

# INCORPORATION OF TOTAL TIME MANAGEMENT INTO HIGHWAY PROJECT TIME MANAGEMENT SYSTEM

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**ABSTRACT :** Time management is one of the critical tasks in project management. Based on the theories of total quality management, this authors presented a project time management method, total time management (TTM), so as to facilitate highway project time management. This paper discussed the four fundamental characteristics of TTM: total factors management, staff management, project life cycle management, and Plan-Do-Check-Action (PDCA) cycle management. Now, most managers use computer software to manage the project. In order to make the theory of TTM more executable, the authors develop a project time management system suitable for TTM. This paper presents this time management system's analysis processes including system requirement, key functions etc..

*Key words :* highway project time management, total time management, time management system, optimized design

## 1. INTRODUCTION

Time management is one of the critical tasks in highway project management. In order to fulfill the goal of project time management, the quality of time management must be improved. Quality refers to the characteristics of the products (the goods or the service) that meet the customer's needs as defined elsewhere [1]. Based on the general definition of quality, the quality of time management can be expressed as the service quality. At present, the total quality management has been widely used as a tool to ensure the qualities of product and service. In order to efficiently manage the process of time management and improve the quality of time management, it is necessary to utilize the theories of total quality management (TQM) to undertake time management. Taking into account the characteristics of time management of the highway project, the authors present a new method, total time management (TTM) that is developed derived in accordance with TQM so as to optimize the highway project time management system.

Corresponding with the theory of TQM, the TTM is a time management method with the characteristics of total factors, staff, project life cycle and PDCA. The successful project time management must depend on all the staff's efforts and cooperation. The time management should exist in all the project phase. In the process of the time management, all the parties involved in the project should be organized reasonably to manage all the factors influencing the project time including man, material, machine, method and environment.

This paper presents the basics pertaining to the TTM

method and its applications in highway project time management system. In order to make the theory of TTM more executable, the authors develop a project time management system suitable for TTM. This paper presents this time management system's analysis processes including system requirement, key functions etc..

## 2. FUNDAMENTALS OF TOTAL TIME MANAGEMENT

The TTM is basically a time management method. The fundamental characteristics of the TTM method, i.e. staff management, project life cycle management, total factors management and PDCA cycle management are presented in the following sections.

### 2.1 Staff Management

Time management is a management activity that requires staff's efforts [8]. Both technical and construction staffs are working together in the process of project management. In general, managing staffs at the middle level are responsible for developing the project schedules, gathering construction information, and responding to the execution of engineering schedules; managing staffs at the top level are responsible for establishing and controlling the ultimate project time goal.

For a highway project, as an illustration, the goal of project time management can be fulfilled only with positive participation and cooperation from every party involved, in particular the contractors, engineers and employer. In highway project management, the speed of construction not

only affect the contractor's construction cost and the engineer's management cost, but also affect the employer's economic benefits. Therefore, the three parties (including contractor, engineer and employer) must coordinate and cooperate effectively. Table 1 presents the major tasks of the

three parties in the processes of project time management.

Actually, the project progress is influenced not only by the above three parties, but also by the design company and the companies and organizations along the highway project.

**Table 1.** Overview of the major tasks of time management

Item	Contractor	Engineer	Employer
scope	Construction section	Supervision section	Whole project
Task of Time Management	Plan execution, checking, and control	Plan evaluation, checking, and control	Development, checking and control of the whole project plan
Technical manager's duties	Accepting tasks, Implementing plans	Checking the implementation of plans	Checking the implementation of the whole project plan
Time manager's duties	Planning activities, scheduling time table, collecting information on execution	Plan evaluation, checking, and control	Evaluating , checking and controlling the whole project plan
Top-level manager's duties	Fulfilling execution goal, checking and controlling plans, making corrections	Fulfilling supervision goal, coordinating with the contractors, inspecting plan implementation, evaluating correction steps proposed by contractors	Fulfilling the ultimate time goal , evaluating and checking the whole project plan

## 2.2 Project Life Cycle Management

The progress of the construction project not only depends on the construction speed of the project, but also depends on the design progress and the progress in the other project stages. We can accelerate the project progress using the optimize technique, such as fast-track, etc.. On the contrary, the delay of the design work may cause the delay of the project progress. The project time and progress is influenced not only by the design, but also by the construction method and the construction scheme.

