RESEARCH ON CRITICAL CHAIN MANAGEMENT AND RISK MANAGEMENT IN PROJECT IMPLEMENTATION MANAGEMENT

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Abstract: According to Standish Group's research, more than 30% of IT projects are unfinished, and about 73% are delayed or exceeded the budget in those completed projects. On average, the cost is 189% of the original planned and the length of completion cycle is 222% of the planned length. This indicates that there are shortcomings in the traditional project management mode. However, critical chain theory provides some improvement method. This paper focuses on the application of critical chain theory to enhance the ability to completing projects on schedule and effectively reduce cost.

1 INTRODUCTION

According to Standish Group's research, one third of IT projects are unfinished, and about three quarters are delayed or exceeded the budget in those completed projects. On average, the cost and the length of completion cycle are nearly doubled of the planned ones. This indicates that there are shortcomings in the traditional project management mode. However, critical chain theory provides some improvement method.

TOC (Theory of Constraints) is named after Israeli physicist and Master of Business Administration, Dr. Eliyahu Moshe Goldratt, which is supported by a serious of thinking method. Figuring out the core problem and proposing a new viewpoint of loop chain is its thinking methodology. Loop chain is made up of several loops; it can only enhance efficiency in the circumstances that loops work in cooperation. Mainly used in production management, project management and distribution management, critical chain theory is the project management method. This method has been utilised successfully to guide several project. This paper mainly focuses on application of critical chain theory to enhance the ability to completing projects on schedule and effectively reduce cost.

2 OVERVIEW OF CRITICAL CHAIN THEORY

2.1 Problems in Project Implementation Management

Project tardiness, excess budget, poor performances are frequently confronted by project managers.

In order to change the current situation, following advices are proposed for the improvement of project implementation:

- Leave room for each stage of projects as uncertainty can exist in every stage.
- Make timely emendations to plans according to project situation.
- Share resources with other projects.
- Early detect and prevent potential risk through statistics analysis.
- Increase the input of investment.

However, do these improvements really work?

- If leave room for each stage of the project, the complete time will be postponed for a long time.
- Plan amendment is necessary, but as to those large projects, there may be enormous changes, affecting the regular operation of projects.
- Sharing resources with other projects may also lead to confliction in projects as the limitation of resources, resulting in implementation delay

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of each project.

- Increasing the investment blindly always means the loss of the project.

2.2 Description of the Critical Chain Theory through Project Plan Schedule

How can critical chain theory used to improve the project management? Following describes the mechanism by comparing the traditional project management method and critical chain management method of a project plan. Figure1 describes the project schedule

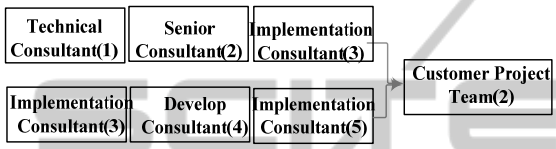

Figure 1: A simple project schedule.

Boxes in Figure.1 stand for different tasks. If two tasks are connected in the horizontal direction, or connected with arrows, it indicates that the beginning of the latter task depends on the completion of the former task. Resources needed for execution are included in the boxes and the number means the length of days to complete the task. Current resources include one technical consultant, one senior consultant, one implementation consultant and a develop consultant.

As those resources may have tasks in other projects, the time for completion is of great uncertain. To solve this problem, adding a buffer period in each task is proposed as stated in Figure.2, the bold lines marked the critical path (the longest oath to complete the task)

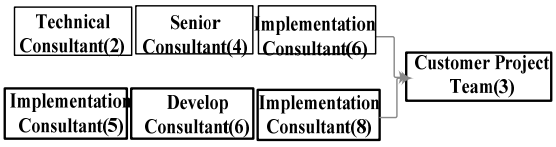

Figure 2: Project schedule added with buffer period.

Though added buffer period, but the outcome seems not as reasonable as implementation consultant is still in the contending state, implementation consultant (6) can only start his task after the completion of implementation (8). Accordingly, the time in critical path (5+6+8+3=22 days) is not the exact time for the project. So, how to make a more reasonable and effective project schedule? The following four steps describe how to apply the critical chain theory to solve this problem:

- Step 1: Solve the contending situation of resources

Firstly, the contending situation of resources should be solved as Figure 3 demonstrated.

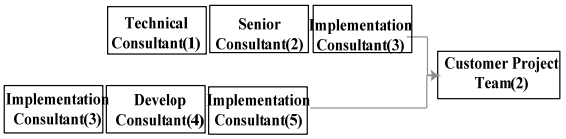

Figure3: The contending situation solved schedule.

