Multi-project Management Research –
A quantitative approach in the Chinese real estate enterprise

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Abstract

Nowadays, with the complex of market environment and intensive market competition, the real estate enterprises face both challenges and opportunities, which are depending on their attitudes towards the change. Multi-project management is the main development trend for the traditional project management. Efficiently managing several projects reflects the core competition of a real estate enterprise. The multi-project management has its own characteristics, which are more flexible and effective.

From the perspective of real estate enterprise, this thesis discusses the implementation process of multi-project management.

Firstly, through the in-depth analysis of the current real estate project management theories, the problems are pointed out, which brings out the multi-project management. And compared with traditional single project management, the content and characteristics of multi-project management are introduced. Furthermore, based on the fact of resource limitation, the selection model is shown to select multi-project portfolio from the potential projects and achieve the objective of maximum profit or minimum cost. The resource usually refers to fund and human resource in the multi-project management. Meanwhile, there is case study to improve the feasibility of the resource allocation model.

Secondly, a new type of organization for multi-project management is mentioned to offset the shortage of the traditional matrix organization, which is setting up project management office (PMO) to coordinate the operation of multi-project management.
At last, based on the approach of analytic hierarchy process (AHP), the performance of multi-project is assessed, to provide evidence for the future development of real estate enterprise.
Acknowledgement

I would like to thank all the people in the Department of Real Estate and Construction Management for their hard working. In the two year’s study, I had learned so much. And it will definitely promote my future career.

In particular, I would like to thank my supervisor, Hans Lind, for his valuable suggestions and guidance in the process of thesis writing. Without that, it’s not possible to finish the thesis. I am appreciating for his work. Also, I want to thank my parents for their support.

At last, I would like to thank the kind Swedish people; I have a very pleasant time in Sweden!
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1. Introduction

1.1. Background

With the continuing national macro-control policies in China, the real estate market is becoming more and more competitive; especially the scarcity of land resources has brought up the new challenge for real estate enterprises. Due to the increasing numbers of projects and the continuous expansion of coverage area, the traditional single project management can’t solve the problem caused by several projects running simultaneously; the multi-project management has become the trend of future development for Real Estate enterprises.

Recently, multi-project management theories and methods are mainly focused on Project Portfolio Management (PPM) and Program Management (PM). Though there are a lot of researches in the field of multi-project management, the application for the real estate enterprises are relatively deficient. According to the characteristic of real estate enterprises, how to draw a sound multi-project management theory, in order to make effective project portfolio selection, formulate project plan and implement project control from the corporate strategic objectives, is an important issue for the real estate enterprises.

1.2. Aims and research questions

The development of project management has lasted for half century, especially with the economic globalization and technological revolution, the importance of project management is increasing every day. With the increasing size of the enterprise, there are more and more projects involved in the real estate enterprise. Meanwhile the trend from traditional single project management to multi-project management is inevitable for a modern real estate enterprise.

In China, the development in the field of real estate is tremendous, especially after the economic reform in 1998, more and more real estate enterprises emerged in the market, by the expansion of the enterprise, the senior managers have to face the problem, how to choose suitable projects from the perspective of corporate strategy; how to organize and coordinate the relationship of human resource, material and fund among several projects in different areas; how to control the multi-project
management and how to evaluate the performance efficiently. And multi-project management is the effective solution.

From the current research, the multi-project management is a hot spot in the world; however, the application of multi-project management in real estate filed is relatively new. Most of the researches are limited by qualitative research; there are only a few formulas provided in the quantitative research.

So it’s valuable to use multi-project management to solve the problems in real estate enterprise. This thesis will discuss the main content and key points in the different processes of real estate multi-project management. Based on the previous research achievements, build multi-project management theoretical system, and combined with the characteristics of real estate enterprises, set up the project-selection model and the performance assessment system to make the multi-project management efficient.

Following this, the main research questions are addressed in this study:

1. How to choose optimized multi-project portfolio from the potential projects in order to achieve minimum resource consumption and maximum profit?
2. What kind of organizations is suitable for the multi-project management to implement smoothly? What’s the difference compared to the common matrix organization mode?
3. How to implement the performance assessment for multi-project management team in the organization?

1.3. Research methodology

This thesis is based on the knowledge of project management, from the two aspects which are multi-project management process and multi-project organization, describes the way of optimizing multi-project management.

Overall speaking, the methodology in this thesis could be best described as designed-based research (DBR)\textsuperscript{1}, based on the in-depth study of existing theory and concept, regarding the current problems in multi-project management. Try to design the appropriate organization forms and functions. And combined with realistic cases, try to test the validity, and generate new project selection models, and performance assessment model for the organization.

\textsuperscript{1} Brown (1992)
In the study, the core content is project management, and the main literature is PMBok, which is published by the APM (American Project Management Institute). This guide book has been recognized as a global standard. International standard organization sets ISO 10006 based on the book. According to the book, project management mainly contains the content of eight aspects, which are:

“Integration management, scope management, time management, cost management, human resource management, quality management, communication management, risk management, procurement management.”

And the research of the multi-project management follows the above requirements. However, some factors are described in detail, such as the organizational structure, the linkage between projects, like the dependency on the same resource. Some are simply mentioned, like the risk management.

At the end of the thesis, the case study is used to show the actual multi-project management in the real estate enterprise. The case is chosen primarily on the basis that the company had multi-project activities; the Vantone Real Estate Company is participated in the study, which is a big real estate developer company. And the study is based on a number of interviews to get the actual overall organizational structures and strategy in the company.

Also it should be mentioned that the intension of this thesis is not to generalize the application and mode to all types of organizations. Meanwhile, I just try to get several possible solutions that could work on the current shortcomings in the Chinese real estate enterprise.

Besides, in order to design the core-content, three other methods are also used in the thesis.

The first one is linear programming, and it’s used to make the multi-project selection model. Linear programming is a mathematical method for determining a way to achieve the best outcome (such as maximum profit or lowest cost) in a given mathematical model for some list of requirements represented as linear equations.\(^2\) Usually, it’s used to optimize a linear objective function, subject to the constraints. In order to get the best outcome, step one is to build a mathematical model, for example, Maximize: \(c^T x\)

\(^2\) From “http://en.wikipedia.org/wiki/Linear_programming”
Subject to: \( Ax \leq b \)

\( X \) refers to the vector of variable, and \( c \) represents the coefficients. And \( Ax \) is constrains.

Step two is using the matrix calculations to obtain the most optimized result.

This method is mainly used in the first part of chapter 4 to determine the multi-project selection model.

The second one is analytic hierarchy process (AHP). And it is mainly used to design the organization assessment structure in chapter 5, and by calculating the weight through logical analysis to get the quantitative performance assessment model, which is more intuitive and easy to compare.

The first step is to set numbers based on the relationship between the performance indexes. Then use matrix to get the weight of each index.

### 1.4. Limitations

This thesis focuses on the theoretical analysis, the discussion is mainly focused on the multi-project management implementation and organization forms and performance assessment, and some other questions are not fully mentioned, for instance, the multi-project risk management and so on.

### 1.5. The structure of the thesis

The overall structure of the thesis is:

- Literature review to make the theory of multi-project management clear.
- Introduce real estate management, point out the problems.
- Solve the problem through the multi-project selection model and performance assessment model.

Chapter 2: describes the theory of project management and multi-project management, compare the differences between them.

Chapter 3: describes the real estate enterprise project management situation, finding out the current problems, which is in resource allocation in the process of multi-project selection, coordination and communication.

Chapter 4: describe the step of implementation of multi-project, which is to choose the best multi-project combination. The multi-project selection model is used
to solve this problem through the linear programming to work out the answer of best choice.

Chapter 5: describes the forms of organizations, mainly focused on the function of PMO (project management office). By in-depth analysis of its setting, operating and managing, the new form is obtained.

Another important issue in this chapter is the performance assessment model, by quantitative data; the performance of multi-project could be evaluated.

Chapter 6: case study.

Chapter 7: conclusion.
2. Literature review

2.1. Multi-project management

1) The definition of project

The history of project is very long, the pyramid of Egypt and the Greatwall of China are both hailed as a model for the early success of project. Almost every field in life can be described as specified project. However, there are different definitions in different fields and different occasions. Despite that project management has been developing over half centuries, there’s still no unified definition.

Here’s the definition given by American project management institute (PMI):

“Project is a temporary process undertaken to create one or a few units of unique product or service whose attributes are progressively elaborated.”

And the Britain association for project management (APM) described as follows:

“Project management is the process by which projects are defined, planned, monitored, controlled and delivered such that the agreed benefits are realized. Projects are unique, transient endeavors undertaken to achieve a desired outcome. Projects bring about change and project management is recognized as the most efficient way of managing such change.”

Above all, the definition of project contains three levels of meanings:

① Project is an unfinished mission with specific requirement and environment; it’s a dynamic concept rather than the result by the end of process.

② Project exists in a given organization, the task need to be finished in required time under the limited resource, and the resource usually refers to human, material, cost and so on. Among the numerous limitations, quality, schedule and cost are the main restrictions.

③ The mission should be fulfilled as the requirement of performance, quantity, technology and so on.

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3 source: (American Project Management Institute)

4 source: (Britain Association for Project Management)
Though the definitions above haven’t reached a consistent agreement, the feature of project that differs from other activities can be summarized as: integrity, unrepeated and clarity of objectives.

