

Research on Control and Management of Cruise Ships Construction Schedule Plan

Yi YU, Jiawei CHEN, Zhengshan SHENG

Abstract— Progress control management plays a very important role in the process of cruise ships construction. How to improve the construction plan management level of domestic cruises ships has become an issue concerned by the industry. By analyzing the status of cruise ships construction plan management at home and abroad, this paper draw up the construction schedule plan suitable for domestic cruise ships, and study the possible deviation in the cruise ships construction schedule. By using the method of network plan graph, the causes of deviation were analyzed and solutions were proposed, so as to ensure the construction schedule of cruise ships.

Index Terms— Cruise ships; Schedule management; Deviation analysis

I. INTRODUCTION

China's cruise market has been developing rapidly since 2006, and various coastal cities have started to transform from cruise tourism to cruise industry. Faced with the extreme imbalance between supply and demand, with the conclusion of more and more joint venture agreements on cruise ships, China has entered the strategic development stage of the comprehensive cruise industry chain, which promotes the construction process of local cruise ships^[1]cars only.

With the rapid development of China's cruise industry, many new problems and challenges have emerged. In modern shipbuilding, it takes two to three times as long to build a cruise ship as it does a ship of the same size. The construction of cruise ships is a systematic engineering with cross-operation of multiple specialties, which requires cooperation and cooperation of several companies. About 70% of the project quantity of cruise ships is provided by various partners, and the coordination of progress control among various departments has become a difficult problem for shipyards to solve^[2,3]cars only Under the tight construction period, the shipyard needs to make overall planning and reasonable arrangement for each subcontractor and supplier to ensure the consistent construction progress of the cruise ship. In the cruise ship construction process, cabin construction and installation cycle accounts for about two-thirds of the ship. This means that the construction and installation schedule of cruise cabin is the most important task in the progress management of cruise project. How to coordinate the progress plan of main hull and prefabricated installation and how to control the errors in the plan is very important^[4]cars only.

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II. STATUS ANALYSIS OF CRUISE SHIP CONSTRUCTION SCHEDULE CONTROL

A 10-ton ship in Germany mayer shipyard process is divided into about 70 total section, they are built using the total period of pattern is very common in the cruise ship building, and the cabin with built-in is separated from the main hull construction, widely used unit modular integral precast technology, which is in addition to the cruise ship engine room area and some advanced cabin to production at the scene, the vast majority of cabin adopts specialized facilities and standardization construction process[5]cars only Similarly, take the German mayer 100,000-ton cruise ship as an example, more than 1000 cabin modules have almost completed all outfitting work before lifting into the main hull. In order to improve the utilization rate of the dock, the foreign shipyard general strict control cabin module construction and installation work, such as Italy Finn candy shipyard, shipyard and Germany mayer require all the outfitting cabin, denso, after the completion of the painting work can enter the dock with stage, at the same time at this stage before all accommodation module after the assembly test and functional check all kinds of equipment, to ensure that the set aside circuit piping system such as the side into the tank installation process can be smoothly connected to main hull manager system[6]cars only The entire control process greatly reduces the number of hoisting times, and greatly shortens the dock cycle, thus improving the efficiency of cruise ship construction. For shipyards, modular construction technology is the comprehensive embodiment of construction and management technology[7]cars only Shipyard in China most of the successful experience of building cruise, for prefabricated tank type module built no mature system of streamline, so reference foreign cruise shipyard management model, and then combined with their own characteristics, and other similar domestic shipyard hull form mature management experience, the formation of construction project management system applicable to domestic cruise liner is feasible.

III. CRUISE SHIP CONSTRUCTION SCHEDULE MANAGEMENT AND PROCESS CONTROL

A. Features of Cruise Ship Construction Schedule Management and Control Simulation Target

The construction work of cruise ships is huge, the time limit is tight, and the construction schedule of shipyards is under great pressure due to the cross-operation of multiple majors. In the face of such factors as long time continuous operation, complex construction process, delayed information transmission of multiple professional departments, etc., it is inevitable to have problems such as work delay or disruption of the flow rhythm, thus resulting in rework. How to

effectively avoid the above problems is the shipyard has to consider in the process of cruise ship construction. Timely and accurate feedback analysis of the accumulated progress data in the construction process is the key to ensure the controllable plan. Timeliness, accuracy and dynamics are the three main control characteristics of cruise ship construction schedule control objectives and tasks.

Timeliness: huge parameter information will be generated every day in the process of cruise ship construction. If the feedback is greatly delayed, the significance of guiding the next phase of work will be lost. Cruise ship construction schedule control requires timely and accurate provision of large, medium and small schedule information and continuous feedback and guidance of construction operations, providing valuable decision-making basis for superior leaders and departments to control and manage.

Accuracy: the large, medium and small schedule, cabin installation and other plans prepared in the control process of cruise ship construction schedule, as well as the start, completion and adjustment time of various statistical work, all require accurate records. If the data statistics are not accurate, the state control reflected in the cruise ship construction schedule will be deviated from the reality directly, and even lead to the false advance or delay of the schedule, which will lead to decision-making errors. Similarly, if the preparation of the control plan is not accurate, the control management of each segment node will lose its benchmark.

Dynamic: as the project progresses, the parameters of each schedule node of the cruise ship construction are constantly changing, and the composition of the schedule planning control system is also changing in real time. The process of schedule planning control needs to continuously adjust the deviation between the actual construction progress of the cruise ship and the planned target, so that the construction process is always in a controlled state. This requires dynamic control of the cruise ship construction schedule, which also indicates that the cruise ship construction schedule is not a one-time work, but a whole-process construction management.

B. Establishment of Cruise Ship Construction Schedule Planning System

The cruise ship construction schedule can be controlled from multiple perspectives. Different participants will prepare control plans of different levels, functions and nodes to meet different requirements in the cruise ship construction process.

The task of the shipowner's schedule control is to control the progress of the whole cruise construction project implementation stage, including the design preparation stage, the design stage, the construction stage, the material purchase stage, and the work progress of the pre-operation stage.

The task of the designer's schedule control is to control the design schedule according to the requirements of the design task commission contract, which is the obligation of the designer to fulfill the contract. The designer shall, as far as possible, coordinate the progress of the design work with the progress of construction and material procurement. Drawing plan is the basis of the designer's progress control and the owner's control of the design progress.

The task of schedule control of the builder is to control the construction schedule of the cruise ship according to the requirements of the construction contract, which is the

obligation of the builder to fulfill the contract. In terms of the preparation of the schedule plan, the builder shall, depending on the characteristics of the project and the needs of construction schedule control, prepare the schedule plans of controlling, guiding and implementing construction at different levels and schedule plans according to different planning cycles.

The task of purchasing and supplier's schedule control is to control the speed of purchasing and supplying according to the requirements of purchasing and supplying contract. Procurement and supply schedule should include procurement, processing and manufacturing, transportation, etc.

C. Schedule Control of Cruise Ship Cabin Prefabricated Modules

Cruise ships started late in China, which is an emerging field. Compared with other ships, the cost is more expensive. In the future, the market may gradually turn into a competition for cost and efficiency. For cruise ship construction, it is necessary for each shipyard to prepare its own prefabricated cabin unit assembly platform in order to control the progress of the prefabricated module of cruise ship cabin. Through the sheet assembly line and unit assembly platform of the shipyard, the mass construction of prefabricated cabin can be greatly accelerated, and the traditional slipway assembly can be changed into integral installation in the workshop, which not only improves the working conditions of the staff, but also effectively reduces the working intensity. The mass production of prefabricated cabin is unified stored and transported, and finally lifted into the cruise ship, forming a nearly standardized construction and installation mode, which can shorten the overall construction cycle of the cruise ship. Figure 1 shows the cabin construction and installation plan control procedures.

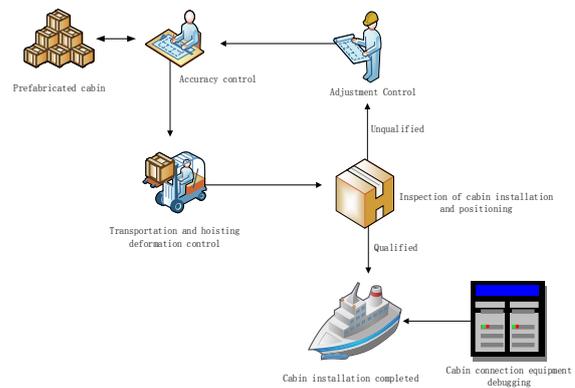


Figure 1 cabin construction and installation plan control program diagram

IV. THE CONTROL PROCEDURE OF CRUISE SHIP CONSTRUCTION SCHEDULE

The development of standardized process control procedures can effectively control the cruise ship construction schedule. There are two types of control procedures that play a leading role in the process control of cruise ship construction schedule planning, one is the management behavior control procedure, and the other is the index control procedure. These two procedures are not only relatively independent and mutually restrictive, but also interrelated and complementary.

A. Management Behavior Control Procedures

Management behavior control, in other words, from the perspective of managers themselves, the management behavior of the relevant departments should meet the pre-determined procedural requirements. The first step is to determine whether the progress plan management system established by the shipyard can effectively control the process of the formation of progress data. The second step is to investigate whether the system is in the state of effective operation. This can be expanded in three steps:

- 1) Establish the review organization and procedure of cruise schedule management system. The establishment of cruise ship schedule management system is to meet the needs of shipyard's own development. The operation quality and efficiency of different professional departments of a shipyard are often not completely synchronized for the same project. How to balance the control deviation between each other is a factor to be considered in the management behavior control procedure. The shipyard needs to establish the review organization and procedure of the progress plan management system, gradually implement the cruise ship construction progress plan operation, and review and summarize regularly.
- 2) Regular target assessment. In the process of cruise construction progress control and management, the responsibilities of the post personnel of relevant departments and the node data to be collected should be reflected in the plan document, and the content should be true and accurate. Evaluate whether each person performs the management duties according to the specified requirements, compile the corresponding inspection list according to the corresponding content, and assign a special person to sort out and file the inspection list.
- 3) Formulate plans and correct deviations. Analyze the causes of the progress deviation from the perspective of the managers themselves, and whether the procedures and standards of the cruise ship construction plan are strictly implemented. The shipyard should timely analyze the problems found in the progress inspection, and then take corresponding plans in accordance with the shipyard's own conditions.

B. Index Control Procedures

It is the key to manage and control the cruise construction schedule whether the target of schedule node can be achieved or not. Cruise construction schedule management indicators are controlled as follows:

- 1) Control the large, medium and small schedule node plans of cruise ship construction. Control the schedule plan and cabin installation plan of the segments of the cruise ship, coordinate the hierarchical relationship between each other and the overlapped operation relationship, form the report data of each stage, count and analyze the completion progress of each node.
- 2) Identify the deviation and analyze the reasons. It is extremely difficult for the node data of each stage to be completely synchronized with the intended target. By comparing the actual occurrence with the target plan, the location of deviation is identified and whether the deviation is within the controllable range is analyzed.

- 3) Plan adjustment and correct deviation. Analyze the impact of the deviation and whether it will cause the construction of the cruise ship to deviate from the established plan. If the deviation is within the controllable range, it is ok to adopt the means of fine tuning; if the deviation is beyond the controllable range, the schedule should be adjusted according to the actual situation.

Figure 2 shows the phased progress index control procedure in the cruise ship construction process.

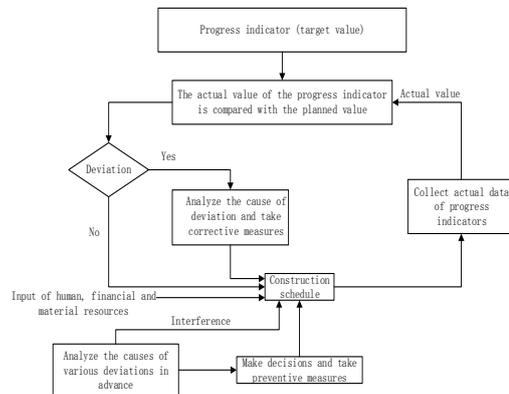


FIG. 2 progress indicator control program diagram

V. DEVIATION ADJUSTMENT OF CRUISE SHIP CONSTRUCTION SCHEDULE

In the process of cruise ship construction, large progress deviation needs to be adjusted in time. There are many angles and directions to be adjusted, such as organizational measures, technical measures, economic measures and management measures. The process of schedule adjustment is the process of continuous adjustment of deviation. To accurately and effectively control the deviation, it is necessary to control the whole process of cruise ship construction and work hard on key sections and processes.

Compared with gantt chart, network plan chart is a common method to compile the project schedule plan. Compared with gantt chart, the logical relationship between the processes in the cruise construction process can be expressed more clearly, and the time limit can be easily calculated. At the same time, the key routes and key work in the cruise construction process can be determined, and the entire construction schedule can be more clearly controlled. Shown in figure 3 job classification for network plan, take a cruise in the process of building any one job, for example, you can work at the same time with the known as parallel work, the work must be completed before the work starts homework, the work is complete to start the follow-up work is called the work after work. The following are the contents and methods of adjustment after the progress deviation occurs during the construction of cruise ships.

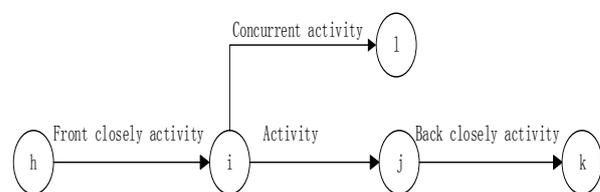


Figure 3 job classification

- 1) Adjust the length of work paths composed of key work in the cruise ship construction network plan. There are two scenarios for coordinating the adjustment of critical work in the cruise ship construction process. When the actual progress is delayed relative to the plan, the key working time that occupies less resources in the unfinished work should be compressed. On the contrary, when the progress is advanced, the critical working time which occupies more resources of the shipyard in the subsequent key work can be appropriately postponed.
- 2) The time difference can be used to adjust the key work of the cruise ship construction network plan. The work on non-critical routes does not have a decisive influence on the construction schedule of the cruise ship. Within the total time difference of cruise ship construction, the non-critical work should be adjusted to balance the shipyard resources.
- 3) Adjust the logical relationship between the pre-tightening and post-tightening work during the construction of cruise ships. Sometimes, according to the actual situation and resources on the site, it will have a good effect to adjust the sequence and logical relations of some work. On this basis, the total construction period will be recalculated to make the network diagram change within a controllable range.
- 4) Adjust the duration of some work in the cruise ship construction project. This method is similar to the first one. Under the premise of not affecting the original plan as much as possible, jobs with great compression potential are selected for adjustment, so as to make the work hour distribution more reasonable.
- 5) Adjustment of input of on-site resources. Sometimes there are problems in shipyard's on-site resources or scheduling, corresponding emergency measures should be taken to coordinate the intensity of resource utilization among various works, so as to ensure that the overall schedule of cruise ship construction will not be affected.

- [4] He Bin. Research on cruise manufacturing based on project management [D]. Dalian maritime university,2014.
- [5] Sun Chuan. Scope planning of equipment and facilities adaptive transformation project of large-scale cruise ship construction shipyard [J]. Ship engineering, 2008,40(S1):371-376.
- [6] Christopher Daniel Rose, Jenny M.G. Coenen. Comparing four metaheuristics for solving a constraint satisfaction problem for ship outfitting scheduling [J]. International Journal of Production
- [7] Wang Chengwen. Research on modern shipbuilding model [D]. Harbin engineering university, 2006.

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VI. CONCLUSION

This article through to the present condition of the cruise industry and the demand of shipyard schedule management were analyzed, and compared to cruise the similarities and differences with other ship building management process at home and abroad, from the main hull and prefabricated cabin modules installed two aspects make the cruise construction schedule management system evolution, the cruise is studied through management behavior and data index construction schedule control program, and finally through the analysis of cruise ship building possible progress deviation in the process of using network plan corresponding adjustment method is given. It provides an effective reference for further improving the domestic cruise ship construction schedule management system.

REFERENCES

- [1] Ding Weikang. Luxury cruise ship construction factory and its construction process [C] jiangnan shipbuilding (group) co., LTD.,2014:119-127.
- [2] Sun Ruihong, Wang Xuiting, Wang yainan, luo yujie, Yang gang, Ye xinliang. Characteristics and enlightenment of the application of "oasis class" luxury cruise ship technology [J]. Ship engineering, 2014,40(08):45-51+111.
- [3] Zhang Minjian, Du Yongjun, Sun Jiaweng. Reflections on developing China's cruise manufacturing industry [J]. Ship engineering,2016,38(S2):252-254.