

**A Prototype Description of
A Shipbuilder's Earned Value Management
System**

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Foreword

There is general agreement among shipbuilders that intelligent control over basic resources (engineering, manpower, material, facilities and time) will result in improved ship construction costs.

The task of estimating costs, planning and scheduling men and materials and then controlling these resources to maximize production output, while minimizing costs, can be a very difficult job. These efforts become more complex with the increase in the size of the shipyard organization and the scope of the yard operations. Modern-day shipbuilding poses no mean management challenge.

A very basic problem has been job progress visibility, or lack thereof. Without it, management must operate blindly. Cause and effect relationships become blurred in the midst of daily shipyard production problems and drain away the capacity to direct production effectively and economically.

Knowing precisely, and in a timely manner, the exact status of men and material, a responsible management can rectify problems quickly before they become critical. Logical priorities can then be assigned to solving various impacted areas of production and ideally new techniques can be developed, simulated and evaluated to improve current yard production methods.

Most shipyards today have means for accounting and reporting job resources and schedules, but mostly employ manual methods which have difficulty in producing complete, accurate and timely information. Manual methods suffer from too much duplicated effort, and the inability to produce sufficient information quickly enough.

Introduction

This document describes an earned value system as implemented within a shipyard. It is intended to serve only as prototype description of how such a system can be installed and operated within a shipyard and the benefits it can provide to effectively manage operational costs and schedules.

The earned value system used here is SPAR's *PERCEPTION* system that has been designed specifically for shipyards and for the large part by shipyards. *PERCEPTION* is oriented around the unique business processes of the shipbuilding and the ship repair industry and adjusts easily for large and small shipyards doing either commercial and/or military work.

The discussions include not only an overview of *PERCEPTION* and its features, but also on its general use within the shipyard. There are some issues described that may apply only to government contracts where more stringent work organization and authorization is required. However, since this document is intended to serve only as a guideline, specific business rules may be made tighter or looser depending on the management needs of the shipyard.

The discussions also have a focus on shipbuilding using hull block construction methods. Other construction methods, however, also can be accommodated by the system including use of non-steel structural materials (for example, aluminum and composites) and other modular forms of component assembly.

Finally, the discussions center on the planning, use and management of labor and material resources. The system also accommodates planning, use and management of outsourced, subcontracted products and services.

1.0 Shipbuilder's Earned Value Management System

Earned value management is a tool that allows the shipbuilder to have visibility into technical, cost, and schedule progress on their contracts. The implementation of an earned value management system is a recognized function of program management. It ensures that cost, schedule and technical aspects of the contract are truly integrated.

1.1 Management Needs.

The implementation of an earned value management system (EVMS) ensures that management is provided with cost and schedule performance data which:

- (1) Relate time-phased budgets to specific contract tasks and/or statements of work;
- (2) Indicate work progress;
- (3) Properly relate cost, schedule and technical accomplishment;
- (4) are valid, timely, and auditable;
- (5) Supply managers with information at a practical level of summarization.

The EVMS also supports the effective concept of project teams designed to pull together skills of all the prominent stake holders in the successful development of interim shipyard products of hull blocks, ship zones, etc. (Figure 1.1-1).

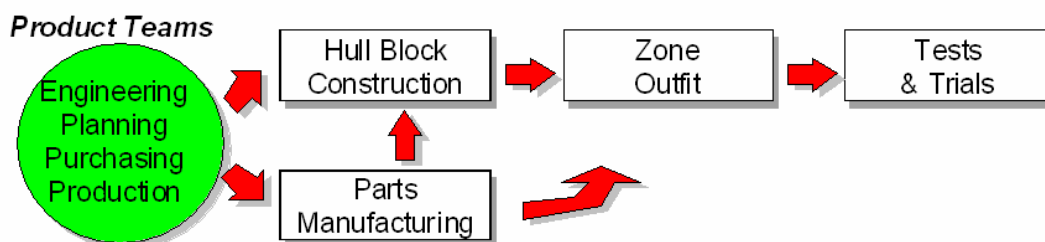


Figure 1.1-1: EVMS Supporting Successful Interim Product Teams

1.2 Criteria Concept.

No single earned value management system can meet every management need for performance measurement. Due to variations in organizations, products, and working relationships, it is not feasible to prescribe a universal system for cost and schedule control, relative to the scope of a contract. The criteria approach establishes the framework within which an adequate integrated cost/schedule/technical management

system will fit. The criteria should be applied appropriately based on common sense and practicality, as well as sensitivity to the overall requirements for performance management. The procedures described in this document provide a basis for an acceptable shipbuilder's earned value management system. This system integrates and coordinates the activities for all primary shipyard departments (Figure 1.2-1).