2) The definition of project management

“Project Management is the application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements.” (PMI)

“Project Management is planning, monitoring and control of all aspects of a project and the motivation of all those involved in it to achieve the project objectives on time and to the specified cost, quality and performance. Alternative definition: Project Management is the controlled implementation of defined change.” (APM)

The definition recognized by Chinese researchers is: Project Management is a method of system management focused on project, and the project is efficiently planed, originated, directed and controlled by a temporary and specified soft organization, in order to achieve dynamic management in the whole process and optimized project objectives (Yangbo 2004).

3) The definition of multi-project management

Multi-project management states that one senior project manager manage several projects simultaneously, it refers coordinating choice, evaluation and control among the projects in the organization. Moreover, splitting a complex project to sub-projects can’t be described as multi-project management.

The benefit of running multi-project management is self-evident; it can adjust the rhythm of process and priority among the projects, to fulfill the flexibility of product delivery. Furthermore, it helps enterprise to achieve cost minimization and profit maximization. Most managers believe that the efficiency is higher when two or three projects run simultaneously (Scott&Aaron 2000). And the effectiveness of multi-project management will be the potential source of competitive advantage through the study of new product development for automobile enterprises in Japan, USA and European countries (Notebook&Cusumano 1995).

4) Multi-project management, project management and strategic management

The operation mode of multi-project management is different from the traditional single project management, and the difference between them is below:

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5 Guiling (2006)
① “Service to a single project” versus “Service to the entire sector”

② “Performance like a bulldozer” versus “Performance like a helicopter”

③ “Self-centered optimization” versus “Overall cross-sectional optimization”

④ “Overall management” versus “Priority management, centralized management”

They are interrelated; also they have their own characteristics. Multi-project management is more focused on the strategy of organization. But project management is more focused on planning, executing and submitting the final product. In the process of multi-project management, the multi-project manager needs to coordinate, balance and manage several projects with different objectives.

<table>
<thead>
<tr>
<th>Character of project management</th>
<th>Character of multi-project management</th>
</tr>
</thead>
<tbody>
<tr>
<td>One project at one time</td>
<td>Several projects run simultaneously</td>
</tr>
<tr>
<td>Concerned about the specific delivery product of the project</td>
<td>Concerned about the value for the company</td>
</tr>
<tr>
<td>Minimize resource requirement</td>
<td>Maximize use of resource</td>
</tr>
<tr>
<td>Different projects, different objectives</td>
<td>Similarity among the projects</td>
</tr>
<tr>
<td>The project team doesn’t concern firm objectives outside the project</td>
<td>The team ensures the objectives from each project would promote corporate objectives</td>
</tr>
<tr>
<td>Concerned about the project itself standards</td>
<td>Concerned about the company strategy</td>
</tr>
</tbody>
</table>

Table 1 The characters of project and multi-project management

Multi-project management is an important part of substantive business strategy, and is the center for coordinating all the projects in the company. Besides, it’s considered to be an advanced form, which is one of the main trends for project management development in future.

6 Geo (1996)
Table 2 The responsibility of project manager and multi-project manager

<table>
<thead>
<tr>
<th>The responsibility of project manager</th>
<th>The responsibility of multi-project manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand the corporate strategy</td>
<td>Keep consistency between project objective and corporate strategy</td>
</tr>
<tr>
<td>Achieve goals</td>
<td>Determine goals</td>
</tr>
<tr>
<td>Draft project’s plan</td>
<td>Approve project’s plan</td>
</tr>
<tr>
<td>Manage the scope, time, cost of project</td>
<td>Approve the change for scope, time, cost of project</td>
</tr>
<tr>
<td>Implementation of the project plan, reporting progress</td>
<td>Monitoring progress</td>
</tr>
<tr>
<td>Choose team members</td>
<td>Choose project managers</td>
</tr>
<tr>
<td>Identify and manage risks</td>
<td>Approve risk plan</td>
</tr>
<tr>
<td>Use best practice</td>
<td>Assessment of best practice, promote the exchange of experience within the project teams</td>
</tr>
</tbody>
</table>

5) The organization for multi-project management

Most researchers considered multi-project management within several interrelated projects can increase overall profit. The establishment of organization must combine with the actual situation of enterprises, and reflect levels of management. Integrated with enterprise strategy, the organization can be divided into: strategy decision-making level, coordinating level, implementation level (Xu 2003). Based on the matrix structure, the improved office structure is: project office, overall coordinating office and strategy office (Xianwang 2007). Although different researchers give different names on the structure, they basically divided it into three levels: senior, middle and primary. And most researchers analyze the multi-project management theoretically.

By setting “project organization model preference” as the main variable, one researcher (Yangbo 2008) got the result: the Chinese real estate enterprises are in the middle of transformation, most respondents hope to change the traditional function-based management model; and the trend of transformation is matrix model. But the subjects of the investigation are limited, the point of the thesis is research process and
result, we can improve the research by enlarge the number of real estate enterprises to get comprehensive and reliable data.

Also, project management office (PMO) is one of the common organization forms in enterprise project management. Although the power and function of PMO are difference in different organizations, people share consensus on its main functions. For instance, PMO provides specialized service for multi-project management, and it’s the internal consulting sector, the main function contains: develop and maintain project management standards, method and procedure, provide consultancy and guidance for project management, provide qualified project manager, provide project management training, and etc.

6) Multi-project selection
Due to the resource constraints, it’s not possible to run all the projects at the same time; the selection has to be sorted through the factor of project, such as importance, urgency and so on, in order to allocate effectively.

The balanced score card has been brought up to sort the new projects according to priority (Ry 2008). It contains: revenue of organization, revenue of custom, risk, efficiency of process, learning opportunities and so on.

There are a lot of researches dealing with the multi-project selecting problem in both qualitative and quantitative ways. First, the affecting factors are described in mathematical languages, then build mathematical evaluation model to help the enterprise to make decisions. But because of limitation of the hypothesis in the mathematical model, especially the interrelation among the projects, this method is not perfect and needs to be improved.

7) Information exchange
A good organization must ensure smooth exchange of information, especially for the multi-project management. The development structure for multi-project management was brought up based on Internet. The core concept is sharing, collaborating and optimizing the information from enterprise strategy aspect. In details, it contains multi-project manage office, manage module and visualized information technology module.

8) Culture
The culture is considered to have an important influence to the maturity of project management. As well, it’s the cornerstone in the process of building the multi-project
management model. And the way to strengthen management can be: focus on team building, strengthen the incentive management, and carry out harmonious management, effective communication, efforts in innovation management and so on.

2.2. Multi-project management in the real estate enterprise

According to the characteristic of real estate enterprise, the multi-project management organization should consider the project and enterprise from its own perspective. As well, setting up project office into three levels is necessary (Junsong 2006).

Regarding to the problem existing in real estate enterprises, which is numerous project involves with many department, the principle of “subject to the overall urban planning, integrated design, overall construction, pursuit economic benefits and so on” was raised up by the researcher (Changhui 2007). And he also mentioned that the requirements in management aspect, which is:

①Correctly handle the problem of several leaders, rationally allocate the right

②Correctly handle the profitable balance and allocation, inspire and stabilize the team member, better custom service, concern the growth of both individuals and the enterprise.

His thesis firstly introduces multi-project management concept to the field of real estate enterprise, which is an innovation. But in some point, it only focused on matrix form in the enterprise organization, there are no further analyze about the other content for the multi-project management, for example, the supporting regulations and system.

From the perspective of medium and large-sized real estate companies, the researcher (Guiling 2004) discussed about the implementation process of multi-project organization and management. He considered that the strategy objectives of the real estate company are the basis of cross-regional project selection, that only the project which matches the strategy of company can be the suitable project for company. And regarding the problem of resource allocation, the author discussed the approach of human resource localization and fund centralized. The thesis described the content of various stage of multi-project management from the perspective of both qualitative and quantitative, it has great research value.

According to corporate life cycle theory, the researcher (Jianrong 2001) analyzed the management features of real estate enterprises in different stage, and the “multi-
project syndrome” from the current situation of Chinese real estate management. And he also discussed the reason from the perspective of “corporate strategy, resource allocation and rules and regulations”, and mentioned the possible solution.

So far as mentioned, the research in the area of real estate multi-project management is less, some discussed the implementing process of multi-project management form the project itself, some referred project management office from the normal enterprise management, and proposed multi-level project office, and some discussed the real estate development enterprise organization in infrastructure construction and management. However, most of them stayed in qualitative analysis, regarding the multi-project selection, they just set up a number of mathematical models with no further calculation. About the performance assessment, they just proposed the content of assessment, without quantitative calculations and considering weights of the assessment. And these questions are valuable to be researched further.
3. **Introduction of real estate project management**

3.1. **The current situation of real estate project management**

With the booming of the economy in China, the urbanized process has stimulated the development of real estate. Nowadays, it has been one of the pillar industries. Moreover, the number of real estate enterprises, employees and investment is increasing rapidly. Meanwhile, because of the globalization, foreign fund stimulates the development of both residential and commercial real estate in China.

From the perspective of developer, the real estate project is not only an investment, but also a construction project. The developer needs to manage the project in the whole process from investment intentions to the rent or sale after the construction finished, and the property management later. Generally speaking, the main steps in modern real estate development are: looking for investment opportunities, feasibility study, obtain land use rights, land acquisition and resettlement, planning and design, plan approval, bid invitation, construction and final acceptance, marketing and property management.

