

Research and Application of Task Matching Oriented Personnel Scheduling in Construction Industry

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Abstract: in the Construction Process of Engineering Project, a Lot of Personnel Scheduling Problems Are Involved. Reasonable Personnel Scheduling Can Not Only Maintain the Efficient Cooperation between Construction Personnel, But Also Save the Cost of Personnel Scheduling and Avoid Resource Waste, Which is of Great Significance to the Progress and Cost Control of the Project. in This Paper, an Integer Programming Model is Established to Minimize the Scheduling Cost, Taking the Scheduling Problem of Construction Project as an Example, Considering the Overtime Time Limit of Construction Personnel and the Flow Limit of Construction Personnel in Each Planning Stage. Using Operation Research Optimization Software Cplex to Solve the Problem Quickly and Accurately, an Efficient and Feasible Personnel Scheduling Scheme is Obtained, Which Provides Decision Support for Construction Management Personnel.

1. Introduction

The Construction Industry is a Labor-Intensive and Capital Intensive Industry, Especially in the Construction of Projects under Construction, Which Requires a Large Number of Construction Personnel to Participate. the Salaries of Construction Workers Are Often Paid on a Daily Basis. According to the Requirements of the Project Schedule, the Project Team Shall Determine the Number of Employees in the Next Stage in Advance and Carry out the Inter Project Work. the Allocation and Flow of Personnel and the Continuous and Efficient Development of the Project Will Not Only Affect the Control of Project Progress and the Labor Cost of Cost Management, But Also Have an Impact, So the Optimization of Personnel Plan is an Important Part of Construction Project Management. in Different Stages of Project Construction, Different Types of Construction Personnel Are Needed, Sometimes Even Coordination of Multiple Personnel is Needed[1]. for Example, in the Steel Structure Construction Project, in Order to Complete the Work According to the Construction Plan, It is Necessary to Adjust the Number of Steel Structure Personnel in Each Stage, So as to Adjust the Labor Cost and Ensure the Construction Progress. However, in the Formulation of the Current Project's Human Resource Scheduling Method, Most of Them Only Consider the Needs of the Next Stage, and Lack of Grasp of the Overall Needs of the Whole Planning Period. Therefore, Combined with the Knowledge of Construction Management, the Optimal Scheduling Plan for Decision Support is Made for Project Managers[2]. in This Study, the Problem of Dispatching Construction Workers in the Construction of Steel Structures is Put Forward, and the Optimal Dispatching of Construction Workers is Studied in Combination with the Integer Planning Method in the Operation Plan. the Main Contribution and Inspiration is to Build a Comprehensive Mathematical Model of Logistics Support for the Personnel during the Planning Period, to Fully Consider the Overtime Time Limit Necessary for the Safe Construction and the Continuity of the Project, and to Ensure That the Flow of Personnel is Also Uncertain[3]. the Objective of the Optimization is to Minimize the Planned Personnel Cost during the Period. At the Same Time, We Use Specific Examples to Verify the Appropriateness of the Model, Explain the Applicable Methods of the Application Problems, and Use the Optimization Software Cplex to Help the Construction Project Managers to Make Decisions.

2. Scheduling Overview

Since the 1990s, many researchers at home and abroad have begun to study scheduling problems to solve resource allocation problems in various fields and help operators make decisions. At present, customized simulation software, many research results project simulators, expert decision systems, etc. have been formed, but the complexity of this problem, the current research has no problem, many areas have not been covered. In particular, countries, both in theory and in practice, are relatively opposite. There are two main project management methods, one is plan review method, the other is critical path method. Of course, these two methods have been continuously and practically confirmed, but these two methods have made specific restrictions and do not consider the impact of resources and projects in terms of projects and operations[4]. In this paper, the project scheduling problem in this case is explained. The center of scheduling problem is to build and solve the model of practical problem, on the other hand, it is practical application. Of course, scholars mainly focus on two aspects. On the other hand, in the actual production, the scheduling problems such as the complexity of the object continuity, the increase of uncertainty, the increase of constraints, the small multi-level, nonlinear and so on are abnormal. Complexity makes modeling more and more difficult. At the same time, its solution has been greatly improved[5]. Since the early 1990s, neural networks and genetic algorithms have been greatly improved in the field of production scheduling. In recent years, many optimization algorithms, such as tabu search, evolutionary strategy, decomposition, ant colony and so on, have appeared in the academic field. These algorithms mainly provide solutions to NP hard problems. On the other hand, it is the application of scheduling problem[6]. Scheduling problem has been fully studied in theory, but each model has its own constraints, it is impossible to get rid of all the situations. Therefore, it often occurs in actual production. There was a non-compliance. At the same time, the application of scheduling is mainly concentrated in the fields of hospital scheduling, production scheduling, traffic scheduling and military operations, and the application is not widespread enough. The research on personnel scheduling in projects is the field of various scheduling problems. At present, there are few researches on personnel scheduling. Based on the overall situation of import scheduling, this chapter introduces several aspects of personnel scheduling, production scheduling, project scheduling and personnel scheduling.

3. Scheduling Research Status

Generally speaking, project scheduling is a relatively broad concept. In daily production and life, many problems can be abstracted into project scheduling problems. As mentioned above, production scheduling problem can also be regarded as a kind of project scheduling problem, including nurse scheduling problem, traffic problem and so on.

