

Research on Time-scaled Process Diagram Driven System of System Project Schedule Management System

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Abstract: The logical relationship between the works of the system of system project is complex, and the process and schedule need to be adjusted frequently, which poses new challenge to the rapidity and accuracy of schedule adjustment. This paper analyzes the needs of system of system project schedule management including compatible work break structure(WBS) framework, multi-level WBS cooperative decomposition, multi-role schedule monitoring, time-scaled process diagram driven schedule update. The project process and schedule management system is developed, which includes 6 main function modules, time-scaled process diagram template module, time-scaled process diagram drawing module, time-scaled process diagram publishing module, time-scaled process diagram monitoring module, schedule list module, role management module. Creating schedule nodes in the time-scaled process diagram, drawing the relationship lines between nodes, adjusting the information of schedule nodes can drive the corresponding items in the schedule list synchronously updated. The operation is intuitive and effective, which improves the efficiency of schedule management. It's an innovative practice for the system of system project schedule management method.

CCS CINCEPTS: Information systems

Keyword: system of system, project process and schedule, time-scaled process diagram

1. Introduction

System of system (SOS) is a complex giant system that integrates many independent and complementary systems according to the same goal^[1]. The schedule management of SOS project has the characteristics of agile projects^[2]. To realize the terminal strategic goal, the stage tactical schedules have the characteristics of gradualism, iteration and emergence. Gantt chart and PERT (Project Evaluation and Review Technique) are commonly used techniques for project management. Gantt chart can not intuitively show the relationship between the works, and PERT can not show the time series of works^[3]. The logical relationship between the works of the SOS project is complex, and the process and schedule need to be adjusted frequently. It is necessary to develop a schedule management system to realize the visual operation of process adjustment and update the schedule automatically, so as to improve the efficiency and accuracy of project schedule management.

2. The characteristics of SOS project schedule management

2.1 The logical relationship between the works of SOS project is complex

The characteristics of SOS project are opened structure, coordination system, diversity of system types, independence system functions, composition evolution, and capabilities emergence^[4].The research contents style of SOS project is wide, including basic theoretical research, technology development, product designing, software and hardware system development, digital or semi-physical test, equipment test, etc. The relationship between above works, input and output, supply chains are all complex. It can be gradually clarified with the deepening of research in the whole life cycle of the project.

2.2 The process needs frequent adjustment

In the SOS project, users need participate all the development process including designing scenarios, building equipment systems, establishing system indicators, measuring system indicators, evaluating capability improvements, product designing and capability verification^[5].Users may iterate the process according to their satisfaction, which brings the process and schedule frequent adjustment. The adjustment cycle is different from traditional space project which takes years, seasons and months, it may be shortened to weeks or days. The frequent change brings new challenge to the project process and schedule management.

3. SOS project schedule management demand analysis

3.1 WBS framework with strong compatibility

The WBS framework of SOS project needs to be able to apply to multiple units, multiple development stages, different types of research results, and different functional departments, and support the adjustment of the WBS framework as needed during the development process.

3.2 Multi-level WBS cooperative decomposition

Multi-level WBS decomposition need to be supported, multiple departments need cooperative form a WBS tree. The level of WBS can be set as needed, the middle levels can be virtual, but the bottom level must be a specific work, not only limits start time, finish time, department in charge, but also the result form, person in charge.

3.3 Multi-role schedule monitoring

Different departments and roles need to monitor the schedules they are responsible for. Department leaders are concerned about their department's schedule state, and individuals are concerned about their own. The schedule state can be visually monitored by drawing a time-scaled process diagram.

3.4 Time-scaled process diagram driven schedule update

Schedule nodes can be created in time-scaled process diagram, then drawing lines between the nodes can definite the time relationship. All level schedule nodes can be displayed, and the historical data of the schedule list can be introduced in. Once the information of the schedule

nodes are adjusted in the time-scaled process diagram, the corresponding items of the schedule list can be synchronously updated. The schedule nodes and relationships created in schedule list can also be automatically drawn in time-scaled process diagram (Figure 1).