How to implement efficient project management, in order to increase the economic and social benefits, is the main problem for the real estate enterprise. The real estate development enterprise plays the role of resource integrator. Reasonable operation can achieve organizational strategic objectives. So it’s necessary to consider all the factors in the project’s life cycle, for example, cost, quality and schedule, in order to meet the custom’s needs.

The content of project life cycle contains as follows:

1) Stage of investment decision: try to find best investment opportunities through full market investigation and market information analysis, and make defined, systematically plans; design and select plan, feasibility study; project approval.

2) Stage of preparatory work: obtain land use rights; land acquisition and resettlement; engineering investigation and design; financing; invite bid.

3) Stage of construction: construction design; project supervision.

4) Stage of project ending: prepare complete acceptable documents; final acceptance and transfer; project evaluation; project warranty and maintenance.
5) Stage of rental and property management: make marketing plan; analyze information of potential customers, follow the needs and intentions of customers; analyze sales trend; property management.

Recently, a number of real estate enterprises develop multiple projects simultaneously, the type of project becomes more diversified, and the content is more and more complex.

From the perspective of project management, the Chinese real estate enterprise is still using traditional single project management. It can neither assure efficient resource allocation and smoothly communication in departments, nor similarity between project objectives and organization strategy objectives. A lot of enterprises stay at the level of single project. Based on the single-project, distributed management is not helpful for the systematical development of enterprises.

### 3.2. The existing problems in traditional project management

With the explosive competition in the real estate market, the real estate pursues meticulous, high-quality and branded project. The traditional project management reveals some problems discussed:

#### 3.2.1. The problem of resource allocation

As we know, the resource of enterprise is limited; all the real estate projects are limited by the resource, for instance, fund, technology and human resource. The conflict may happen when the specific resource was put into one project and it means the other project can’t use it at the same time. For instance, one million SEK was used for advertising, and the leader has already made a decision to put eighty thousand SEK into the commercial project in Beijing, so the sixty thousand SEK putting into the villa’s project cannot implement at the same time. If these problems aren’t solved properly, they will decrease the efficiency of the project resource allocation, or even decrease the profit of the whole enterprise.

Single-project management requires smaller scale in team size, but the operating cost is rather high, especially under the situation of multi-project is implementing simultaneously; it will give a heavy burden on the real estate enterprise. Meanwhile, it’s necessary to coordinate and share resource in different project teams, but it may also cause conflict because of different interest among different project leaders. For example, in order to stimulate the sale of product, the project manager tries to get
more fund and best salesman, build luxury sales offices, and make beautiful advertising books and TV shows, though it's not necessary for residential project which is located for the middle and low income people. This behavior of pursuing profit maximum can boost the sales, but in the multi-project environment, the project manager's behavior is not suitable. In traditional project management, the object of project management is profit maximum of single project; but in multi-project, it's the overall profit maximum, and it's not simply superposition of each single project. Above all, in the process of achieving goals, it's necessary to setup the resource in the level of real estate enterprise.

3.2.2. The coordination problem of projects

In traditional single real estate project management, project managers are used to responsible for one project, from the perspective of single project; they are willing to choose those behaviors which are good for their projects, in order to achieve the goals. While in multi-project management, each project compete for the limited resource, managing these projects needs to start form enterprise strategy and overall profit, integrate several projects, achieve mutual success rather than single success.

In a small size real estate enterprise, the number of projects is less; the leader can monitor and coordinate efficiently. But with the growing of the enterprise, it becomes more challenge and hard for the leader to manage everything.

Now, under the situation of several projects running simultaneously, the relationship of each projects is staying as competitors, the leader usually allocates resource and awards team members according to performance of each project. It will cause harmful outcomes, for instance, some small projects failed because of inadequate resource supply. Then the management team is possibly blamed, and it can’t reveal the real situation of project. Their confidence is affected, finally decrease the efficiency and overall profit, and block the achievement of the organization strategy.

3.2.3. The problem of coordination between project management office and functional department
In traditional single-project management, the coordination between project management office and functional department exists as well, but functional department is usually servicing for the specific project, with identical objectives, which is easy to handle the relationship. However, the relationship between multi-project office and functional department is more complex. The functional departments have to face multiple projects. This will raise the problem of priority, for instance, which project should be served first. And it may cause responsibility unclear and deepening conflict, for instance, in X real estate company, both project A and project B are needed to be planned at the same time by the planning department, but the planning department can only take over one project, which is tricky to make a choice. How to choose the one from the two projects? This process needs the coordination and communication of the project A team, project B team and the planning department, to avoid harming the benefit of each part.

3.3. Optimization on the traditional project management

The real estate enterprise faces a number of projects, how to assure the similarity about the project objectives and corporation strategy and achieve the corporation strategy better? How to make full use of limited resource, and manage the numerous projects efficiently? Multi-project management is one effective scientific approach which can assure to achieve these goals.

Multi-project management is summarized by two American doctors (Tobis 1995), which is using system engineering and psychology methods to train skills and increase productivity and satisfaction from different angles and backgrounds. To achieve economic and effective managing multiple projects, it’s necessary to implement multi-project management, and it also works in real estate enterprise. Implementation of multi-project management can make full use of core-technology and stimulate technical development. It’s also helpful to increase the cross-sectional coordination and project management level.

3.4. Content of real estate enterprise multi-project management

3.4.1. Content and feature of multi-project
Modern project management system is based on PMBok which is published by PMC in 1984. This guide book has been recognized as a global standard. International standard organization sets ISO 10006 based on the book. It refers that the main content contains as below:

Integration management, scope management, time management, cost management, human resource management, quality management, communication management, risk management, procurement management.

About the content, besides the nine traditional regions, multi-project management focuses on the overall profit according to the project analysis, appraisal, project selection and dynamic management. As well, it emphasized the interaction of profit, technology and resource among projects. Through setting priority and project portfolio selection, solve the problem of resource conflict, and emphasize information exchange and sharing.

As a new management approach, the differences are quite big between the two approaches, as shown in table 3.

<table>
<thead>
<tr>
<th>Project information</th>
<th>single project management</th>
<th>Multi-project management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start point</td>
<td>Profit of single project</td>
<td>Corporation strategy and overall profit</td>
</tr>
<tr>
<td>objectives</td>
<td>Achieve project goals</td>
<td>Integrate multi-projects, reach profit maximum</td>
</tr>
<tr>
<td>emphasis</td>
<td>Resource need of single project</td>
<td>Coordination and communication among multi-project</td>
</tr>
<tr>
<td>Decision maker</td>
<td>Project manager</td>
<td>Middle or senior managers</td>
</tr>
<tr>
<td>Management cycle</td>
<td>Short, from project starting to ending</td>
<td>Long, existing in the life cycle of enterprise</td>
</tr>
</tbody>
</table>

1) Traditional single project management

The traditional single project has the following characteristics:
① The start point of single project management is form the benefit of its own, it emphasizes how to do the management, for instance, implement a series of effect project management approaches, to achieve the goal of schedule, cost and quality. PMBok introduces the management approaches and content from nine areas.

② The traditional project management is targeted the interior of project, the main decision maker is project manager.

③ The traditional project management is focused on the resource need of single project and try to reduce dependence on the resource.

④ The time period of traditional single project management is short, it’s from the project staring to the ending.

2) Multi-project management
As a new management approach, the main features are listed as below:

① From the perspective of corporation strategy, multi-project management emphasizes “which projects are going to be implemented”, in order to achieve similar strategy, and to reach profit maximum.

② Multi-project management involves with multiple projects, and is organizational management activities, which is the process of organizational decisional making.

③ Through setting priority, multi-project management emphasizes the cross-sectional coordination and communication to reach the efficient resource allocation.

④ Multi-project management exists in the life cycle of the enterprise

3.4.2. The content of multi-project management in real estate enterprise
From the perspective of real estate enterprise, the interaction of each projects is emphasized, especially the resource sharing and conflicting, information and experience exchange to reach the overall profit maximum.

According to the process of project implementation, multi-project has the following content:
① Project portfolio selection: combined with the real estate corporation strategy and according to the uniform evaluation procedure and standard, choose the right project portfolio which is helpful for the development of enterprise.

② Multi-project plan: make the resource plan according to the needs of resource, the limitation of resource and interaction of projects. And make schedule by the resource and requirement of project duration.

③ Multi-project implementation: building environment which is helpful for operating multi-project, emphasize the coordination and communication of multi-project management, operate dynamic monitoring.

④ Multi-project performance assessment: build complete project performance assessment system; evaluate the performance through scientific evaluation procedures and methods.

This thesis will expand on the clues above.
4. Multi-project plan in real estate enterprise

Through describing the scope, content, cost and schedule, multi-project plan is the specific operating process regarding the corporation strategy, and it’s also the important documents and standard to direct the project implementation.

Firstly, real estate enterprise needs to make an investment decision which is to choose one project portfolio. Then based on specific principles to define project group, and make project portfolio plan, to reach effective resource allocation.

4.1. Multi-project selections in real estate enterprise

4.1.1. Multi-project selection process

Due to the restriction of resources, the real estate enterprise has to face the problem of projects selection. If lack of considering the corporation strategy, it usually causing discord between the operating project and the corporation. Real estate enterprise multi-project management need to build up effective selection procedure to avoid starting the wrong projects which is harmful for the enterprise’s development.