Table 1 Steel Structure Installation Personnel Demand Plan

Planning period (month)	January	February	March	April	May	June
Number of people	4	6	7	4	6	2

Table 2 Personnel Scheduling Scheme in the Planning Period

Planning period (month)	January	February	March	April	May
Actual number	4	6	6	4	3
Number of participants at the beginning of the month	1	2	0	0	0
Number of departures at the end of the month	0	0	2	0	1
Shortage of staff	0	0	1	0	2
Redundant personnel number	0	0	0	0	1

4. The Idea of Personnel Scheduling Problem with Task Matching

The essence of maintenance personnel scheduling is the process of determining task allocation in stages. In order to carry out maintenance work, each phase allocates corresponding maintenance personnel. In order to maximize the quality and quantity of maintenance work, the maintenance

matching of tasks is maximized in each stage. Complete the question. The arrangement of dispatched personnel and the maintenance of the project are considered as complex matching problems in different stages. That is to say, the maintenance working time is the demand for different abilities of the staff, and the maintenance staff should have the abilities needed for the work. Therefore, for the problem of logistics support of maintenance leader, a single maintenance project leader can take task decomposition, analysis of qualification conditions and capability conditions of each task, and initial analysis of task qualification for screening[7]. Match the ability of employees to meet the needs of maintenance tasks. In this way, the maintenance scheduling problem can be transformed into a multi-stage maintenance problem through the integration of requirements and capabilities. The model established in this paper provides a solution to the maintenance scheduling problem of civil aviation from the point of view of maximum demand capacity matching. Maintenance process is a process that generates value through the participation of maintenance requirements and maintenance personnel capabilities. The idea of matching is based on the individual requirements of maintenance. Firstly, the maintenance requirements are analyzed. Then, in order to meet the conditions, determine the maintenance quality and standardize the ability conditions, the qualification and ability of the maintenance personnel should cooperate with the specific category[8]. In addition, in order to ensure the reasonable structure of maintenance personnel and effective collaborative process, matching is carried out to the maximum extent.

5. Construction Process

In the process of civil engineering, it is necessary to adjust and control the scheduling of five elements, including manpower, capital, material machinery and construction methods. Among them, human resource scheduling is one of the most difficult scheduling problems. In addition to ensuring project schedule and cost management, human factors should also be considered. At present, the research on the humanistic effect of construction projects mainly focuses on multi project, multi skill and multi-purpose humanistic scheduling[9]. In order to minimize the cycle of chemical industry and ensure the balance of resources, Liu taimen et al constructed the time cost optimization model under the condition of limited human resources, and applied the hybrid genetic algorithm to solve the problem. Younidari et al. Studied the optimal scheduling under different project phases and objectives, and proposed a knowledge evolution method to solve it. Julian et al. A multi-purpose optimization model is proposed. The objective of optimization is to minimize the project cycle and cost, which is suitable for the problem of transferring construction workers. The model and algorithm are verified by an example. Hdmel and others have a better understanding of the integer planning model and the optimization quality of the discovery algorithm for multi skilled human resource scheduling. The problem of project scheduling, such as bunhawawk, needs to be repeated many times, and its optimization goal is to minimize the idle time of resources. In addition, considering the fixed and variable costs related to Correia and other [7] projects, the impact of another objective function is analyzed. Therefore, this study focuses on the optimization of personnel scheduling among multiple projects and the optimization of personnel scheduling aiming at cost and scheduling. However, the construction safety and quality problems related to personnel scheduling are almost not involved. Therefore, in order to ensure the safety and quality of the building logistics support personnel's overtime time and personnel flow restrictions, considering the integral planning method in the research of driving technology optimized by CPLEX, this paper proposes the logistics support plan for the building executors. Decision support by operators

6. Case Study

This paper will use the following examples to illustrate the application of the above integer programming model in the construction project personnel scheduling, and how to accurately solve the model through ILOG cplex12.6 software. The steel structure installation is carried out in the construction of a project. It is planned to be completed within 6 months, and the number of installation workers required per month is shown in Table 1. According to the project regulations,

personnel changes can only occur on the first and last day of each month. New personnel are allowed to join on the first day and leave on the last day. Among them, each new employee needs to point out 100 yuan, and each employee needs to pay 160 yuan. If the number of workers is greater than or less than the number required, additional expenses will be incurred. The unit expenses for missing and redundant workers are 200 yuan. In order to ensure the construction safety and quality, it is stipulated that the overtime time every day shall not exceed 25% of the working time, and the number of new workers at the beginning of each month shall not exceed 3, and the number of personnel leaving the project at the end of each month shall not exceed 1 / 3. In the initial stage of the plan, there are three steel structure workers in the project, and due to the demand for follow-up work, three workers are required to remain on the project at the end of June. The goal of personnel scheduling is to minimize the scheduling cost. Run matlab on personal computer and call ILOG cplex12.6 to solve the integer programming module. After less than one minute of calculation, the optimal scheme of personnel scheduling in the planning period is obtained. The expenditure cost of personnel scheduling is 154 yuan. See Table 2 for specific scheme

7. Conclusion

This study comprehensively considers the optimization of personnel scheduling in the construction of construction projects, proposes a more comprehensive construction personnel scheduling model than previous studies, and considers the mobility restriction of personnel in the planning period. The number of new personnel at the beginning of each month and the number of personnel leaving at the end of each month must be controlled within the specified range to ensure the continuity of the project. In addition, the limitation of overtime hours is considered to ensure the construction safety. The ultimate goal is to minimize the related expenditure by coordinating the personnel scheduling during the planning period. In this paper, an integer programming model is established to express the relationship between constraints reasonably, and the optimization software is applied to the field of construction engineering to realize the rapid optimal scheduling of project personnel. This research takes the common steel structure construction personnel scheduling problem in the construction as an example, uses the operational research method to realize the personnel optimal scheduling within the planning period, which is helpful to promote the application of operational research in the construction field and provide decision-making basis for the project cost control.

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