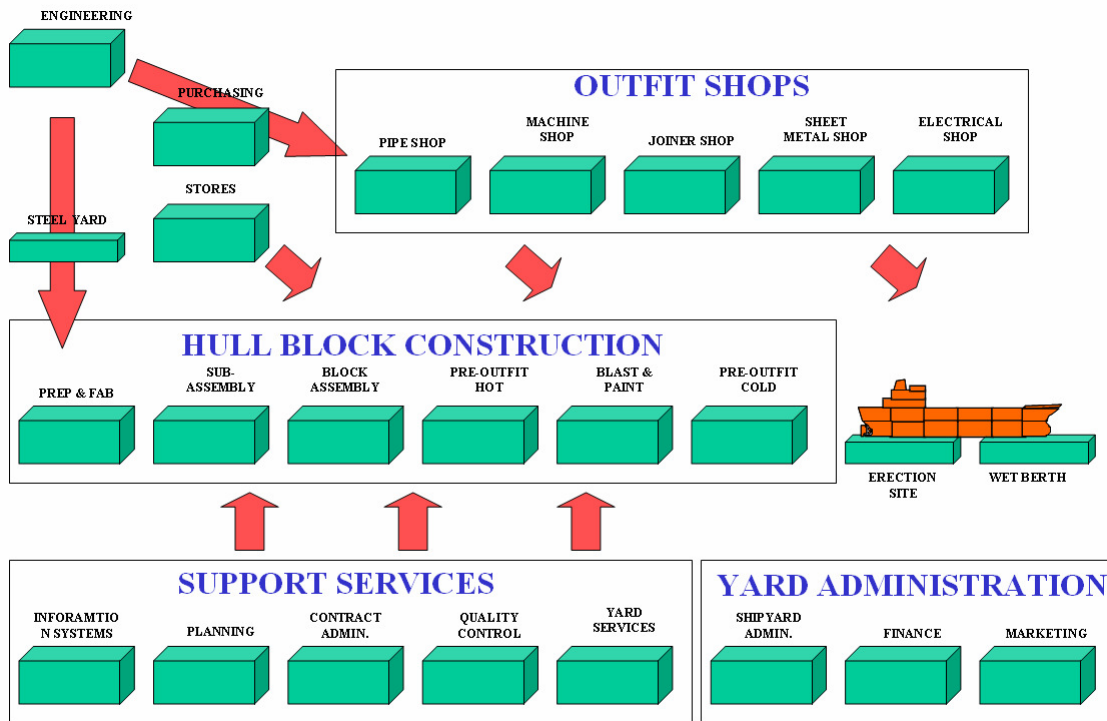


Figure 1.2-1: Integrating & Coordinating Activities across Shipyard Departments

1.3 Earned Value Management Systems

In designing, implementing and improving the earned value management system, the objective should be to do what makes sense. The management system that meets the letter of the criteria but not their intent will not support management's needs. Earned value management systems that comply with the intent of the criteria will facilitate:

- (1) Thorough planning;
- (2) Timely baseline establishment and control;
- (3) Information broken down by product as well as by organization or function;
- (4) Objective measurement of accomplishment against the plan at levels where the work is being performed;
- (5) Summarized reporting to higher management for use in decision-making;
- (6) Reporting discipline;
- (7) Analysis of significant variances; and,

- (8) The implementation of management actions to mitigate risk and manage cost and schedule performance.

These are all inherent features of a good earned value management system.

1.4 PERCEPTION

This document describes the earned value management system called *PERCEPTION*®, a system developed specifically for shipbuilders and ship repair companies by SPAR Associates, Inc., Annapolis, Maryland. *PERCEPTION* integrates the following shipyard business functions (estimating, planning and scheduling; labor and manpower cost management; purchasing and material cost management; earned value and cost/schedule management reporting (Figure 1.4-1).