According to the multi-project selection model (Archer 1998), this thesis will cut the project selection procedure into three stages: the stage of corporation strategy study; the stage of project evaluation; the stage of multi-project selection.

Figure 1 Multi-project selection model

1) The stage of corporation strategy study
Multi-project management is an important part of corporation strategy management, only the projects that are matching the corporation strategy are valuable to choose.

In order to connect the project objectives with the corporation strategy, the real estate enterprise needs to build up clear strategy objectives and future plans. Then, the corporation strategy objectives can be divided into a series of measurements, and given specific weights, which contains: project scope, deliverables, durations, cost, benefit and risk.

2) The stage of project evaluation
The effective evaluation procedure and rules can help real estate enterprise to find best multi-project combination. Also, it’s a fair process for all the projects, no matter the projects that are just started or the projects which are already on-going.

In this stage, all the relevant data needs to be collected and arranged, it contains: cost of each project, benefit, resource requirement, schedule requirement and risk; calculate relevant index, for example: the similarity with the corporation strategy, net present value, payback period, internal rate of return, rate of return on investment; according to the evaluation procedure and rules to keep the projects which are suitable for the requirement of corporation strategy.

3) The stage of multi-project selection
Though the cost and benefit has been shown by the previous stages, not all the projects which are low-cost and high-profit can be chosen because of insufficient consideration of the resource restriction and correlation among projects. So it requires deeper analysis.

4.1.2. The interaction in multi-project
In real estate enterprise, decision maker always needs to choose one multi-project combination from several potential choices. In reality, the potential choices are usually having obvious interactions, and will directly influence the overall inputs and outputs of the multi-project combination. For example, in the process of decision making process, the cost is always lower to choose two projects which have short distance because of economy of scale.

The interactions can be divided in to three parts: resource interaction, benefit interaction and outcome or technology interaction (Robert 2009).

1) Resource interaction
The resource interaction refers that the resource consumption of real estate multi-project is not equal to the sum of resource consumption by each projects. Generally speaking, multi-project can save the resource and increase the utilization, thus it can help the enterprise to make optimized choice. In other words, the real estate projects can share planners, sales staff, hardware and other resource, so lower requirements for resource when the multi-project is implemented.

The resource interaction of projects can be described as resource influence matrix, suppose $U^i$ denotes the relevant matrix between projects and resource $i$. In resource influence matrix, the diagonal element $U_{ij}^i$ denotes the project $j$’s demand of resource $i$. And the non-diagonal element $U_{jk}^i$ denotes the interaction of multi-project $j$ and $k$’s demand of resource $i$. For instance, $U_{21}^3 = -6$ denotes that when project 1 and project 2 are chosen at the same time, the demand for the resource 3 is 6 units less than the total demand of resource when project 2 and project 3 run respectively. And for the simplicity, we set the matrix as triangular matrix, which is when $k>j$, $U_{jk}^i = 0$.

And the triangular matrix is like:

$$
\begin{bmatrix}
  a_{11} & 0 & 0 \\
  a_{21} & a_{22} & 0 \\
  a_{31} & a_{32} & a_{33}
\end{bmatrix}
$$

Suppose the total demand of interactional multi-project $k$ for resource $i$ is $R^i_k$:

And it can be described as the following equation:

$$R^i_k = X^k U^i X^k$$  \hspace{1cm} (Equation 1)

$(X^k$ refers multi-project $k$’s vector, which each element denotes one kind of potential projects, $X^k = (x_1^k, x_2^k, \ldots, x_n^k)$, $x_j \in \{0, 1\}$, $n$ refers the number of potential projects, if the project $x_j$ is selected, $x_j=1$, otherwise, $x_j=0$)

For example, the resource influence matrix $U$ is:

$$
\begin{bmatrix}
  10 & 0 & 0 \\
  -10 & 20 & 0 \\
  0 & 30 & 30
\end{bmatrix}
$$

In this example, there are three potential projects $x_1, x_2, x_3$. And $U_{11}=10$ means the project $x_1$ needs 10 units resource, so does $U_{22}$ and $U_{33}$.

$U_{21}=-10$ means when project $x_1$ and project $x_2$ are chosen at the same time, there will be 10 units less in resource consumption. So does $U_{31}$ and $U_{32}$.

And the total resource demand
\[ R_i^k = X^k U^i X^k \]
\[ = \sum_{i=1}^{n} \sum_{j=1}^{n} ( U_{ij} + \sum_{k=i+1}^{n} U_{jk} v_{jk} x_{i} ) \]

In this example, \( R = 10x_1 + 20x_2 + 30x_3 - 10x_2x_1 + 0x_3x_1 + 30x_3x_2 \)

If \( x_1 \) and \( x_2 \) are chosen, then \( x_1 = x_2 = 1, x_3 = 0 \)

\( R = 20 \)

2) Benefit interaction
The benefit interaction refers that one real estate project can affect another project. The affection can be divided into four kinds: synergism, substitution, repulsion and prerequisites.

And the synergism refers to the implementation of the interacted projects, the total benefit will increase. The substitution refers to the opposite, which the total benefit will decrease. The repulsion means only one project can happen, the others must be exclusive. The prerequisites means one project is based on other ones.

Similarly, the benefit impact can be described as a profit matrix, suppose \( V_r \) denotes the relevant matrix about profit \( r \) within the projects, in this matrix, \( v_{jj}^r \) denotes the profit of project \( j \) without the impact of other projects, and \( v_{jk}^r \) denotes the extra profit when project \( j \) and \( k \) are chosen at the same time (it might be negative), for instance, \( v_{21}^r = 3 \) denotes that when project 2 and 3 are chosen at the same time, the profit is three units more than the total profit if they run separately. Also, when \( k > j \), \( v_{jk}^r = 0 \).

And the total profit of project portfolio \( B^k \), can be expressed as below:
\[ B^k_r = X^k V^r X^k \]  \hspace{1cm} (Equation 2)

\( X^k \) refers to multi-project \( k \)'s vector, which each element denotes one kind of potential projects, \( X^k = (x_1^k, x_2^k, \ldots, x_n^k) \), \( x_j \in (0, 1) \), \( n \) refers to the number of potential projects, for example, if multi-project \( x_j \) is selected, \( x_j = 1 \), otherwise, \( x_j = 0 \)

3) Outcome or technology interaction
The outcome refers to the success probability of a project; the outcome interaction refers that the successes of one project can influence the others. Generally speaking, the implementation of one project will increase the success probability of another project. For example, the real estate enterprise successfully implemented one high-
grade residential project, and it will increase the success probability of general residential project in suburb.

The interaction can be described as the outcome matrix $P$; $P_{ij}$ refers the success probability of project $j$ without the influence of other projects. And $P_{jk}$ refers the change of project $j$’s success probability, generally, $P_{jk}$ is not equal to $P_{kj}$, which means the influence from $j$ to $k$ is not same to the influence from $k$ to $j$.

Because of the expected return equals to the profit of projects times the success probability. So the matrix of expected return $B$ can show as the profit matrix $V$ times the success probability matrix $P$.

### 4.1.3. The selection model of multi-project portfolio

According to the interactions of projects, the following linear programming model:

$$\text{max } E(X) = \max \left( X'BX - \sum_{i=1}^{m} R_i \right) \quad (\text{Equation 3})$$

(The maximum expected return on multi-project $X$ equals to the total return minus the total resource consumption)

$$\begin{align*}
X'U'X &\leq b_i \\
X &= 0 \text{ or } \begin{cases} x_j = 1, \text{ if project is chosen, } x_j = 0, \text{ otherwise} \end{cases} \\
\text{s.t. } &x_j - x_k = 0 \text{ if } j, k \text{ are prerequisites} \\
&x_j + x_k \leq 1 \text{ if } j, k \text{ are repulsion} \\
i &= 1, 2, \ldots, m; j, k &= 1, 2, \ldots, n
\end{align*}$$

In this equation, $m$ denote the type of resource, $n$ denotes the number of potential projects, $b_i$ denotes the total available resource $i$. The total demand resource for $i$, $R_i = X'U'X$. $B$ denotes the profit matrix.

Next, four conditions will be discussed about this model:

1) Only interacted by resource

Projects are only interacted by resource, there’s no benefit or outcome interaction. So the expected return of multi-project equals to the sum of return of each project, and the expected return matrix $B=V'P$, the corresponding model is:

$$\text{max } E(\ X ) = \max \left( X'BX - \sum_{i=1}^{m} R_i \right)$$

$$= \max \left( \sum_{i=1}^{m} \sum_{j=1}^{n} P_{ij} V_j X_j - \sum_{i=1}^{m} R_i \right) \quad (\text{Equation 4})$$
In this equation, \( m \) denote the types of resource, \( n \) denotes the number of potential projects, \( s \) denotes the types of generating profit, \( b_i \) denotes the total available resource \( i \). The total demand resource for \( i \), \( R_i = XU^i X \). \( B \) denotes the profit matrix.

