

## Studies on Construction Schedule Control Technology in Engineering Projects

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### Abstract

Construction schedule management during the process of engineering management is a very important process, it will influence the whole orientation and construction quality of the engineering project, and featuring a certain dynamics in the process, it is also running through every process of engineering construction. And conducting powerful and manageable control to the construction schedule during the construction process of engineering project will not only generate great influence on the scheduled delivery of the engineering, but also generate influence on the image and benefits of the whole entity.

**Key words:** Engineering project; Schedule control; Influence factors; Guaranteeing measures

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### INTRODUCTION

Just like investment control and quality control, the so called engineering schedule control is part of engineering management, it will not only be used to guarantee the reasonable proceeding of engineering, but also can contribute to the efficient resources layout and deployment, and it is still a very important measure to reduce the engineering cost of the project,

save the cost and improve economic performance. It is also a significant measure to guarantee the scheduled delivery of the engineering, the reasonable resource supply and arrangement, as well as save the cost of the engineering.

## 1. ENGINEERING SCHEDULE CONTROL THEORY AND INFLUENCE FACTORS

### 1.1 Schedule Control Theory

The so called schedule control means a kind of action procedure to monitor, guide, inspect and rectify the entire construction process within the established time limit for the project based on the determined reasonable and efficient engineering schedule and plan in advance. And the established time limit for the project consists of occupied time of the construction action from commencement of work to the completion of works for the project. The specific targets of the time limit for the project include: The overall time limit target of the project realized in the overall schedule plan; the time limit target for the project realized by the sub-schedule plan (procurement, design, construction and so on) or the secondary schedule plan; the milestone target realized by the schedule plan in each of the stage (Ding, 2007).

### 1.2 Schedule Control Principle

#### 1.2.1 Dynamic Control Principle

The schedule control of the project is a proceeding process which is accompanying with the implemented engineering of the project during the construction of the engineering project, it is a dynamic process, but not a static process, furthermore, it is a circularly conducted process. Since the beginning of the engineering project, the schedule has entered into the run phase, which means the schedule plan has come into the stage of implementation. If any deviation occurred, it shall analyze the specific reasons

for the deviation, and take the corresponding measures and solutions, it also needs to adjust the schedule plan to make the new plan come with the practice and realize coordinated working in the new connecting points, and it shall make every effort to conduct the project according to the adjustment of the new plan.

### 1.2.2 Systematic Principle

During the process of conducting schedule control of the project, the first step shall prepare each of the plans for the engineering project, including the schedule plan. The preparation of the plan shall insist on the principle of from the big image to the detailed image, and its contents shall be based on the details from the sketch image, so as to form the overall plan system for the entire engineering project. And different constructors shall establish a kind of organizational system, and form the overall organizational and structural system for the project. As well as in order to guarantee the smooth implementation of the project as scheduled, it shall assign the dedicated person to conduct supervision and inspection to each process of the project (Bian, 2010).

### 1.2.3 Closed Circulated Principle

The overall process of the so called schedule control for the project is a kind of circulated ritual in fact, its activities constitute of preparing the plan, inspection and implement plans, comparing and analyzing, confirming and adjusting measures and rectifying the plans, which has formed a relatively closed circulated system. And the schedule control process is a continuous running process under the closed circle.

### 1.2.4 Information Principle

Information is a very important basis for the schedule control of the project. All information involved in the schedule plan of the project are delivered from up to down, to the related workers who are responsible for the schedule control and research on the detailed implemented engineering construction of the project, so as to make the plan implement and carry out routinely. However, information related to the project is feedback to each department from down to up, so as to help them make decisions and make timely adjustment, in order to guarantee the normal performance of the planned schedule time limit for a project (Xie, 2012).

### 1.2.5 Flexibility Principle

As a kind of engineering, one of the features of Xiangmanyuan is its long term time limit and with many influenced factors. In terms of the workers who are engaged in preparing schedule plan, it requires him or her, based on their own engineering experience, conducting analysis to the target of the schedule and estimate the risks of it when confirming the target of the schedule based on all kinds of possibly occurred factors and all the possibilities that influenced the schedule, so as to preserve space for the time of the schedule. And when conducting the schedule controlling of the project,

these flexible working hours can be fully used, so as to be benefited for the adjustment of the connections of all the works, and to make the project realize its own time limit target timely.

### 1.2.6 Network Plan Technical Principle

The network planning chart can be used not only to establish schedule plan target, but also can be applied to the optimized design, designing and management of the schedule plan. As a science course, networking planning can not only realize the scientific management to the schedule, but also a very efficient measure to the schedule plan control of the engineering project, especially in the relatively complex large-scale schedule control of the project, its strengths are more obvious.