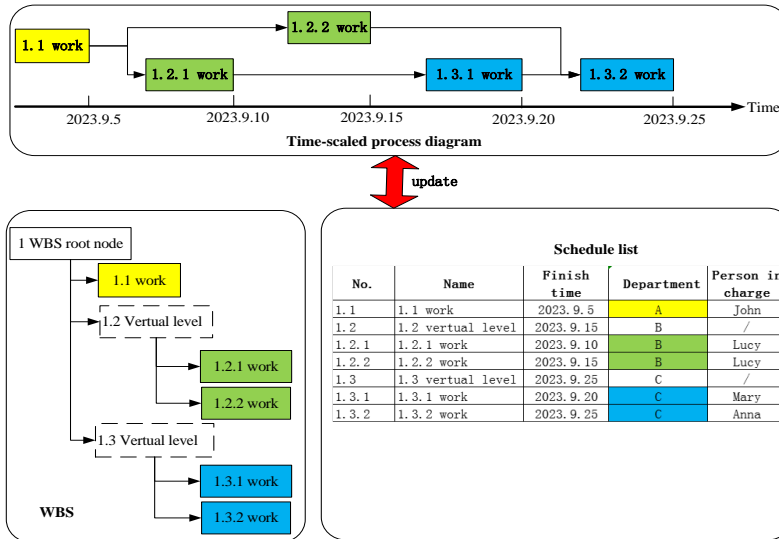


Figure 1 Time-scaled process diagram driven schedule management

4. The project schedule management system

The project schedule management system is developed, which includes 6 main function modules, time-scaled process diagram template module, time-scaled process diagram drawing module, time-scaled process diagram publishing module, time-scaled process diagram monitoring module, schedule list module, role management module (Figure 2).

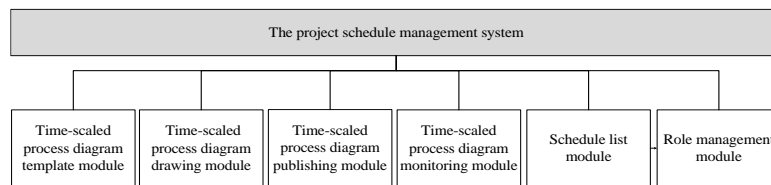


Figure 2 The project schedule management system modules

1) Time-scaled process diagram template module. Time-scaled process diagram can be drawn referring to the template. The new template can also be added to the module database as project knowledge. In the time-scaled process diagram, a rectangle is usually be used to present a schedule node. The shape and color can be used to distinguish different departments in charge. The horizontal axis is the date .The position of the schedule node on the horizontal axis represents its finish time. The next level process diagram can be accessed by double clicking the WBS virtual level node. Figure 3 is time-scaled process diagram drawing software interface.