2) Only interacted by resource and outcome

If there is only interaction with resource and outcome, which is not related to benefit interaction, the success probability of project \( j \) is function of vector \( X \), which is:

\[
P_j = P(X) = \sum_{k=1}^{j-1} P_{jk} x_k
\]  

(Equation 5)

So, the model is:

\[
\max E (X) = \max (X^B X - \sum_{i=1}^{m} R_i) 
\]

\[
= \max \left\{ \sum_{r=1}^{s} \sum_{j=1}^{n} V_{jr} x_r \left( \sum_{k=1}^{j-1} P_{jk} x_k \right) - \sum_{i=1}^{m} R_i \right\}
\]  

(Equation 6)

\[
\begin{cases}
XU^i X \leq b_i \\
X = 0 or \{ \text{if project is chosen, } x_j = 1, \text{ otherwise } x_j = 0 \}
\end{cases}
\]

s.t.

\[
\begin{cases}
x_j - x_k = 0 \ (j, k \text{ are prerequisites}) \\
x_j + x_k \leq 0 \ (j, k \text{ are repulsion}) \\
i = 1, 2, \ldots, m; r = 1, 2, \ldots, s; j, k = 1, 2, \ldots, n
\end{cases}
\]

In this equation, \( m \) denote the types of resource, \( n \) denotes the number of potential projects, \( s \) denotes the types of generating profit, \( b_i \) denotes the total available resource \( i \). The total demand resource for \( i \), \( R_i = XU^i X \). \( B \) denotes the profit matrix.

\( B = VP \).

3) Only interacted by resource and benefit

If there is only resource and benefit allocation, without outcome benefit, the profit of project \( j \) is:

\[
V_j^r = V_{jj}^r + \sum_{k=1}^{j-1} P_k V_{jk}^r x_k
\]  

(Equation 7)

So the model is like:
\[
\text{max } E(\ X\ ) = \text{max}(\ X^T B X - \sum_{i=1}^{m} R_i )
\]

\[
= \text{max}[\sum_{r=1}^{s} \sum_{j=1}^{n} P_{rj} X_{rj} + \sum_{k=1}^{i-1} P_{kj} V_{jk} r x_k - \sum_{i=1}^{m} R_i ]
\]

\text{(Equation 8)}

\[
\begin{cases}
X^T U' X \leq b_j \\
X = 0 \text{or} \{ \text{if project is chosen, } x_j = 1 \text{, otherwise } x_j = 0 \} \\
\text{s.t. } x_j - x_k = 0 \{ \text{if } j, k \text{ are prerequisites} \} \\
x_j + x_k \leq 0 \{ \text{if } j, k \text{ are repulsion} \} \\
i = 1, 2, \ldots, m \; ; \; r = 1, 2, \ldots, s \; ; \; j, k = 1, 2, \ldots, n
\end{cases}
\]

In this equation, \( m \) denote the types of resource, \( n \) denotes the number of potential projects, \( s \) denotes the types of generating profit, \( b_j \) denotes the total available resource \( i \). The total demand resource for \( i \), \( R_i = X^T U' X \). \( B \) denotes the profit matrix.

\( B = V^P. \)

4) Interacted by resource, outcome and benefit

In this condition, the model is like:

\[
\text{max } E(\ X\ ) = \text{max}(\ X^T B X - \sum_{i=1}^{m} R_i )
\]

\[
= \text{max}[\sum_{r=1}^{s} \sum_{j=1}^{n} X_{rj} \left( \sum_{k=1}^{i-1} P_{kj} V_{jk} r x_k \right) - \sum_{i=1}^{m} R_i ]
\]

\text{(Equation 9)}

\[
\begin{cases}
X^T U' X \leq b_j \\
X = 0 \text{or} \{ \text{if project is chosen, } x_j = 1 \text{, otherwise } x_j = 0 \} \\
\text{s.t. } x_j - x_k = 0 \{ \text{if } j, k \text{ are prerequisites} \} \\
x_j + x_k \leq 0 \{ \text{if } j, k \text{ are repulsion} \} \\
i = 1, 2, \ldots, m \; ; \; r = 1, 2, \ldots, s \; ; \; j, k = 1, 2, \ldots, n
\end{cases}
\]

In this equation, \( m \) denote the types of resource, \( n \) denotes the number of potential projects, \( s \) denotes the types of generating profit, \( b_j \) denotes the total available resource \( i \). The total demand resource for \( i \), \( R_i = X^T U' X \). \( B \) denotes the profit matrix.

\( B = V^P. \)

\subsection*{4.1.4. Multi-project selection case study}

Suppose there are 5 potential projects which is in keep with the corporation strategy, only consider fund in resource demand, and only consider economic profit in benefit, and the relevant material is shown in the table below, the question is how to get the best multi-project combination in the condition of less than 200 million SEK.
And, \( u_{21} = -10, u_{41} = -20, u_{52} = -5, v_{31} = 40, v_{53} = 50, p_{42} = 0.2 \)

\( u_{21} = -10 \) means that if project 2 and 1 are chosen at the same time, the resource demand will be 10 units less than they are chosen separately. \( v_{31} = 40 \) means that if project 3 and 1 are chosen at the same time, the profit will be 40 units more than they are chosen separately. And one unit means one million; project 1 and project 5 are prerequisites, and project 2 and project 3 are exclusive.

Table 4 Relevant material of projects

<table>
<thead>
<tr>
<th>project</th>
<th>Cost(million)</th>
<th>Profit(million)</th>
<th>Success probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>200</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>300</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>350</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>700</td>
<td>0.8</td>
</tr>
<tr>
<td>5</td>
<td>90</td>
<td>800</td>
<td>0.4</td>
</tr>
</tbody>
</table>

The material above refers that there are interactions in all the three factors: resource, outcome and benefit. For example, when project 2 and project 1 are implemented at the same time, the cost will decrease 10 million, and when project 3 and project 1 are implemented at the same time, the profit will increase 40 million, when project 2 is implemented, the success probability of project 4 will increase 20%.

The resource matrix is:

\[
U = \begin{bmatrix}
30 & 0 & 0 & 0 & 0 \\
-10 & 45 & 0 & 0 & 0 \\
0 & 0 & 40 & 0 & 0 \\
-20 & 0 & 0 & 80 & 0 \\
0 & -5 & 0 & 0 & 90
\end{bmatrix}
\]

The benefit matrix is:

\[
V = \begin{bmatrix}
200 & 0 & 0 & 0 & 0 \\
0 & 300 & 0 & 0 & 0 \\
40 & 0 & 350 & 0 & 0 \\
0 & 0 & 0 & 700 & 0 \\
0 & 0 & 50 & 0 & 800
\end{bmatrix}
\]

The outcome matrix is:
\[ P = \begin{bmatrix} 0.6 & 0 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0.6 & 0 & 0 \\ 0 & 0.2 & 0 & 0.8 & 0 \\ 0 & 0 & 0 & 0 & 0.4 \end{bmatrix} \]

So the expected return is:

\[ B = \mathbf{V} \ast P = \begin{bmatrix} 200 & 0 & 0 & 0 & 0 \\ 0 & 300 & 0 & 0 & 0 \\ 40 & 0 & 350 & 0 & 0 \\ 0 & 0 & 0 & 700 & 0 \\ 0 & 0 & 50 & 0 & 800 \end{bmatrix} \ast \begin{bmatrix} 0.6 & 0 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 & 0 \\ 0 & 0 & 0.6 & 0 & 0 \\ 0 & 0.2 & 0 & 0.8 & 0 \\ 0 & 0 & 0 & 0 & 0.4 \end{bmatrix} \]

\[ = \begin{bmatrix} 120 & 0 & 0 & 0 & 0 \\ 0 & 150 & 0 & 0 & 0 \\ 24 & 0 & 210 & 0 & 0 \\ 0 & 0 & 0 & 560 & 0 \\ 0 & 0 & 30 & 0 & 320 \end{bmatrix} \]

So the net income is:

\[ B - U = \begin{bmatrix} 120 & 0 & 0 & 0 & 0 \\ 0 & 150 & 0 & 0 & 0 \\ 24 & 0 & 210 & 0 & 0 \\ 0 & 0 & 0 & 560 & 0 \\ 0 & 0 & 30 & 0 & 320 \end{bmatrix} - \begin{bmatrix} 30 & 0 & 0 & 0 & 0 \\ -10 & 45 & 0 & 0 & 0 \\ 0 & 0 & 40 & 0 & 0 \\ -20 & 0 & 0 & 80 & 0 \\ 0 & -5 & 0 & 0 & 90 \end{bmatrix} \]

\[ = \begin{bmatrix} 90 & 0 & 0 & 0 & 0 \\ 10 & 105 & 0 & 0 & 0 \\ 24 & 0 & 170 & 0 & 0 \\ 20 & 0 & 0 & 480 & 0 \\ 0 & 5 & 30 & 0 & 230 \end{bmatrix} \]

Put the data into the integer programming model, which is:

\[
\text{max } E(\mathbf{X}) = 90x_1 + 105x_2 + 170x_3 + 480x_4 + 230x_5 \\
+ 10x_1x_2 + 24x_1x_3 + 20x_2x_4 + 5x_2x_3 + 5x_3x_5 \\
\text{subject to:}
\]

(Equation 10)
\[
30x_1 + 45x_2 + 40x_3 + 80x_4 + 90x_5 - 10x_1x_2 - 20x_1x_4 - 5x_2x_5 \leq 200
\]
\[x_1 = x_5\]

s.t.
\[x_2 + x_3 = 1\]
\[x_j = 0 \text{ or } 1\]
\[j = 1, 2, 3, 4, 5\]

Thanks to the software LINGO, the result can be got as below:

<table>
<thead>
<tr>
<th>Multi-project</th>
<th>x1</th>
<th>x2</th>
<th>x3</th>
<th>x4</th>
<th>x5</th>
<th>R</th>
<th>E(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X^1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>X^2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>160</td>
<td>544</td>
</tr>
<tr>
<td>X^3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>45</td>
<td>105</td>
</tr>
<tr>
<td>X^4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>120</td>
<td>650</td>
</tr>
<tr>
<td>X^5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>150</td>
<td>440</td>
</tr>
<tr>
<td>X^6</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>125</td>
<td>585</td>
</tr>
</tbody>
</table>

As the table shown, the best multi-project is X^4 which is project 3 and project 4, and the net income is 650 million.