### 1.3 Schedule Control Measures

The schedule control measures of the engineering project will decompose the target of the time limit for the Project Contract layer by layer, guided by the circulated theory, it will often conduct comparison between the practical values with the target value, so as to adjust the measures timely, as well as coordinating the relations of the schedules among different contracted units.

### 1.4 Schedule Control Methods

The schedule control of the engineering project is a very complex, overall work with higher integrity. This is just because each link implemented in the schedule of the overall time limit will do affect the schedule plan of the project. Therefore, we must implement a certain method in each area so as to facilitate the control of the schedule. Making use of systematic engineering management methods, preparing network plan is just an initial point, and the key points are how to conduct controls according to the timeline of the schedule, so as to guarantee the realization of the plan. In order to realize this target, the schedule control methods carried out include the following:

(a) It shall enhance the organizational management. From the aspect of time arrangement, the network plan is very compact, it requires mutually coordinated working of the engaged constructors and the managers. In order words, it shall arrange the workforce, materials and machines uniformly through setting out from the overall entirety, and it shall become the papers that must be obeyed by all the engineering workers in organizational structures, so as to create favorable conditions for the implementation of the network plan.

(b) In order to guarantee the realization of the overall target, it shall conduct control to all the sub network plans which are emphasized by the time limit. Furthermore, it shall determine the related duties strictly, and set out the comprehensive controlling methods for the overall target, phase target and node target.

(c) The detailed implementation performance of the network plan shall be linked with the economically duty

related systems. It shall carry out layer responsibility system to the specific requirements of the network plan contents, node time, at the same time, it shall also stipulate the assessment indexes to the implementation performance during network plan. So as to make the requirements, safety, quality and civilized construction in engineering schedule fulfilled well.

(d) At present, our commonly used plan index is based on the network plan. First of all, focusing on the overall construction of the project, preparing the overall and sub network plans of the process will play an essential part in the macro control of the engineering. Secondly, with the guiding of the network plan, we can prepare the yearly, monthly and daily working targets respectively, then issued to each working group to carry out. Thirdly, during the process of implementing network plan, it must deal with the mutual relations between the labor force and the materials sufficiently. Fourthly, on the premise of guaranteeing the quality of the engineering, it shall make use of the key points of the network plan to conduct the assessment (Hu & Qi, 2015).

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## 2. INFLUENCED FACTORS OF ENGINEERING SCHEDULE

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### 2.1 Factor From the Owner

The owner will pay a tight attention to the schedule of the engineering generally for the sake of their vested interests, but their over-hastiness and harsh push will result in an effect of more haste less speed. In order to guarantee engineering schedule, the owners will shrink the time limit of the engineering at all risks, often they will not provide a very rational time limit for the project, which will make the overall engineering under the passive situation from beginning to the end.

### 2.2 Factor From Supervisor

As a supervisor, fairness and procedure are the number one belief of their works. However, at present, there are a log of supervision units take the schedule control under the quality control, and lay excessive emphasis on the quality, and they considered the schedule control the engineering to be an issue of construction capacity unilaterally, even though the supervision party has conducted control to it, the effect is not satisfied enough. And this kind of thought has made the supervision unit to release the control to the engineering schedule. According to our market survey and analysis, the current schedule control of the supervision units are all passive control at all.

The schedule under this situation will be compromised significantly. From the aspect of practical examples of engineering, the schedule control will not generate practical effect until it has conducted pre-control. At present, many supervision units have introduced many

advanced management software, such as BIM and so on. However, there are not too many enterprises that making use of electronic computer technologies to conduct supervision works, and this kind of efficient tool has not been fully exerted and given full play at all. And supervision units shall introduce more technical and skilled talents, making use of advanced management technologies to conduct adjustment and control of the schedule control.

### 2.3 Factor From Contractors

From the construction site, we know that, the technical personnel of the construction units have very weak control to the schedule control, and they even don't know how to conduct control to it. It means that, for the sake of shortage of technical personnel, it results a situation that they have no idea how to deal with many technical requirements, and it is difficult to confirm the construction scheme, even result in reworks and other serious effects, which will have advance influence to the time limit of the overall engineering. At the same time, in order to in accordance with the will of some owners, the construction units will prepare schedule plan randomly without any rational basis. Furthermore, the construction units have no clear understand to the relations between the schedule and the cost of the engineering, and they will not take the key issues of schedule control into consideration during the bidding stage of the engineering, and if any problems occurred, it will result in great loss to them, finally the engineering can't be delivered timely and such a vicious circle.

### 2.4 Other Factors

The survey and exploration data are not accurate enough, even some errors, and the geological conditions can not be reflected authentically; there are discrepancies between the drawings and the practical conditions, the coordination between the professional types of works are not close enough and so on; equipment maintenance and other unpredicted force majeure factors and so on.

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## 3. GUARANTEEING METHODS OF ENGINEERING SCHEDULE

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### 3.1 Guaranteeing Methods of Constructors

In the aspect of staff composition, it must deploy a certain percentage of engineering construction personnel, and these people shall be equipped with related experience, especially with the controlling capacity of the engineering quality, schedule, cost and other factors overall. In order to confirm the targeted time limit of the project, it shall guarantee all the required labor force, materials, machines can meet the demands of the engineering. After signing the Contract,

the chief responsible persons and the managers for the Project shall be in position timely, to prepare the construction schedule plan for the project, meanwhile, they shall contact with the local residents well, and make every efforts to create benign environment for the surrounding areas, and so as to get the understanding and supports from the local residents. Before the commerce of the project, it shall do well in the assembling of the temporary equipment and the construction preparations through combining with the conditions of the construction site, as well as preparing the construction scheme of the project. Furthermore, it shall prepare the specific guiding manuals to the key construction stages and difficulty points of the engineering, and these manuals shall be submitted to the supervising engineers for approval, these above mentioned methods can be used to cut the preparation time of the construction as far as possible, to guarantee the sooner entrance to the sites. During the construction, it shall conduct standardized construction, and conduct supervision and control according to the related specifications, and it shall also prepare yearly, monthly schedule plans in accordance with the quality management standards. Through arranging the work procedures reasonably, it can realize paralleled and smooth construction, so as to accelerate the construction schedule. Under the guiding of the reasonable construction organization and scientific works, it shall arrange the work procedures reasonably, and realize paralleled and smooth working, and so as to accelerate the construction schedule. It also requires establishing analyzed meeting system, the construction procedure shall be analyzed by the meetings, and carry out the corresponding measures through analyzing each construction procedure, it shall grasp the key works, scientific arrange can make use of the adjustable time schedule to accelerate the construction schedule. At the same time, the management department shall make full use of the adjustment effect of the economic leverage to mobilize the working activities of the wide engineering personnel efficiently (Guo, 2014)

### **3.2 Guaranteeing Methods of Construction Materials**

In order to guarantee the smooth proceeding of the engineering, it shall prepare all the required materials and components ahead of the schedule, and do the acceptance works of all kinds of materials, to guarantee the quality of all the products. According to the schedule plan of the engineering, the construction units shall issue material purchasing documents and make further notification. So that when signing the purchasing contract, it shall also clearly explain the delivery time and place except for the requirements of the quality.

During the practical engineering, some of the required materials are provided by the construction units, and

these materials are very easy to pre-controlled, such as the specification, color, textures of the materials, if the construction units thought it is not in conformance with the practical engineering, it shall coordinate and communication with the construction units to replace timely. To some products that require inspection by the authorized departments, such as the fireproof doors, flame resistant materials and so on, it shall not be used until they got the inspection reports of some departments, and all the works shall be pre-arranged to guarantee the smooth proceeding of the engineering (Hai, 2012)

### **3.3 Guaranteeing Methods in Construction Machines**

The influence of construction machines of the engineering to the construction schedule is also significant, such as the tower crane, the working of the tower crane will generate influence on the schedule of the overall construction. Hence, to the tower crane at the erecting of the foundation to the assembling of the tower crane, it requires dedicated responsible person to conduct site supervision. And all the used equipment shall be inspected by the inspection department, and the operators shall be equipped with work license and tower crane operation license and so on. The construction units shall carry out post responsibility system, carry out strict requirements and implement according to the operation specifications, so as to guarantee the safe and smooth proceeding of the overall engineering.

### **3.4 Guaranteeing Methods of Construction in Winter and Rainy Seasons**

Before entering into the winter construction period, it shall prepare winter construction plan first; for example, the procurement of winter construction materials, temperature control and so on. The welding works of reinforcing steel bar components shall be carried out indoor, and the construction to the concrete engineering shall use anti-freezing agent that is specified by the specifications, and the machines, equipments shall do anti-freezing treatment, such as adding anti-freezing agents and so on, the concrete after pouring shall conduct post processing, such as covering by heat preservation films etc..

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## **CONCLUSION**

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The Schedule control of the engineering project is the key that influence the time limit of the project, but also related to the scheduled and smooth delivery of the overall engineering, as well as the economic benefits of the construction enterprises, on the premise of guaranteeing the quality of the engineering, it shall carry out suitable methods to optimize the targets of the schedule, and conduct schedule control, so as to generate better economic benefits, as the construction

units, it shall pay more attention to the influence of the schedule control, and the supervising units shall learn how to optimize the time limit for the project, and make use of the management software to improve their service level.

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