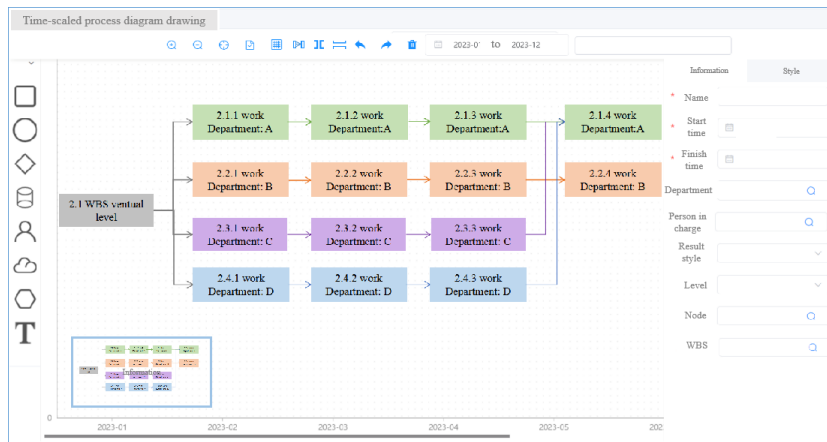


Figure 3 Time-scaled process diagram drawing software interface

2) Time-scaled process diagram publishing module. After drawing time-scaled process diagram, the added or adjusted schedule nodes and relationships can be updated to the schedule list by publishing function. If the schedule nodes that are not associated with the WBS, they would be created under the WBS root node by default after publishing. If they are associated with the WBS, they would be generated under the corresponding WBS node. If the schedule node already exist in the schedule list, it will be checked whether the information has been changed. If no change is made, nothing adjusted. If there is any change and the schedule node state is delivered, it needs to go though the adjust program, then update after approval. If change happened and the state is undelivered, it is necessary to judge whether the creator of the schedule node, if yes, adjustment is allowed, otherwise it is not allowed to adjust. If the state is completed, it is also not allowed to adjust. Figure 4 is publishing rules flow chart.

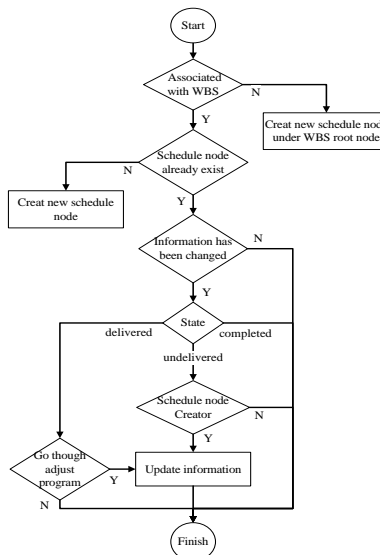


Figure 4 Time-scaled process diagram publishing rules flow chart

3) Time-scaled process diagram monitoring module. The time-scaled process diagram can display the state of the schedule node through different colors lights, including unstarted, undecomposed, going, uncompleted, overdue completed (Figure 5).



Figure 5 Time-scaled process diagram monitoring software interface

4) Schedule list module. Schedule list is a list of all the schedule nodes (Figure 6), which are also the WBS bottom level works. Schedule node can be created here or in the time-scaled process diagram then be published here. The system will send each schedule node's work to the person in charge, and update the node's state in time.

No.	Warning	Name	Status	Start time	Finish time	Department	Result style	Person in charge
1		1 virtual work	■	2023-01-02	2023-09-23	A		
2		1.1 work	■	2023-01-02	2023-01-13	A-1	Document	John
3		1.2 work	■	2023-02-02	2023-02-19	A-1	Document	John
4		1.3 wokk	■	2023-03-09	2023-03-24	A-2	Software	Linda
5		1.4 work	■	2023-05-03	2023-05-05	A-2	Software	Mary
6		1.5 work	■	2023-05-03	2023-05-05	A-2	Software	Mary
7		1.6 work	■	2023-06-08	2023-06-11	A-3	Software	Lucy
8		1.7 work	■	2023-06-01	2023-06-11	A-3	Document	Lucy
9		1.8 work	■	2023-07-07	2023-07-25	A-3	Software	Anna
10		1.9 work	■	2023-09-01	2023-09-04	A-3	Document	Anna
11		1.10 work	■	2023-01-02	2023-09-23	A-3	Software	Susan
12		1.11work	■	2023-07-05	2023-07-26	A-3	Document	Diana

Figure 6 Schedule list software interface

5) Role management module. For different roles such as project manager, quality manager plan manager, technical department leader, and engineers , the browsing and operating rights

of the time-scaled process diagram can be set. Each role can draw own schedule nodes in a time-scaled process diagram, and can also authorizes others to view, so as to realize multi-role and multi-perspective monitoring and management of the project process and schedule.

5. Conclusion

There is a challenge to adjust process and schedule rapidly and accurately for SOS project. The Schedule management system is developed. By creating schedule nodes in the time-scaled process diagram, drawing the relationship lines between nodes, adjusting the information of schedule nodes can drive the corresponding items in the schedule list synchronously updated. The operation is intuitive and effective, which improves the efficiency of schedule management. It's an innovative practice for the SOS project schedule management method.

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