4.2. Multi-project plan in real estate enterprise

Reasonable grouping can help the enterprise to optimize the resource and effectively allocate the resource, increase the core competence. Generally, the process follows the principles as below.

1) Region of projects

The real estate project is not similar to the other project, it’s highly regional. Generally speaking, the projects in same group should have same region. No matter the plan, design or sales of the projects, it should respect the local law and customs. If the projects can reflect the local culture and combine the local residents’ favor, the excellent economic profit will be reached. Besides, it’s more convenient to allocate resource and effectively use resource, in order to increase work efficiency.

2) Priority of projects

The projects in the same group should have same priority, which refers the urgency of project and point out the sequence of accessing resource. It’s better to put the projects with high priority in the same group, which the good and effective projects can be
operated with priority. However, in mixed priority group, the project with high-priority can get resource easily, even the resource that it doesn’t require. This will cause the need of low-priority can’t be fulfilled. Moreover, in different situation, the standard of setting priority sequence is different, for instance, when the enterprise is already occupied the market of specific area, then it can set the order as net income.

3) Categories of projects
The projects in the same group should have similar category, the category here indicates the projects’ scale measured with required resource, value and schedule. When big, medium and small projects are mixed, usually there will be unbalanced situation. In one hand, big projects are usually considered as important, which means they probably get too much resource; in the other hand, due to small projects can be finished soon, and display the progress of the project, it might be also assigned too much resource.

4) The life cycle of the project
The projects in the same group should have similar life cycle. The schedule of each project is different, but with similar life cycle, the projects can also have unified plan. For example, the residential project A and B have similar life cycle, the sales plan of residential project A can make combined with the sales plan of residential project B, which will be implemented half year later. Doing this can help the project group manager to coordinate the management better and to improve the implementation and management skills.

5) The complexity of projects
In order to carry out multi-project better, the project group should be as simple as possible, the complex solution may increase the profit of a real estate project, meanwhile it requires more energy and management, doing this may cause distraction, the other projects can’t get enough attention.

6) The technology of projects
The same project should have similar technology; this will increase the efficiency of management. Using mixed technology requires different team, and it will increase the complexity of implementation and management, decrease the efficiency of multi-project management.
5. The implementation of real estate multi-project management

In the process of multi-project management implementation, the real estate enterprises need to control a number of projects, and make a friendly environment in the organization, rules and regulations and technology, to assure the multi-project operating smoothly. And the performance of the multi-project are needed to be evaluated, it can reflect the operating situation correctly. Besides, based on the reflection, the environment can be improved.

5.1. The real estate enterprise project management organization

5.1.1. The traditional project management organization

Recently, the matrix organization is the most common way in real estate enterprise, which is shown as figure 2.

Figure 2 The traditional matrix organization

In this figure, in order to finish the real estate project, the project members are chosen from each functional department, and leading by project managers. These members belongs to the functional department, at the same time, they are directed by the project manager. Once, the project is done, they will return to their previous functional department.

In this organization, the specialized knowledge within the function can be fully utilized; also it can promote the horizontal cooperation among the functional departments, which makes the different departments as a whole unit, and provides opportun-
ities of development for both the functional and project sector. Moreover, increase the resource utilization and organizational resilience.

However, the shortcomings of this kind of organization are obviously, from the perspective of structure, it forms double leader, for instance, the functional staff are directed by both project manager and functional manager. It will make the staff uncomfortable and confusion, in other words, it requires the staff have very high interpersonal communication skills and intensive training. Meanwhile, the project manager and functional manager possess the same right at the same time; it will definitely consume a lot of energy and time to balance the right. For instance, a number of meetings have to be held to decide the solution of conflict.

5.1.2. Multi-project management organization

Regarding the problem of traditional matrix organization, from the characteristics of multi-project, this thesis will set up a new organization, which is:

Figure 3 Multi-project management organization

Compared with the traditional project management organizations, the project management centre and project management office (PMO) is the additional department in the multi-project management organization. And the functional staffs that are used to direct by functional manager are turned into project team members who are directed by the project manager.
This new kind of organization effectively broke the barrier between the functional department and project department, and avoids the dilemma between “function” and “project” in the traditional matrix organization. Moreover, it provides more effective platform for the multi-project management. The main features of the multi-project organization are:

① The whole real estate enterprise provides service for the projects, the projects teams face the customers directly to make the customers satisfied with product. And through the information system, the feedback is sent to every team members.

② In real estate enterprise, the project teams have the right of decision-making, they participate every process from project planning to the implementation. The enthusiasm and creativity of staff are aroused. The team members are directed by project managers who are in charge of planning and improving every process, setting up working plan and budget. Meanwhile, they need to evaluate about the performance of project members which is very important for the team members in the final assessment.

③ The functional managers lost the traditional leading authority, they don’t participate the project management details, however, they act more like “coach”, pay more attention to the staffs’ promotion and career development. At the same time, train the new project staff with professional skills; coordinate the project manager to achieve the project objectives.

④ The project management centre has the right to empower and supervise every project manager, and coordinate all the projects from the perspective of enterprise. Generally speaking, the staff of project management centre is made up of the senior managers of the company, who are familiar with the corporation strategy and objectives. Besides, they have the ability of allocate the weight of resource to achieve the profit maximum.

⑤ The project management office is made up of skilled staffs who are capable for professional project management.

5.2. The project management office (PMO)
The real estate project usually has a long operating duration, and the investment fund is quite large, besides that the regional differences are big. In multi-project management, there are several projects running at the same time, in order to make the overall plan for all the projects, it’s necessary to set up the project management office (PMO) according to the corporation strategy objectives.

5.2.1. The main functions of PMO in multi-project management

Project management office provides professional service for the real estate multi-project; meanwhile, it’s the decision-making department. It contains both the traditional function of management and the function of strategy management as well depending on the demand of the enterprise. And the main functions contain⁷:

1) Provide management supporting for project management team

PMO is responsible for making the real estate project plan, writing the real estate developing report and the project management software manual and project manual, provide support for project team members.

① Make the real estate project plan

A number of plans are needed in the process of real estate implementation, for instance, the project schedule plan, resource plan and sales plan. And these processes are usually involving with relevant software, and the best way is making the staff of PMO and project members work together, according to the project demanding, to adjust or update the plans.

② Make the real estate development report and distribute them

From the stage of project start to the project plan, implementation, sales and property management, there will be all kinds of results; these results need to be record and distributed to all the relevant staffs. Through attending the meetings of all the projects, the staffs of PMO can make these reports and then distribute them. Most importantly, summarize and share the different kinds of project knowledge, technology and experience. For instance, the project in residential, commercial and touring real estate projects are very good comparables.

2) Provide consultation and guidance for project management team

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⁷ Lu (2007)
With the more and more complex projects, the requirement for the professional knowledge is increasing. The senior managers can make the corporation strategy according to the consultation. Besides the project members can also solve the problem in the management through the help of PMO. The inner project management consultation mainly contains:

① The support for the real estate project start

The successful start of real estate project is crucial for the whole project. Without adequate market research and good consideration of local culture, it may mean failure in the very beginning. PMO can provide excellent project start experience, for example, teaching them how to make scientific project management regulations and project scope, and design and organize the project start meetings.

② Provide dynamic response for the real estate projects

With the development of the real estate project, there may happen a lot of unexpected situations, for example, the project cannot be completed on schedule; the conflict with the construction team and so on. Then the staffs in PMO can make fast and dynamic response for the project members.

③ Provide risk evaluation for the real estate projects

Every project has risk in the process of implementation, for example, the shortage of fund may cause the failure of projects. In the real estate field, it may be an unfinished building. The risk evaluation before the project start is the responsibility of PMO, they need to turn in the risk report. Though they don’t have the right to deny a risky project, at least their report can give vigilance to the senior level of decision-making.

3) Provide criterion, methods and procedures for the development and maintenance of the real estate project management

With perfect criterion, methods and procedures, the real estate members will have unified operations guide, which can assure the consistency of different projects. It’s the PMO’s responsibility to develop and maintain these criterion and methods, for instance, the real estate sales channels and promotion methods; the templates, forms and documents for the real estate development; improve the project plan and communication; conduct project review, collect and summarize the experience and lessons from the project management.
Nowadays, project management has been an important part of the operations of real estate enterprises; PMO should make consistent cross-sectional process for the real estate project management. These process instructions should provide detained guidance for the project operation. Meanwhile, they cannot be too complex and wordy. For example, the real estate multi-project selection process, the PMO can set up a series of complete index system, with considerations of the expected return, the risk and the recovery time.

4) Provide professional management training
The management training is also an important function of PMO, and the training can be done by the PMO or by the outside training agency. The contents of project management training are various, which contains:

① Project management basics, for instance, the project life cycle, cost management, schedule management and human resource.

