of IT projects is significantly different from that of general physical projects. At the same time, different companies face different risk issues. At this point, it is difficult for researchers to obtain a unified conclusion. For different companies, even if they are similar in scale and strength, the risks that exist due to different projects are quite different. Therefore, in the process of risk response, companies must thoroughly analyze their own corporate characteristics and project characteristics, comprehensively consider the main sources of risks, and prevent risk outbreaks, so as to ensure the orderly progress of IT multi-project management.

4. In terms of improving countermeasures, the five types of collaborative risk control capabilities are studied separately, and in terms of human resource allocation and coordination, suggestions are made respectively on sufficient and tight human resources; In terms of organization and management collaboration, it is proposed to further improve the organizational structure; in terms of project knowledge collaboration, it is proposed to build a support platform for knowledge collaboration; In terms of project cultural collaboration, propose differentiated collaboration methods; In terms of external environment coordination, it is proposed to position reasonably and evolve from project-based cooperation to strategy-based cooperation. (Tao et al., 2020; Zhnag et al., 2019; Meng et al., 2019)

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