There is no buffer period in this Figure.3; the number in boxes means the average time to complete the task. The buffer time will be added later.

Some tasks, such as technical consultant (1) and senior consultant (2), will start at the late starts. This is because the start date will be advanced only when buffer period is added, but where to add this buffer period is still being uncertain presently.

The scheduling Figure.3 has the shortest construction time; however, it is necessary to note that only in the absence of any uncertainty will be the case.

- Step 2: Identify the critical chain

To fully utilise the buffer period, it is required to identify a set of tasks which determines the cycle of the whole project. This set of tasks is called the Critical Chain.

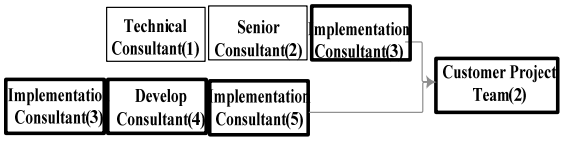

Figure 4: Critical Chain.

It is easy to identify that tasks in bold boxes determine the cycle of the whole project, as any of those delayed will cause a delay in the project.

- Step 3 and 4: Add buffer period appropriately

To avoid delay of projects is of vital importance to project managers. To solve this problem, a buffer period is added at the finish point, as stated in Figure.5.

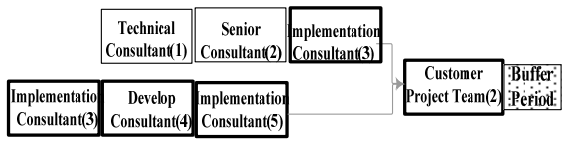

Figure 5: Schedule with buffer period.

The reserve buffer period can be used in the project; it is derived from the statistical length of fluctuation time. It should be noted that the protection is intended for the whole project rather than a single task. It is still of great importance for projects which have not generated critical chain. In short, advance risk and postpone idleness.

Projects are protected by establishing project buffer, but other parts of the project also need consideration.

Specifically, insert vibration period at the connection point between non-critical chain task and critical chain task, as shown in Figure.6. Finally, we get a practical plan not only ensure relatively short cycle, but also consider how to avoid interference of fluctuation.

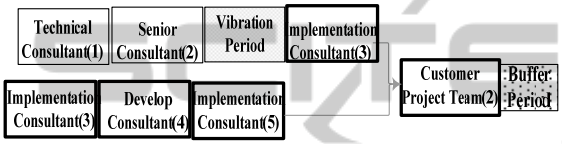

Figure 6: Project scheduled according to critical chain theory.

3 THE APPLICATION OF CRITICAL CHAIN IN LARGE PROJECT MANAGEMENT

3.1 Stage and Milestone in Projects

There are many reasons contribute to the delay of project cycles and budget overrun, however, among those reasons, not having good stages or milestones is one of the most important. The Figure below well illustrates this problem.

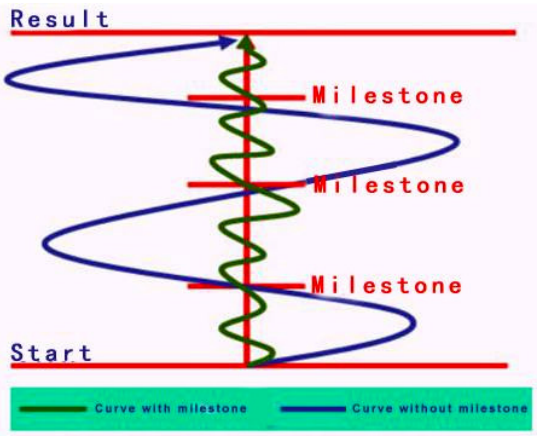

Figure 7: Comparison of executive curves.

As shown in Figure.7, there is a long way to go for the success of the project, and there is not a readily available method to draw on. If project manager wants to settle the project at one go and not divide the project into several stages, it is easily take unperceived detours. When realised, it has been far from the targets. Even corrected, it is easily deviate to another unperceived direction. Repeating like this, become the blue track in Figure.7. If divide the whole implementation into several stages and each stage has its symbolic milestones, though detours cannot be avoided, it does not go far and forming the green track in figure. It can be easily seen from the figure that these two tracks have different length, and the blue one longer than the green one, which indicates that the former spend more cost and time than the latter, indicates the budget overrun and schedule delay.