② Senior project management, through the practice, case study and role play, learn the skills of real estate plan-making and resource allocation.

③ The application of project management software.

④ Professional knowledge, for instance, the lessons for the real estate planning, property management.

⑤ General business knowledge, it contains: the lessons for financial, project marketing, customer relationship and organizational behavior.

The role of PMO in the training should depend on the realist situation, if there is a very skillful training department, PMO should only assistant their work, however, no matter what role the PMO played in the training, they should dominate. Because their own role, they have absolute right of speech about the demand of project management training.

5) Provide qualified project manager
The implementation of a successful project can’t be done without an excellent project manager. Qualified project managers both have solid technical knowledge, management skills and talent. The ability of develop human resource can satisfy the increasing demand of project managers in real estate enterprise.
First of all, PMO should define the required skills for a real estate manager; it contains both technology and management. From the perspective of real estate enterprise, the project managers need to have acquaintance about the development process and skills. Besides, the ability of communication and interpersonal skills is also important.

Then, build up the database for professional project management human resource, define suitable person and introduce them to the most suitable working position. At the same time, follow their performance in the process of project management and correctly give feedback their ability and performance.

Lastly, a friendly environment is helpful to keep high-quality managers, for instance, provide attractive salary and benefit for their career development.

Because the real estate projects are worldwide, the members in the project team may scatter worldwide, in order to effectively communicate and exchange information rapidly, PMO should learn manage a team that is invisible, provide an environment to help the virtual team effectively. For instance, build and maintain a central database which contains: all the documents, schedule and financial data. No matter where are the members of team, they can be empowered to visit at any time. Besides, the communications can be done through telephone, e-mail, fax, television meeting, speed post and other ways.

5.2.2. The setting and application of PMO
A lot of energy needs to be paid in the process of setting up PMO, so the arrangement of PMO has to be well considered. If the scale of the real estate enterprise is small, usually there is only a small and simple project operating, it’s useless to set up project office. However, in a big real estate enterprise, which has a lot of cross-regional projects, it’s comparatively worthy to have the department of PMO. Generally speaking, there are two stages to set up PMO, which is the idea stage and implementation stage.

PMO is valuable for both project members and construction enterprise; it can provide consultation and training for the project members. At the same time, it can save the data of previous real estate project management, which can be used for the future reference. While operating PMO is definitely not an easy thing, especially the PMO provides full service. If the operation is not successful, it may cause centralization of power to make the inconsistent between planning and realistic.
Once the PMO is started, the staffing, and the position in the real estate are needed to be explained explicitly. For example, the working places of PMO, in the corporate headquarters or changing with projects. The next step is making the development plan for the PMO, and makes it perfect in the process of implementation, make sure it runs smoothly.

5.3. The performance assessment of real estate multi-project management

Under the environment of running multi-project, the performance assessment of real estate multi-project management is rather important and complex. In the process of multi-project management, the real estate enterprise manages the projects in the form of group, to achieve the maximum profit. So the performance based on the project groups is reasonable. This thesis assesses the single project’s performance based on the approach of analytic hierarchy process (AHP) firstly, and combined with priority; the multi-project is assessed to reflect the overall situation of several projects.

5.3.1. The BSC performance assessment index system of single real estate project

The traditional assessment is mainly using financial indicators, but with the development of economy, the human resource, brand and process are becoming more and more important, therefore, adding this information in the performance assessment index has scientific significance. In the current performance assessment index, the balanced score card (BSC) build up an overall assessment system. It emphasizes the connections of financial index and non-financial index, with balancing the short-term and long-term benefit; qualitative and quantitative. So it is valuable for the guidance of the enterprise development and management.

Based on the thought of balanced score card and the previous research\(^8\), combine with the realistic situation of real estate enterprise, from the perspective of financial, customers, inner business process and learning and growth, build up the index system as follows:

Figure 4 Real estate project i’s performance assessment index

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\(^8\) Changhui (2007)
1) Financial

The financial factor in this index contributes to measure the past performance of real estate enterprise. The financial index shows whether the strategy and implementation
is helpful for increasing the profit, and it’s the start point of the other three factors. The level of financial mainly comments the growth ability, profitability. The common measurements are: sales area, sales, net profit and net profit growth.

1) Sales area

Compare to other enterprises, sales area is the special measurement of real estate enterprise. It perfectly reflects the degree in keeping with the objective market.

2) Sales

Sales refer the total income in the sales of real estate project, it is usually made by the contract between the enterprise and the customers, and it’s the main income of real estate enterprise. The net income is also needed to be calculated due to it doesn’t consider the impact of cost.

3) Net profit

Net profit equals the number that total income takes away all the taxes; it measures the sales performance of the real estate enterprise, and the more the better. From the perspective of enterprise, the net profit is both the main factor for the expected return and the basics of operation and management. The calculation formula is:

\[ \text{Net profit} = \text{total profit} \times (1 - \text{income tax rate}) \]

Net profit cannot reflect the operating efficiency of the real estate enterprise, so the net profit growth is added.

4) Net profit growth

Net profit growth refers the ratio between the increasing amounts of this period and the previous amounts of the previous period; it reflects the development capacity of the enterprise.

The calculation formula is:

\[ \text{Net profit growth rate} = \frac{(\text{the profit in this period} - \text{the profit in previous period})}{\text{the profit in previous period}} \times 100\% \]

2) Customers

The ability to provide excellent service and qualified product is the determinants of enterprise competitiveness and future development. The concept of “customer is god”
is very important as well. Meanwhile, defining the objective customers and their requirement are crucial. The common customer factors contains: market share, the customer satisfaction and customer profitability.

① Market share

Market share refers to the market coverage in the local region, in some fact, it reflects the success or failure and the brand of the project, the calculation formula is:
Market share = the enterprise sales area / the market sales area × 100%

② The customer satisfaction

Customer satisfaction refers to a kind of mental feeling; it comes from the comparable between the feelings and expectations for the real estate product and service. It reflects the performance of the real estate management system, also it provide reference for the improving of the system. The common ways are: questionnaire, interview, telephone assessment and panel discussion.

③ Customer profitability

Customer profitability refers to the profitability of the customer through providing real estate product and service.

3) Internal business process

In order to attract customers and keep the customers satisfied with the product, the real estate enterprise has to improve its internal business process, it contains both short-term improvements for current business process and future reform of service, from every step of project development, the common internal process index contains: change of objective cost rate, construction quality, the deviation of schedule and internal business process efficiency.

① Change of objective cost rate

In the competitive market, the real estate enterprises pay attention to cost management day by day. They try to decrease the cost without affecting the profit. The change of objective cost reflects the ability to control the cost. The calculation formula is:

The change of objective cost rate = (the actual cost – objective cost) / objective cost × 100%
② The construction quality

The construction quality is a very important issue in the real estate enterprise. If the construction quality is bad, it will increase the maintenance cost and compensatory cost, furthermore it will affect the reputation of the real estate enterprise, the construction quality reflects the ability of the project management. And it can be measured by the pass rate of one time.

③ The deviation of schedule

The real estate project has very strict duration constrains, in some areas, the constructions cannot be implemented in some special period, for example, in the extreme cold winter in the northern part or the rainstorm season in the south area.

As well, the sales time of real estate project, in china, it’s the best market time for selling the houses during the September and November every year.

So the schedule is quite important, and it reflects the ability of real estate enterprise to control schedule, the calculation formula is:

The deviation of schedule = the realistic schedule – the planning schedule

④ The inner business process efficiency

The inner business process efficiency refers that the degree of refinement of real estate enterprise compared to other leading enterprises. It reflects the efficiency of the inner business process. The inner business process should combine with the actual implementation of real estate enterprise, and based on the rich experience of other enterprises, to assure the operability and efficiency.

4) Learning and growth

Under the intense global competition, in order to achieve long-term development, the real estate enterprise has to innovate and increase the ability of learning. The common learning and growth factors are:

① The employee satisfaction

The employee satisfaction reflects the degree of employee satisfaction. Same with customer satisfaction, it can be measured through interviews and so on.

② The employee training

The employee training is an important part of the human resource management in the enterprise, it can not only increase the knowledge and management skills of
employee, but also make the employee to know the enterprise culture and increase the working efficiency, keep the enterprise competitiveness.

③ The office automation

In the information age, office automation is basics for the enterprise to increase the competitiveness; it can transmit the information quickly and increase the office efficiency. The office automation reflects the level of the information system in the enterprise.

5.3.2. The performance assessment of real estate multi-project

Based on the single real estate project performance assessment, this thesis evaluates the whole multi-project combined with priority of projects, in order to stimulate the overall profit.

1) The real estate performance assessment index

Suppose the number of projects is m, and the single project i’s performance assessment is shown in the figure 6. The performance assessment index of project i (i=1, 2, …, m) is \( U_{ij} \) (j=1, 2, 3, 4), and they are financial \( U_{i1} \), customer \( U_{i2} \), inner process business \( U_{i3} \) and learning and growth \( U_{i4} \).

And the corresponding weight is \( W_{ij} \).

In each index \( U_{ij} \), there are sub-indexes, which is \( W_{ijk} \).

According to figure 4, among the sub-indexes, when j=1 and 3, k=4. Similarly, when j=2 and 4, k=3)

It needs to be explained that the model in figure 4 is only a reference system; it has only considered the most relevant indexes for the real estate enterprises. In the reality, with the difference of operating environment, strategy objectives, development cycles and competence, the performance assessment index may need to be changed according to the own characteristics.