Time management is project life cycle management. It should be utilized to guide every project phase. It not only exists in construction phase, but also exists in design phase. It not only exists in the construction phase of engineering (including implementing plans and controlling plans), but also exists in planning phase of engineering (including cost and schedule, detailed planning, etc) and turnover phase.

## 2.3 Total Factors Management

In the processes of undertaking project time management, there are many factors that that may have an effect on time management. In general, those factors can be classified into five categories: man, material, machine, method, and environment, i.e. 4M1E. In order to manage the project efficiently, project engineers should focus on these factors.

**Man.** Man is a complicated factor which influences the project progress constantly. From the above first characteristic, we can know that all the people of the project have influence on the project progress. The quality of time management and the progress of undertaking project management not only depend on the management level of the contractors and the technical level of the constructors, but also depend on their working enthusiasm and

cooperation spirit (team work). In order to manage the process of undertaking project management more effectively, it is necessary to consider all members' ideas, promote cooperation, and coordinate all members' efforts.

**Materials.** The supply of the material and the quality of the material have influence on the project progress. In the process of undertaking project management, whether materials are supplied in time or not and whether the qualities of materials meet the needs of the project can affect the project management.

**Machine.** The performance and quantity of equipment and machine have a direct effect on the project management.

**Method.** The project management will be affected by those methods employed in the process of project management, such as technical methods, organization methods, etc.

**Environment.** The surround conditions such as natural environment and social environment (weather, geology, soil of construction site, etc) will also affect the project management.

## 2.4 PDCA Cycle Management

Time management is a management activity that involves four phases: plan, do, check and action, i.e. PDCA. According to the changes of internal and external environments of the project, the management process is dynamic and evolves following either a circulation type or a spiral type, as shown in Figure 1. With PDCA cycle method, the time management can be upgraded continuously and the management goal can b achieved eventually. Figure 2 shows the basic theories of PDCA cycle management. For example, in highway project management, the larger circle is the PDCA cycle of the employer in the whole project; the

smaller circle is the PDCA cycle of the engineer in the supervision section; and the smallest circle is the PDCA

cycle of the contractor in the construction section.

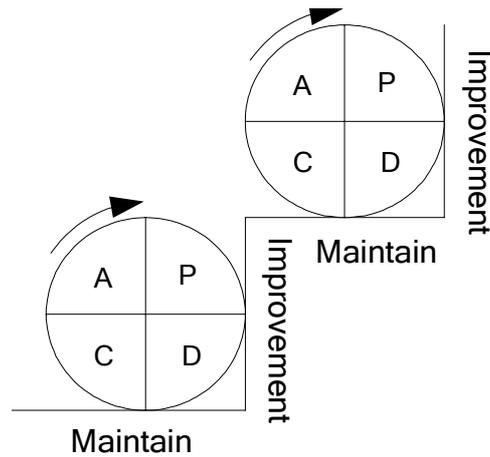


Figure 1. Process of Time Management Based on PDCA Cycle

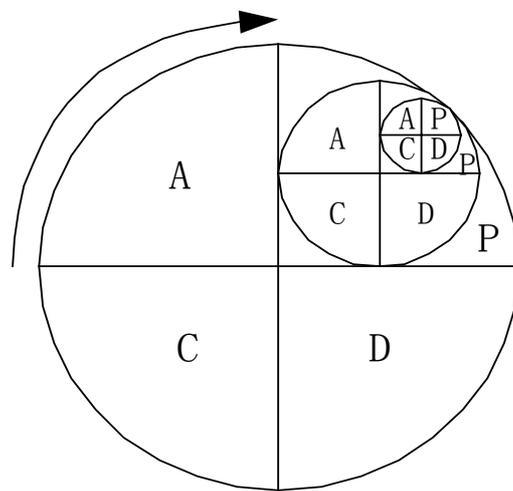


Figure 2. Graphical Illustration of PDCA Cycle Management

### 3. REQUIREMENTS ANALYSIS OF HIGHWAY ENGINEERING TIME MANAGEMENT SYSTEM BASED ON TOTAL TIME MANAGEMENT

Now, most managers use computer software to manage the project. In order to make the theory of TTM more executable, the authors develop a project time management system suitable for TTM.