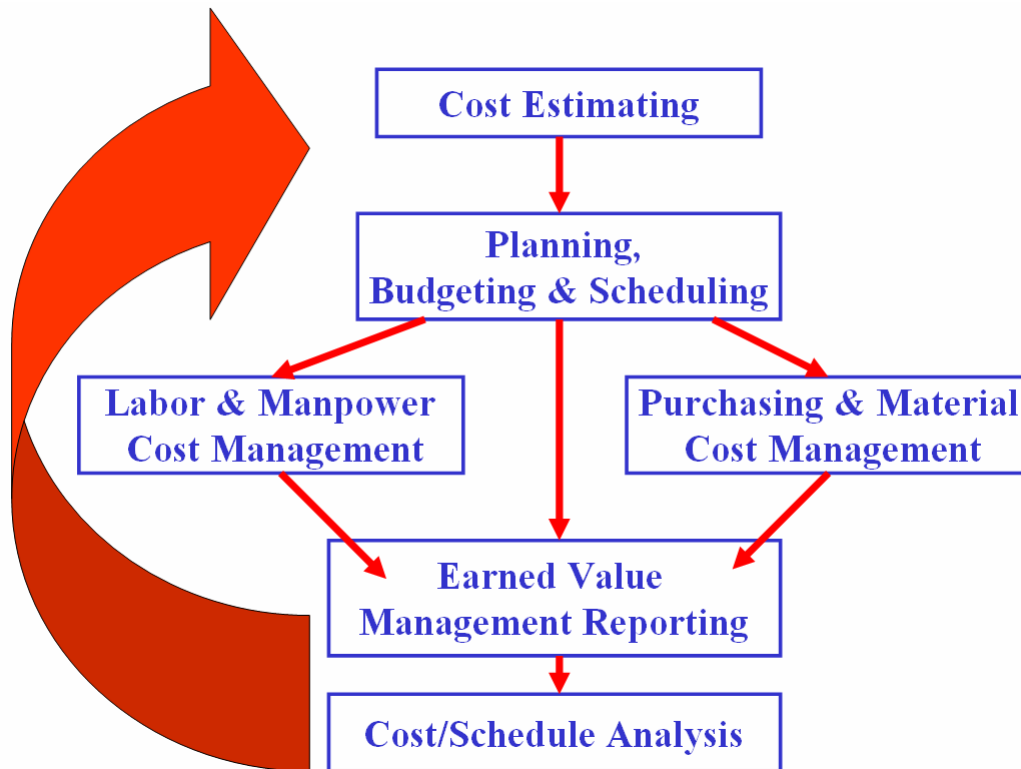


Figure 1.4-1 PERCEPTION Integrating Shipyard Business Functions

In addition, *PERCEPTION* electronically links to financial and accounting systems (payroll, accounts payable and receivable and general ledger) and with a variety of computer-aided ship design systems (Figure 1.4-2)

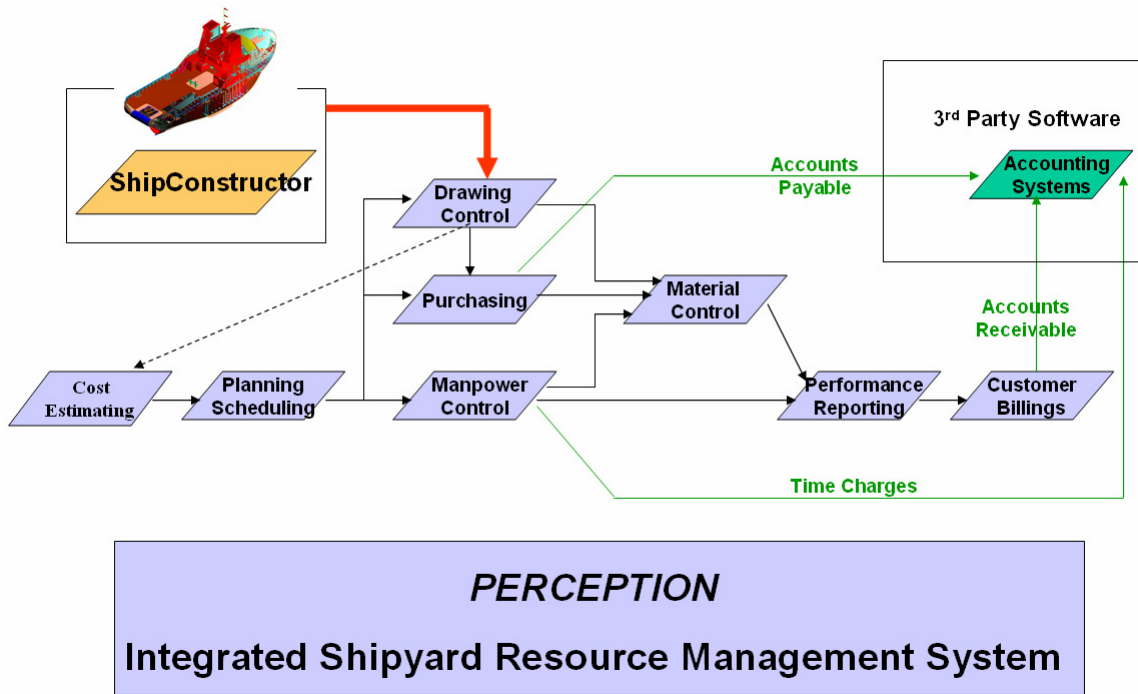


Figure 1.4-2: PERCEPTION Links to Financial & Accounting Systems and With CAD Software Products.

PERCEPTION is broken down by modules that address the basic planning and operational management needs of the various shipyard departments.

1.4.1 PERCEPTION ESTI-MATE

PERCEPTION ESTI-MATE is the computer software system component offering functions for estimating contract labor and material resource requirements. Cost estimates are developed within the bounds of the WBS and these estimates form the basis for establishing, upon contract award, labor and material cost budgets which are the corner stones for the operations of the EVMS capabilities of the *PERCEPTION* system.

1.4.2 PERCEPTION WORK-PAC

PERCEPTION WORK-PAC is the computer software system component offering a common database to many levels of management for labor performance reporting. Data flows into *WORK-PAC* from any one of a number of departments, including Engineering, Planning & Cost Control, Estimating, Production Superintendents, and from the yard employees themselves via their time charges. All time charges are accumulated against authorized budgeted and scheduled work orders that relate directly to the contract WBS/OBS.

WORK-PAC is flexible; information can be added, updated or deleted quickly and easily; the impact of changes, both proposed and actual, can be reviewed immediately.

WORK-PAC does not run the shipyard; an aggressive management team will always be required, but *WORK-PAC* does point out areas requiring management action and offers the media for simulating the effects of various possible responses invaluable for applying yesterday's experience to tomorrow's problems. It additionally performs many complex and tedious calculations and yard performance analysis quickly and easily to assist management in making appropriate and timely decisions. It is a development from actual shipyard experience.

1.4.3 PERCEPTION MAT-PAC

PERCEPTION MAT-PAC is the computer software system component offering a common database to many levels of management for material performance reporting. Data flows into *MAT-PAC* from any one of a number of departments, including Engineering, Planning & Cost Control, Estimating, Purchasing, and from the yard Stores activities.

MAT-PAC provides a full range of purchasing and material control functions:

1. Engineering drawing bills of material control
2. Materials and subcontract services requisitioning
3. Production material issue and work order pallet management functions
4. Purchasing RFQs and purchase order management functions
5. Material receiving and warehousing management functions

All material and subcontract costs are accumulated against authorized budgeted and scheduled work orders that relate directly to the contract WBS/OBS.

MAT-PAC also provides functions for managing the tool room resources.

1.4.4 PERCEPTION PERT-PAC

PERCEPTION PERT-PAC is the computer software system component offering functions for scheduling contract labor and material resources. The system is fully integrated with *ESTI-MATE*, *WORK-PAC* and *MAT-PAC*. *PERT-PAC* not only produces preliminary planned schedules directly from cost estimate information, but can be automatically updated with revised planning details for labor and material activities as they evolve over the course of the contract performance period.

PERT-PAC generates and schedules project Planning Activities using a Critical Path Method (CPM). Schedules of work orders and material requirements (requisitions) result when they are assigned to appropriate Planning Activities. Off-budget and off-schedule

performance feedback data from work orders and planned material requirements can be processed for automatic impact analysis and for re-planning purposes if that is necessary.

1.4.5 *PERCEPTION* Highlights

PERCEPTION produces complete labor and material cost/schedule reporting using earned value methods for measuring performance across a range of management interests:

- By Ship System (SWBS)
- By Ship Zone, Hull Block, Module, Assembly (PWBS)
- By Work Center (Ship & Shop)
- By Trade Category

PERCEPTION generates

- Continuous final cost projections;
- Automated progress reporting (although optional, no manual physical assessments required)
- Continuous cost/schedule variance reporting
- Automated Manpower Requirements as planned, as actually expended, and as projected to complete.
- Convenient cost/schedule modeling to show impact of future work with current work loads
- Increased performance visibility provides more control and reduced costs.

1.4.5 *PERCEPTION* Special Capabilities

PERCEPTION offers features addressing solutions to problems and situations unique to the business of shipbuilding:

- Re-work control
- Time-phased level-of-effort activities
- Distributed work orders
- Management reserves
- Premium man-hour control
- Man-hours charged after work order closing
- Indirect costs
- Undistributed budget control
- Variance reporting
- Integrates labor and material requirements, costs and schedules
- Links cost estimates with contract budgets and reserves

-
- Interfaces with various CAD systems to download detail bills of materials for purchasing and for production control
 - Interfaces with financial accounting systems for payroll, accounts payable, accounts receivable and general ledger.
 - Operates using state-of-the-art SQL relational databases, Windows-based operating systems, local area client/server networks as well as operations over the Internet.

1.5 Conclusion.

The criteria and associated reporting requirements have proved their value over many years. The criteria approach ensures that the shipbuilder has an adequate management system that integrates cost, schedule and technical performance. This approach also provides better overall planning and control discipline on all shipyard contracts. The associated cost performance reports summarize objective data from the shipbuilder's internal systems. Substantive improvements in management can be achieved by senior management and the program manager taking accountability for system effectiveness and use. A criteria compliant system, properly used, ensures that valid cost, schedule and technical progress information provide managers with an effective tool for decision making.