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AN APPROACH TO SUCCESSFUL SHIPYARD PLANNING AND SCHEDULING

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ABSTRACT

Critical paths, "I-J" nodes, and activity duration are all words of the network designer. All are usually foreign to the shipyard planner, and in general, shipyard planning personnel tend to shy away from the networking approach to ship construction planning. Networking, however, can be used to plan, and subsequently schedule, the production work orders required to complete the construction of any vessel, regardless of its complexity.

The fundamental approach to successful shop production planning and scheduling using networking techniques that have reduced planning time dramatically are described.

Two basic criteria for the planning and scheduling network are "simplicity" and "accuracy". Simplicity is concerned with the creation, development, and maintenance of a production plan. Accuracy defines the manner in which the plan reflects the actual construction of the vessel in question.

This is not intended to be another discussion of some new and fabulous planning tool, or an indepth presentation of SAME theoretical concept to improve your planning department, It is to demonstrate an actual, proven approach to planning which has been used successfully on a number of vessels, and to briefly describe the techniques and software tools used in that approach.

The planning approach presented is the result of a serious, concentrated effort on the part of the planning staff of SPAR Associates, to improve the plans and schedules of SPAR's c1ient shipyards. The approach centers around a no-nonsense, pragmatic discipline whose primary objective is to produce reliable and accurate production workorders, scheduled in such a manner as to represent the actual building philosophies of the shipbuilding industry.

SPAR's planning approach continues to mature, fed by experience derived from planning all or part of six individual vessels over the past 12 months, In addition, yard generated plans for four other ships were reviewed, using SPAR's "Standard Planning Guide" as criteria for the analyses.

Most shipyards deal with a finite number and specific type of vessel that they normally bid on. Planning becomes somewhat. more direct, in that planning personnel tend to become accustomed to the exact nature of the ship, and eventually develop an informal standard for plans and schedules within that yard, SPAR, however, must deal with a larger number of ship types, and seldom gets the luxury of learning the internal workings of the client. yards. As a result, SPAR's planners bad to rep1ace the yard's planning standards with a clearly defined planning discipline to insure the integrity of their product. This discipline has become so accurate that certain client. yards have actually begun to implement. the disciplined approach in lieu of their traditional planning methodologies.

To establish a basis for successful planning, certain preliminary requirements have to be defined. In short, a "planning-plan" must exist to guide the planners through the many paths necessary to realize the full potential of their experience, use of computer tools, and the continual evaluation of the vessel. Therefore, the planning procedures must spell out such items as kick-off meetings, planning milestones, and standard documents to be prepared,

The initial development of the plan should begin as early as possible within the construction cycle of the ship. Preferably, the planning effort should begin when the initial request. for quote was presented to the yard, resulting in a schedule of the major development and construction milestones, A good preliminary plan at this stage should contain roughly 10% of the total estimated number of workpackages that will comprise the final plan, This first published schedule thus forms the backbone of the overall Vessel's direction, in that all of the yard's resources can be focused on the ship. By completing this high-level schedule within weeks of the RFQ, all departments can review their own abi1ity to perform. Engineering can view the timing of the drawing release sequence, Material can evaluate any potential delivery problems for specification items, and Management will be afforded an up-front assessment of the impact on the yard. This schedule may also contain “canned” activities to direct the development of the quote by indicating the required involvement of Production, Engineering, Material, and other departments,

Once Management decides to bid on the contract, Planning must swing into high gear to complete the detailed production schedules in time to support the construction, Here is where the discipline of planning takes its full form. Prior to start of work, Planning must prepare schedules to support drawing release, material procurement,’ shop loading, steel erection, and the full complement of workpackages required by Production. Everything must be covered,

Shop fabrication and assembly of steel and systems must be defined. Testing schedules must be ready for review by Quality Control. All construction milestones must be prepared and reviewed by Production and Management.

This approach is definitely bold, calling for planning to be in control of the yard, To realize this effort, planning must understand all of the yard’s constraints, be flexible and responsive to the needs of production, and be capable of adapting its techniques to accomodate the changing climate of the contract, driven by the customer, engineering, and the environment of the year. To accomplish this feat, the shipyard must have set policies governing planning and all affected areas subject to the planning department, The planning department must. function from strict procedural guidelines to insure that their plans are accurate and the schedules are workable. To insure this, planning must. have a discipline which must focus on the following points.

1. Individual planners, both SPAR's and the client yard's, have their own "technique" towards the preparation of the plan. Therefore, the discipline must. establish the complete guide1ines to eliminate redundant work, insure the integration of segments planned by different people, and to clearly define each person's responsibilities.

2. The resultant plan and schedule must be easily visuaiized by all departments within the yard.

3. The systems or product work breakdown structure must. be recognized, understood, and accepted by all depart.-ments within the yard,

4. The resultant plan and schedule must be flexible to allow for customer or engineering changes, preoutfit versus normal outfitting construction, recovery planning, and resource constraint. evaluation.

5, Finally, a standard "Planning Document" must. be created to provide for historical analyses, plan and schedule maintenance, and as a basis for the planning of future vessels of the same or similar type.

The planning methodology centers around the use of an "I-J" node network, After dividing the ship into standard zones, each zone is encoded into its nominal form and placed onto SPAR'S PERT-PAC system, under the Micronet library, An example of a nominal zone would be one cargo tank with activities defined to accomodate the construction of any such cargo tank. A complete cargo midbody can thus be networked by repetitive "calls" to the Micronet library to transfer in the cargo tank, changing such variably defined items as the zone number, lead steel unit number, or the user defined "increment" number. After the transfer, this tank can be customized by removing excessive activities or by adding those activities particular to this cargo tank.

The PERT-PAC system's Micronet library permits the definition of activities in terms of variables;. Thus, a workorder may be defined as a combination of ship's account, ship's zOne, and some arbitrary digit, combined for a six <6> digit workorder number. For example, an activity on a Micronet might read "AAAZZW" with an account number assignment of 248, Upon transfer of this micronet to the master network, the ship's zone and the extra digit would be specified to complete the definition of this workorder, For example, TRANSFER (12345) Z=25,W=8 would generate a workorder of

“248258”, Since subsequent transfers would reference a different. zone, no duplication of 248258 would occur.

The planning discipline insures that these zone transfers will not generate redundant or conflicting activities, by dictating the workorder numbering scheme and the I-J node numbering approach, Duplicate workorder definitions are flagged as an error and are not loaded to the master network, The discipline states that each zone placed onto the Micronet library be self-contained. Each zone construct, therefore, must contain activities for Engineering, Material procurement and control, Fabrication/Assembly, Installation, component testing, and the necessary network links to systems tests and master network control activities, such as sea trials or delivery.

While the rules for workorder and node numbering are rather detailed, the careful use of the discipline by the planning group has demonstrated that one vessel can be planned by numerous people with no problems surfacing when the pieces are integrated into a final network. Even system5 testing, which must be "fed" by numerous installation activities throughout the network, does not create a problem, since a single-activity MiCronet is Created, and its account. number is left. as a variable, 80 When a planner needs to accomodate systems tests for account 123, an additional Micronet transfer is merely coded: TRANSFER <1154893> A=123. If some other pianner has previously supplied this systems testing activity, the PERT-PAC system will reject the 1atter definition. The planner is thus assured that his required testing activity is in place, whether or not his transfer actually placed it into the master network.

Planning by zone is a very important part Of this approach. The total network picture need never be drawn. Instead, graphical presentations of the nominal zone micronets and an overview sketch of the master network provides enough visibility into the plan to make it workable. The capabilities of the PERT-PAC Micronet facility thus augments the natural planning methods associated with zone oriented production. The combination of network philosophies, the PERT-PAC computer system, and the written procedures for the planning endeavor insures that the resultant schedules are accurate, simplified, and complete.

SPAR Associates has defined a planning approach based on:

* NETWORKS - for design and visualization of the plan
* PERT-PAC - for maintaining the network and generating schedules
* DISCIPLINE - to insure accuracy and simplicity of the entire planning operation

The discipline, being the controlling element, has received the most attention in terms of development and review, While the

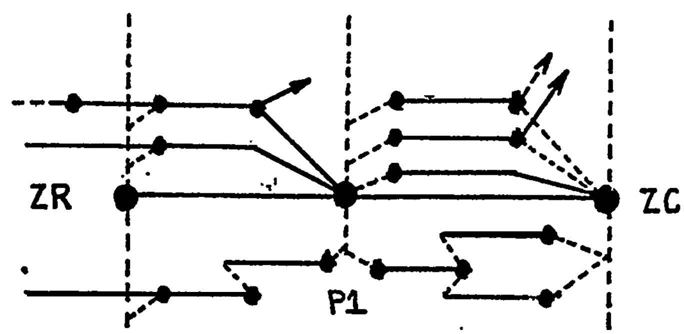
Standard Planning Guide cannot be considered complete, its COn-tinued use for planning the client's vessels provides an excellant field-testing environment,

Complete Plans

* Engineering drawings
* Material Requirements by CWBS and Zone
* Fabrication of Steel and Systems
* Assembly of Steel and Systems
* Steel Erection
* systems installation
* Testing by Zone, System, Compartment
* Major Milestones

PERT-WC Micronets

I---------------c-



* Variable Definitions

* Repetitive Use Without Duplicated Packages

* Easily Removed for Substitutions

* can Be "Cloned" for Alternative Planning

* Automatic Node Linking to Form Chains (Steel, Erection)

Standard Planning Guide: Table of Contents

APPENDICES

FIGURES

S,P,G, : Table of Contents, continued

Ship's Planning Documentation

SPAR will deliver to the client shipyard a document describing the general planning approach used, problems encountered, brief analysis of schedules, constraints encountered or used, and required maintenance necessary to support the network. The documents vary from ship-to-ship, both in context and scope, depending primarily upon the complexity of the vessel. The following outline presents the major points in the Ship's Planning Documentation.

1, Pre-Planning

A. Review of shipyard management structure

1, Planning Department
2, Production Deaprtments
3, Engineering/Drawing Office
4. Material Procurement and Control
5. Project Management

B. Observations regarding the vessel

1, Steel and systems complexity
2, Urgency of needed schedules
3, Quantity/Quality of planning done by yard
4. Extent of customer changes, past and current
5, Extent of pre-outfit installation to be done
6, Extent of pre-outfit painting to be done
7, Extent of equipment modularization to be done

C, Analysis of existing planning on this vessel

I, Strength of existing workorder numbering scheme
2, Quality of zone assignments
3. Extent of planning per-formed to-date
4, Any observable problems

II. Steel

A. Workorder identification

1. Fabrication
2. Assembly
3. Erection
4. On-ship Welding
5. Miscellaneous support

B. Micronet configuration

C. Pre-outfit "hot" and "cold" configuration, if applicable

D. Pre-outfit paint considerations, if applicable

E. Erection sequence constraints

1. Primary; build direction
2. Secondary; geographic relationships
3. Design; partial ship movement, planned delays, etc

F. Problems

III. systems

A. Workorder identification

1. Purchased items
2. Shop fabrication
3. Shop/ship assembly
4. Ship installation
5. Pre-outfit installation

B. Micronet configurations, by ship's zone

C. Installation sequence constraints

1. Supported material
2. Supported engineering
3. Steel structure; bulkheads, overheads, etc
4. Planned delays

IV. Testing

A, Zone or Unit testing

,. Workorder identification
2. Scope
3. Problems

B, Independent tank testing

1. Workorder identification
2, accuracy based on knowledge of hull structure
3, Accuracy based on required support testing equipment
4, Problems

C. systems testing

1, Workorder identification
2, Micronet configuration
3, Testing plan
4, Problems

v. Network/Schedule Maintenance

A. Change of build direction

B. Change of pre-outfit quantity/quality

C. Error detection and correction

1. Bad durations or lead times
2, bad activity relationships
3. Loops

D. Schedule problems

1, Delivery too late
2, Missed milestone dates
3. *Late* material or engineering
4. Failed tests
5, Customer changes
6. Engineering change notices

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