Having long cycle spans, it is not realistic to foresee and make plans of future in advance. Accordingly, the best way to solve this problem is to divide the whole project reasonably and set up milestones at the appropriate positions. As for the subdivision of project, it can utilise the seven steps of implementation methodology as the basis and subdivide the project according to the practical situation of each project. Following methods can be considered in subdivision:

- Large projects usually implemented for several stages, for example, implementing financial accounting in the first stage, implementing supply chain in the second stage and implementing administrative accounting in the third stage.
- After the division of large stages, divide the project into detailed stages according to the practical situation of each project.
- Detail the task planning and milestones for each stage.

3.2 Adopting the Principles of Risk Advancing and Idleness Postponing Detailing the Project Schedule

The core principle of critical chain theory is to advance risk and postpone idleness.

Figure.8 describes the relation of complete time and complete probability of a project, the difference in projects and the ability and experience of team are certain to have impact on the shape of curves.

We can draw conclusion from the figure that the possibility of completing tasks in advance or delayed is very low, but it really exists. Usually, the consultant will choose the corresponding complete

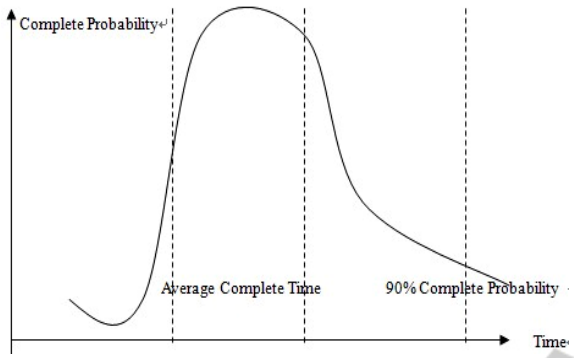

Figure 8: Curve of project complete probability and complete time.

time of the 90% complete probability, meanwhile, there is still possibility that the project cannot be completed timely. However, according to the critical chain management method, all the safe time of each task will be taken away and add it at the completion point of the whole stage, working as the buffer time of this stage, protecting the critical chain. Accordingly, we should tell consultant to estimate each task based on 50% complete probability time, namely the average complete time in Figure.8. Try the best to complete the plan, if cannot finished timely, adjust the task utilising the buffer time of this stage.

3.3 Scheduling Plan and Resources in Accordance with Critical Chain

In the view of resource allocation manager, plan means two sheets; one is the task sheet, which gives an overall view of what recourses are needed from the perspective of project manager. This sheet can be generated by PROJECT, stating, I need a financial consultant from 8 to 12 in April to conduct the financial requirement investigation in preparation for Project A. The other one real-time priority arrangement, usually, this sheet stating, do this immediately or why Project A gets nowhere. The first sheet changes with the project, maybe once a week, however, the second sheet changes more frequently, maybe every hour a change, especially in large projects.

Traditional project management method also needs to arrange project plan, allocate resources and schedule. Following will demonstrate the advantages and improvements of critical chain theory:

- Making detailed project plan and scheduling resources with critical chain theory is mainly aimed at current detailed stage targets and milestones.
- Leave no room for buffer time for each task.
- In the critical chain method, task scheduling outlines priority but there is no exact time to complete the task. This is a significant difference between traditional theory and critical chain theory. In the circumstances that fluctuation cannot be avoided, it is better not giving the exact start time rather than estimating the start and finish time and adjust when fluctuation occurs. So it is critical to strictly adhere to one rule: Finish your job as soon as possible when you are assigned with tasks.
- The most significant difference with traditional project management method lies in scheduling plans and resources according to the critical chain rather than non-critical chain. In the process of scheduling, we should pay particular attention to the over-loaded bottleneck resources rather than try to solve every problem concerning resource contention. Unless significant changes occur, we do not rearrange plans frequently, in other words, not changing the priority of tasks frequently.
- Considering the tasks in non-critical chain, we should also pay certain attention to them. In order to ensure that non-critical tasks do not affect the overall progress of the project to the largest extent, it is strongly recommended that arrange the start time as early as possible and leave adequate vibration period between critical chain tasks and non-critical chain tasks.
- As all the safe time in each task has been taken away and the tasks in non-critical chain have been brought forward, the problem of resource contention is more outstanding than traditional ones.

3.4 Establish Project Tracking Mechanism

Contingencies are inevitable in the project implementation process, establishing a tracking mechanism to monitor the execution of projects is also of great importance.

This tracking mechanism is called “Buffer Period Management”. According to the situation task completion, we can easily monitor how much of the buffer time has been used. For example, as to schedule in Figure.5, after 8 days work, technical consultant (1), senior consultant (2), and implementation consultant (3) all have finished their tasks and develop consultant has nearly completed.

In Figure.9, we use the blue line stands for the completion of tasks. It can be seen from the figure that technical consultant (1) and senior consultant (2) have delayed for one day, as there is vibration period so the delay does not impact the project progress. However, tasks in critical chain, implementation consultant (3) and develop consultant (4), also delay a day, accounting for a day of the buffer period in Customer Project (2), as stated in Figure.9.

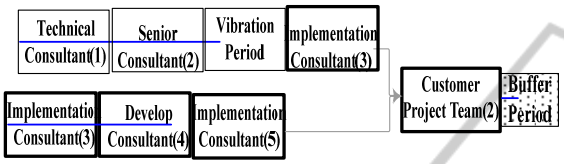

Figure 9: Buffer period state.

The establishment of tracking mechanism is of great importance to projects. Following are some suggestions on how to establish tracking mechanism:

- Establish weekly meeting system to monitor the implementation the projects.
- Regarding those critical tasks in critical chain, weekly tracking cycle is too long, daily tracking system is necessary.
- If there were serious problem during the tracking process, it is necessary that rearrange the project plans and resources allocation, in order to ensure the completion of whole project.

4 APPLICATION ANALYSIS OF THE PROMOTION OF CRITICAL CHAIN

4.1 Problems and Strategy in the Application of Critical Chain

In the implementation of critical chain, there are some inevitable problems, following are detained analysis of these problems and corresponding strategy:

Table 1: Problems and strategy in the implementation of critical chain.

Problem Category	Problem description	Strategy and Analysis
Cognition	Inertia determines that project managers are reluctant to change the previous method, even though they are proved to be ineffective.	Strengthen the training in project plan scheduling and critical chain theory, enhancing the cognition of project managers.
Organization	The application of critical chain is more demanding, it is vital to identify the urgent degree of resources in order to allocate effectively.	When resources cannot be coordinated within teams, department manager should communicate with other teams to solve the problem.
	In the implementation of critical chain, the main task is to ensure the tasks in the critical chain, repeating tasks in the non-critical chain should coordinate with other resources.	1. Establish echelon team ability in the implementation department, with both senior consultant and assisted consultant. 2. Develop implementation partners, make then undertake the on-tech tasks in busy period.
Assessment	Team members work harder to ensure the completion of tasks, but project manager and consultant may be thinking: why should we work so hard, there is buffer period, and even finished, there are other continue tasks.	1. Taking task completion time and input cost as measuring indicators. 2. Project manager and consultant promote mutually, project manager has the right the assess consultant, which is beneficial to find out problems and solve them timely.

4.2 Proposed Steps for the Promotion of Critical Chain

As the implementation system is divided into three levels, enterprises, regions and branches, and different branch offices have significant differences in implementation ability, accordingly, different focus on different points in the implementation of critical chain. In the level of enterprises and large regions, most of the project managers have relatively stronger ability and most of the projects are large

projects, which can be promoted in large scale. The key branch offices in Beijing, Shanghai and Shenzhen not only have capable project managers who can be responsible for large projects, but also have project managers being responsible for medium and small projects. When carrying out the critical chain, we can choose the appropriate ones for the project according to the ability of managers and the scale the projects. As for the small branch offices, due to the relatively low ability in project management, even though large projects were signed, usually, the project manager was dispatched by enterprises or large regions.

4.3 Summary of the Prospects of the Application of Critical Chain

In the light of the previous analysis, in order to promote the critical chain in implementation systems, we can conduct the work from the following aspects:
Strengthen the training for large project managers.

- Select appropriate project managers to conduct projects, summarizing and accumulating experience on a trial basis.
- Make modest adjustment in terms of organizations, resources allocation ratio and development cooperation partners in implementation.
- Match assessment system with corresponding large projects.

If promoted smoothly, it can bring following values for enterprises:

- Enhance the management ability of large project managers.
- Effectively improve the on time delivery rate in the implementation of large projects.
- Effectively control the input cost and increase profits in the implementation of large projects.
- Improve customer satisfaction to a certain extent.

5 CONCLUSIONS

This paper analyzes the critical chain theory, implementation steps, how to implement in projects and how to promote within implementation systems. On the premise of fixed project resources capability, this paper mainly discusses how to utilize critical chain to solve the problems, such as project delay, resources contention, in traditional project management.

REFERENCES

Eliyahu, Goldratt., 2006. *Critical Chain*. Beijing: Electronic Industry Press.

Qunting, Liu., Zhibin, Jiang., Zhiying, Zhang., 2008, *Project Manufacturing Planning Control Process Models and Critical Issues*, Industrial Engineering and Management.

Goldratt, E. M., 1997, *Critical Chain*. New York:North River Press,1997.