#### 3.1 The System Requirements for Total Factors and Life Cycle Management

4M1E denotes the factors that affect the execution of highway project management. To effectively manage project time, we must focus on managing the influencing factors such as labor, materials, machine, methods, environment, etc. The time management system should be established in accordance with the requirements of total factors management. To meet the requirements for

managing the 4M1E factors, a database should be established to store information on the consumption of labor, materials and machines during each construction phase. Such as database usually is called quota database. In order to meet the requirements for managing random or fuzzy factors such as the weather, the effect of the random or fuzzy factors must be considered in the time management system.

In order to meet the requirements for life cycle management, the system should have the functions to manage the process of all the project phase, such as design phase, etc..

#### 3.2 The System Requirements for Staff Management

In the processes of managing time, the system has different requirements for the staffs at different levels as shown in Table 1.

Requirements for contractors. Developing and optimizing

schedules for the project construction; allocating resources; gathering time information on each activity; analyzing the actual project progress; and then taking measures to modify schedules to accelerate project progress.

Requirements for engineers. Evaluating the construction plans proposed by contractors; gathering and analyzing time information on the supervision of project construction; supervising the implementation of plans and providing advices to contractors when delay occurs.

Requirements for employer. Developing and optimizing the whole project plan; gathering time information on the

project; and analyzing and controlling the whole progress of the project.

Requirements for sharing information. The contractor, engineer and employer should share information throughout the process of construction so as reduce time delay and miscommunication.

### 3.3 The System Requirements for PDCA Cycle Management

Table 2 gives the system requirements for PDCA cycle management.

**Table 2.** Requirements for PDCA Cycle Management

Plan	Do	Check	Action
Developing, optimizing, and evaluating plans; allocating resources	Gathering information, and analyzing the implementation of plans	Making corrective measures to accelerate construction	Feedback on planning, implementation, and controlling in the process of time management

## 4. OPTIMIZING TIME MANAGEMENT SYSTEM FOR HIGHWAY CONSTRUCTION BASED ON TOTAL TIME MANAGEMENT

### 4.1 Principles of Optimization

Based on the concept of TTM, the principles utilized to optimize the time management system in highway project are summarized below:

- (1) Meeting the requirements of total time management and promoting the application of total time management in project management.
- (2) Modification in accordance with the characteristics of highway construction project and meeting the requirements of time management of highway project.
- (3) Avoiding the use of complicated systems.

### 4.2 Primary Modules of Time Management System

The time management system for highway construction project consists of four primary modules: developing plans module, gathering data module, analyzing data module and feedback module. These four modules are explained in detail as follows:

Developing plans module. Developing and optimizing engineering plans; scheduling project activities; allocating resources; evaluating plans; and presenting plans using various tables and diagrams such as Gantt chart, network diagram, etc.

Gathering data module. Inputting, revising and gathering information on investment, quantity, completion percentage of construction at different levels (activities, sections, etc.); and presenting project progress using various kinds of diagrams such as pillar diagram, etc.

Analyzing data module. Analyzing project progress using various kinds of indexes and diagrams; applying those indexes and diagrams to measure the deviations between planning and real progress; identifying the reasons for the deviations; and planning the subsequent activities.

Feedback module. Throughout the process of project construction, all managers are required to share the

information gathered in each construction phase.

Figure 3 shows the detailed procedures associated with the four modules of the time management system for highway construction project.

### 4.3 Optimized Functions of Total Time Management

Based on the requirements of total time management, the system functions are optimized as follows:

- (1) Containing various functions of management. With different management goals, the managers of different parties such as the employer, engineer, and contractor have different management responsibilities with different management methods. According to the real situation, the system should provide various management functions to assist various managers in managing the project.
- (2) Containing functions at various management levels. The managers at different levels such as managers at low levels, middle levels and top levels have different rights to deal with information. The system allocates different rights such as Input, Browse, Revise, Delete, Print, Edit, etc. to managers at different levels to ensure information communication quickly and properly, and guarantee the security of information in the meantime.
- (3) Having basic database. The system should have databases for storing basic data such as quota data, weather data, work breakdown structure, etc. so as to avoid the use complicated system.
- (4) Having various kinds of templates. Those templates focus on expert experience. Using those templates, managers can finish some tasks such as developing plans quickly.
- (5) Containing many optimized models developed by the authors, which consist of the new project scheduling model considering the effect of the random factors, the project schedule evaluating model based on the highway quota and the multi-objects resource optimization model using the genetic algorithms. Those models improve the traditional scheduling techniques and are more suitable for the characteristics of the highway project.

(6) Combining the network diagram, Gatte diagram, tracking Gatte diagram, pie diagram and pillar diagram with

the photos and the videos on the construction site to describe the construction progress.

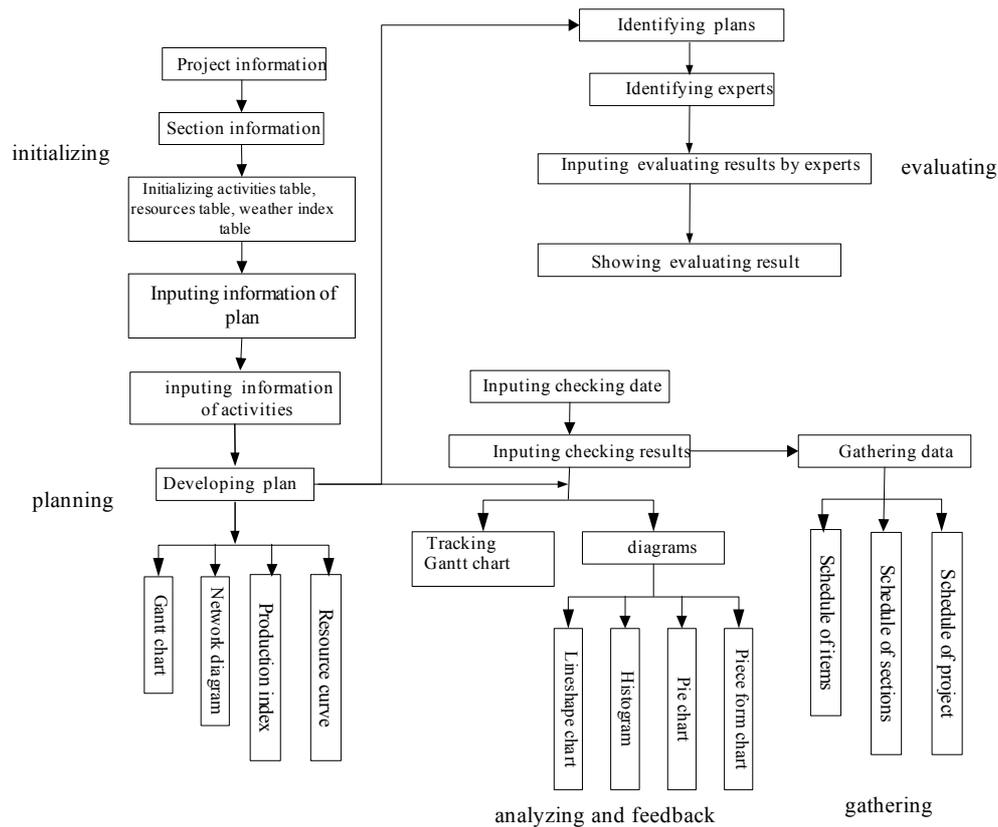


Figure 3. Flowing Chart for Time Management System

## 5. APPLICATION STATEMENT

The Lin-Chang expressway is located in Hunan province ,China. Its length is 180 kilometers, and total investment is 5,200 million RMB, and the total duration is 3 years. It is the project loaned by the World Bank. Due to the delay of the project invitation, the project starting date is delayed for 6 months. In order to finish the project within the limited project duration, the project managers used the TTM method and the time management system to manage the project progress, which have an good effect on the project. The project duration was shorten 6 months while ensuring the project quality, and its time goal is achieved.

## 6. CONCLUSIONS

Based on the theories of total quality management, this authors developed the theory of total time management. After application research on this theory, this paper

presented the total time management is a project time management method of the four fundamental characteristics: total factors management, staff management, project life cycle management, and Plan-Do-Check-Action (PDCA) cycle management.

After analyzing the system requirements for total time management, the authors developed a project time management system suitable for TTM. The system was applied to the Lin-Chang expressway management, and had a good effect. This application showed the TTM is a scientific method for the project time management, which can avoid reducing the project quality and increasing the project cost while accelerating the project progress, and have a good effect on increasing the benefit of the project investment. This method not only is applicable to the highway project management, but also is applicable to the other civil engineering.

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