2) The determinants of index weight

The index weight reflects the degree of importance; higher weight means the index is more important. However, in different stages, the weight of index may have to be changed. This thesis uses AHP to decide the weight.

① Set up the AHP model as shown in figure 4 above.

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9 Because there are four sub-indexes in Financial and internal business process.
② Calculate the weight through matrix

In order to get quantified matrix, the range of “1-9” is introduced to judge the relationship between the index p and index q, which is shown in table 6.

<table>
<thead>
<tr>
<th>Quantification</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The index p is as important as index q.</td>
</tr>
<tr>
<td>3</td>
<td>The index p is slightly important than index q.</td>
</tr>
<tr>
<td>5</td>
<td>The index p is more important than index q.</td>
</tr>
<tr>
<td>7</td>
<td>The index p is much more important than index q.</td>
</tr>
<tr>
<td>9</td>
<td>The index p is absolutely more important than index q.</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>Refers the middle condition in the above judgment.</td>
</tr>
</tbody>
</table>

 reciprocal
If the judgment $a_{pq} > 0$, then $a_{q} = \frac{1}{a_{pq}}$ and $a_{pp} = 1$

With this process of qualification, the judgment matrix is like:

$U_i = [U_{i1}, U_{i2}, U_{i3}, U_{i4}]$

And its transpose matrix is $U_i^T = [U_{i1}, U_{i2}, U_{i3}, U_{i4}]^T$

The judgment matrix is shown in table 7:

<table>
<thead>
<tr>
<th></th>
<th>Financial</th>
<th>Customer</th>
<th>Internal business process</th>
<th>Learning and growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial $U_{i1}$</td>
<td>1</td>
<td>$a_{12}$</td>
<td>$a_{13}$</td>
<td>$a_{14}$</td>
</tr>
<tr>
<td>Customer $U_{i2}$</td>
<td>$a_{21}$</td>
<td>1</td>
<td>$a_{23}$</td>
<td>$a_{24}$</td>
</tr>
<tr>
<td>Internal business process $U_{i3}$</td>
<td>$a_{31}$</td>
<td>$a_{32}$</td>
<td>1</td>
<td>$a_{34}$</td>
</tr>
<tr>
<td>Learning and growth $U_{i4}$</td>
<td>$a_{41}$</td>
<td>$a_{42}$</td>
<td>$a_{43}$</td>
<td>1</td>
</tr>
</tbody>
</table>

10 The judgment $a_{pq}$ refers that the relationship between index p and index q
a. The arithmetic mean of each row of the judgment matrix is:

$$\overline{W}_p = \frac{1}{n} \sum_{q=1}^{n} a_{pq}, \quad p = 1, 2, \ldots, n$$

(Equation 1)

For example, when $p=1$, it is:

$$\overline{W}_1 = \sqrt[4]{a_{11} + a_{12} + a_{13} + a_{14}}, \quad p = 1$$

(Equation 2)

So,

$$\overline{W} = [\overline{W}_1, \overline{W}_2, \ldots, \overline{W}_n]^T$$

(Equation 3)

b. Calculate the weight $\overline{W}$ as percentage:

$$W_p = \frac{\overline{W}_p}{\sum_{q=1}^{n} \overline{W}_q}, \quad p = 1, 2, \ldots, n$$

(Equation 4)

For example, when $p=1$

$$W_1 = \frac{\overline{W}_1}{\overline{W}_1 + \overline{W}_2 + \overline{W}_3 + \overline{W}_4}, \quad p = 1$$

(Equation 5)

So: $W = [W_1, W_2, \ldots, W_n]^T$  

(Equation 6)

3) The performance assessment of single project $i$

After getting the weight of each index, the total score of project $i$ can be calculated. First, the value $U_{ij}$ of each index in project $i$ should be given by the PMO, which can be through democratic evaluation questionnaire and so on.

And the performance assessment of project $i$ is:

$$U_i = \sum_{j=1}^{4} W_{ij} U_{ij}; \quad i = 1, 2, \ldots, m$$

(Equation 7)

4) The performance assessment of multi-project

Combined with the priority of each real estate project, based on the performance of single project score, the multi-project performance assessment is:

$$U = \sum_{i=1}^{m} w_i U_i$$

(Equation 8)

$w$ is the priority of the project $i$ in the multi-project.

Vantone Real Estate Company is one of the biggest real estate companies in China. It works on developing real estate projects from feasibility analysis to the final marketing and property management, in other words, it’s a fully functional company.

In Vantone, there are usually four to five on-going large development projects with full-scale, and each one employs between 150 and 200 people. For example, project 1 is the residential project designed for medium-income objective people in Beijing. Project 2 may be the commercial project located in the CBD of Shanghai. And each large project is also divided into several sub-projects, which contributes to easier management. Generally speaking, the projects usually last for three to four years depending on the scale.

About the multi-project management, in Vantone, PMO (project management office) has a relative strong position in the organization. The overall departments are: system department, projects integration and coordination department, PMO and the strategic department.

1) The system department is made up of different functional sectors, like the designing, planning, accounting and others. Another important responsibility of this department is to determine new projects. And the mission of assessment is fall on the evaluating board; the evaluating board is made up of people from different functional sectors. And it belongs to the system department.

“The system department makes the decision through the evaluating board, the main principles of choosing new projects is depending on the interactions among the projects. A few years ago, we only focused on one large project. Today, we must handle a variety of projects. It’s more challenging when came to the dependency of projects, the actual situation is so complex.”

(Manager, system department)

According the system department manager, the multi-project selection is rather complex and important; the selection is in line with the corporation strategy and direct profit. And in reality, the staff of the evaluate board are dynamic, in order to increase the transparency and openness. When came to the priority, the profitability is the main factor in the discussion.
2) The project integration and coordination department is responsible for integrating all the projects according to the specifications and quality standards. It performs like the glue to stick the whole organization. Another responsibility is implementing the performance assessment for the projects team, and gives feedback directly to each team member in the project.

3) The PMO plays a very important role in the process of multi-project implementation. And it’s responsible for the project planning in the management controlling. And the manager of PMO is empowered as the senior managers in the organization. The entire project managers are appointed by the manager of PMO, as well, the PMO manager has the right to decide the final plan for the multi-project portfolio and to coordinate among the various projects.

   “After the system department manager turns in the multi-project plan and their responsibility is deciding which project portfolio is to start and the implementation processes. After the decision, I can make the final decision and deliver the responsibility to every project managers.” (Manager, Project Management Office)

   According to the project manager of PMO, the staffs of PMO are mainly responsible for providing expert advice for the project manages of each project. Also, the resource is also an important issue. Normally, Vantone has one large project with highest priority. In order to fulfill the resource requirement for this project, other projects will have resource constrains. Besides, the resource allocation is based on the accordance with the corporation strategy and targets. With the planning function of PMO, the priority of projects is determined, and then the critical resource is handled.

4) The strategy department is committed to set the strategy of company, and it reflects the core-competence. The development of organization is heavily relied on the corporation strategy. In Vantone, the strategy department is mainly providing support for the other departments. And it’s directly influence the priority setting, resource allocation and the multi-project selection. It’s a highly integrated department.

   As it seems, the project management office and the system department play the key roles in the process of controlling multi-project management in Vantone. And the evaluating board is responsible to handle the multi-project portfolio, and the PMO has
the final right to proceed. And the strategy department’s opinion has an important weight in the final priority settings and the critical resource allocation. Compared to the organizational mode in chapter 5, the project management office has a rather important weight in the whole process of multi-project management, in some points; it increases the requirement for the PMO manager’s skills and abilities. However, in the other hand, it may cause power centralization.
7. Conclusion

Multi-project management is a new form of project management, compared to traditional project management, it is helpful to organize several projects well and increase the enterprise competence in the market. This thesis discusses the process of multi-project management. Through the application of the multi-project management theory and method in real estate filed, the problems in the traditional single project management are solved in the following three aspects:

① From the perspective of real estate enterprise, the current project management situation is described, meanwhile the problems in the process are revealed. Furthermore, bring up the optimized way, which is the implementation of multi-project management.

② Considering the limited resource in the real estate enterprise, and the three interactions among projects, which are resource interaction, benefit interaction and outcome or technology interaction, the linear programming multi-project selection model is set up to discuss the potential four conditions, which are “Only interacted by resource”, “Only interacted by resource and outcome”, “Only interacted by resource and benefit” and “Interacted by resource, outcome and benefit”. Then the detailed case is used to test the feasibility.
Also, the grouping rules are discussed later, which is based on the logical relationship in the processes and resource restrictions.

③ Based on the multi-project management theory, evaluate the current matrix organization, and bring forward the new multi-project management organization and discuss the function, setting and operations of project management office (PMO) in the real estate enterprise.
At last, through the methodology of analytic hierarchy process (AHP), the performance assessment system of multi-project is built.
The purpose of this thesis is structuring the overall real estate multi-project theory, make reasonable resource allocation for the projects that are helpful in the process of enterprise development. Also assure the smoothly running of projects from organization, regulations and information, and monitor and assess the performance, in order to achieve the profit maximum.
However, it’s only preliminary study to bring up some possible solutions; some questions are still needed to be in-depth studying, for instance, the risk management. And the project resource plan is described qualitative, and it needs to be refined further.
Reference:


