Planning New Construction
&
Major Ship Conversions
Using
PERCEPTION®

SPAR
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Fundamental Project Tasks

- Develop the Basic Product Structure
  - Hull Blocks,
  - Ship Zones, and
  - Equipment/Outfit Modules
- Identify Product Teams & Responsibilities
- Develop Manufacturing & Build Strategy
- Develop Management Strategy
- Execute the Plan

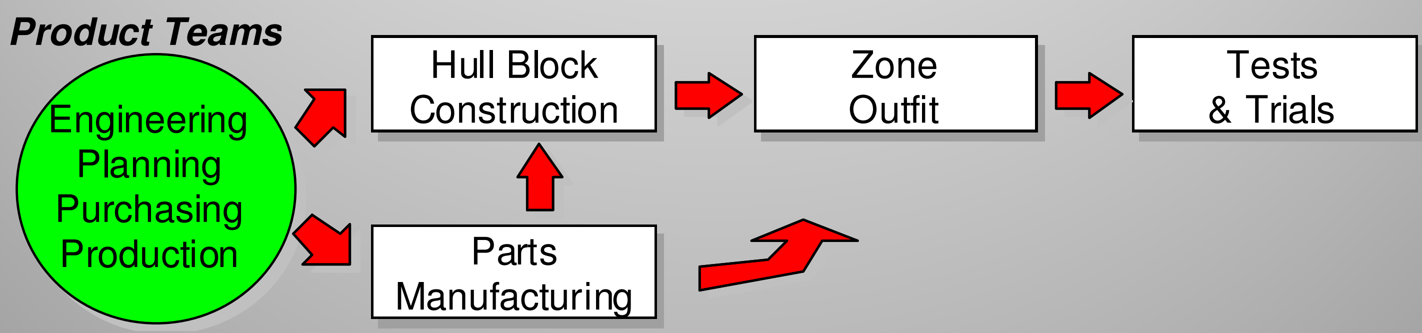
Develop
the
Production Management Plan

- Budgets (Labor & Material) & Schedules
- Work Orders & Time Charging
- Material Control & Work Order Pallets
- Technical Packages for Production
- Tests & Quality Assurance

Develop
the
Contract Management Plan

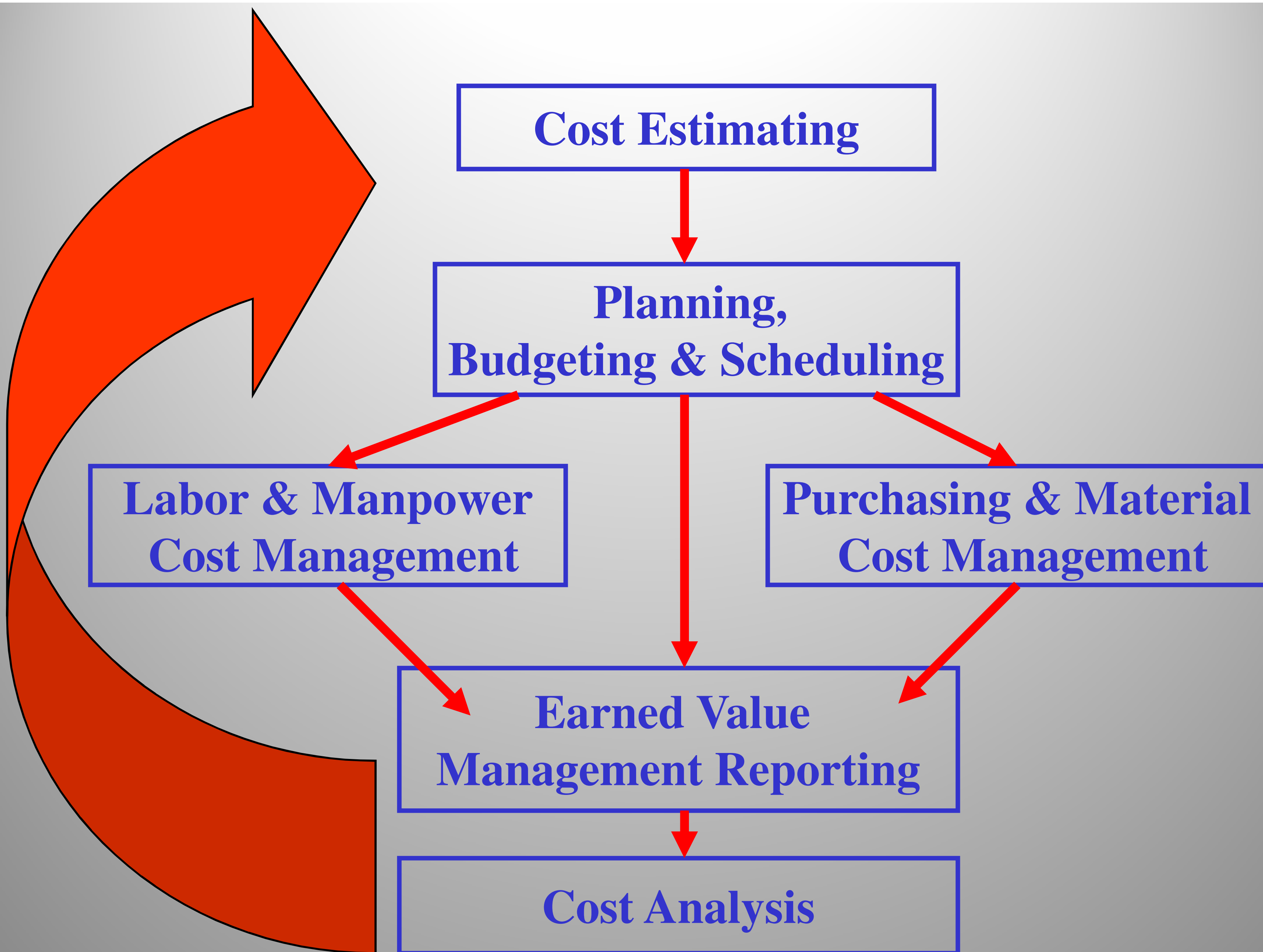
- Project Management Team
- Change Order Management
- Progress Milestones & Payment Management

Establish the Basic Building Plan

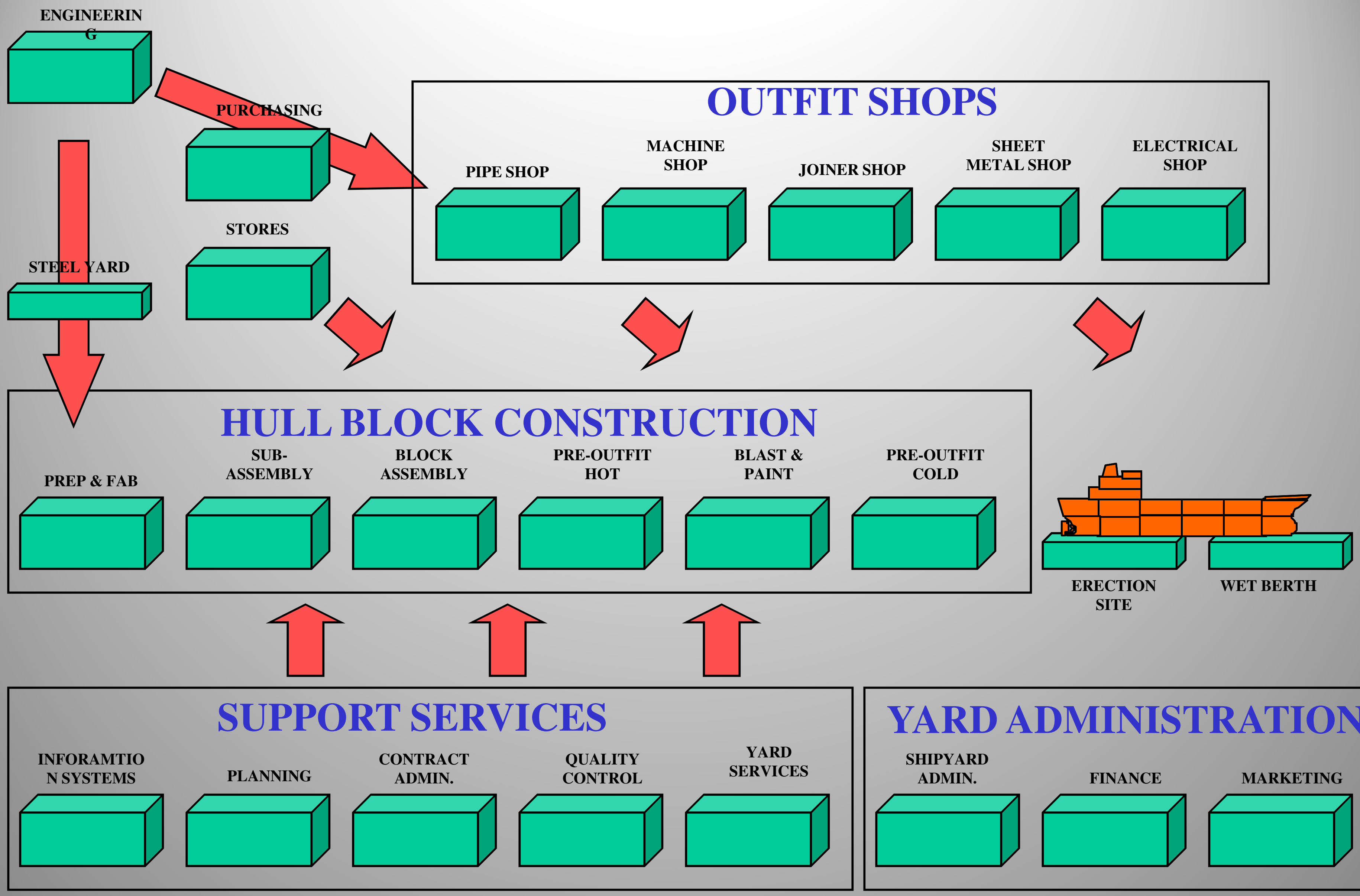


An integrated planning and resource management system coordinates schedules and tracks costs for

- Engineering,
- Purchasing & Deliveries,
- Inventory Control,
- Work Orders & Material Pallets,
- Trade Manpower,
- Subcontractors, and
- Shipyard Facilities.


Cost Estimating
Planning,
Budgeting & Scheduling
Labor & Manpower
Cost Management
Purchasing & Material
Cost Management
Earned Value
Management Reporting
Cost Analysis

PERCEPTION Integrates the Shipyard Business Processes



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Planning and managing ship construction requires careful coordination of a wide variety of different resources & responsibilities.

- **Engineering & technical development**
- **Purchasing & material control**
- **Subcontractors & vendors**
- **Production shops, trades & support services**
- **Hull erection sites and assembly areas**
- **Waterfront facilities & equipment**
- **Financial & project management services**
- **Classification societies & government authorities**
- **Ship owner representatives**

Assembly operations are the most significant cost drivers.

They are influenced by a very large degree by when the assembly is performed.

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Assembly on Outfit Unit

(most productive stage of construction)

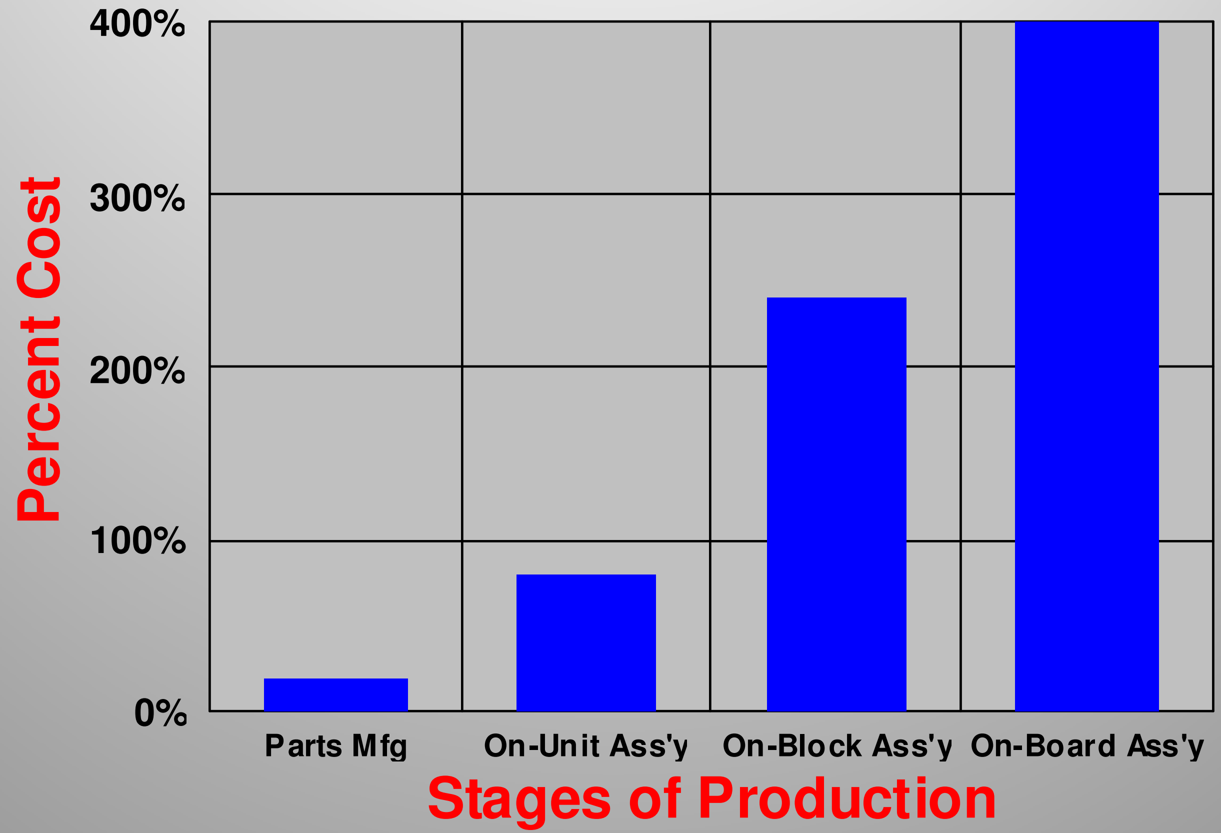
Assembly on Hull Block

(more productive than on board ship)

Assembly on Board ship

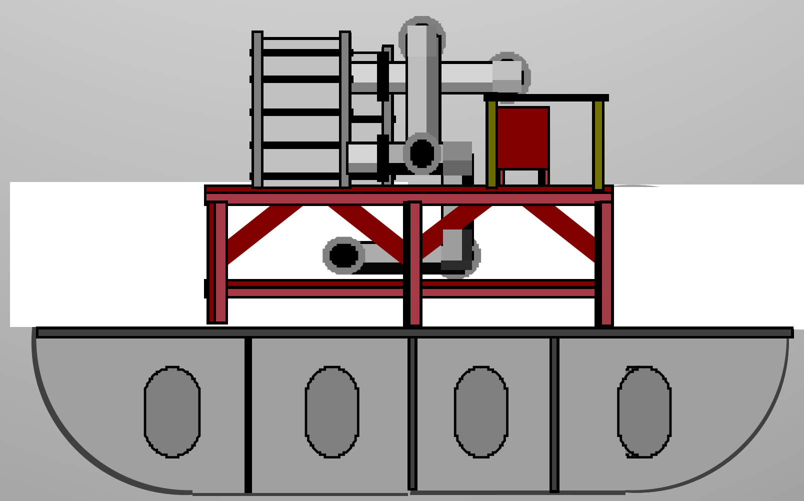
(least productive stage of construction)

Primary Labor Costs: Assembly & Installation

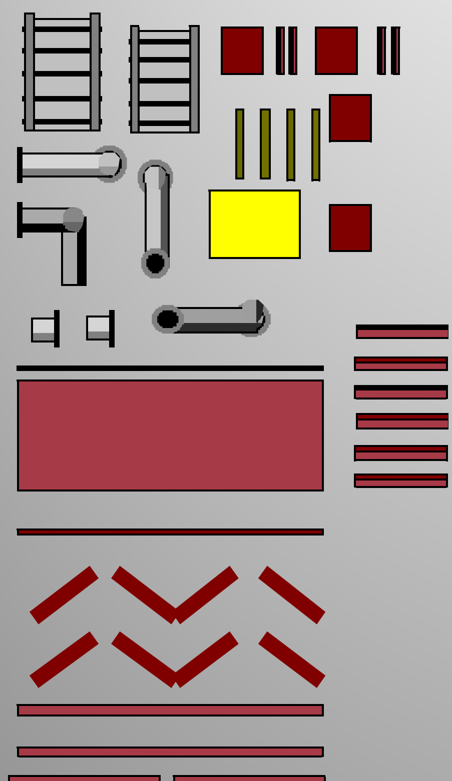


Options for outfitting hull blocks:

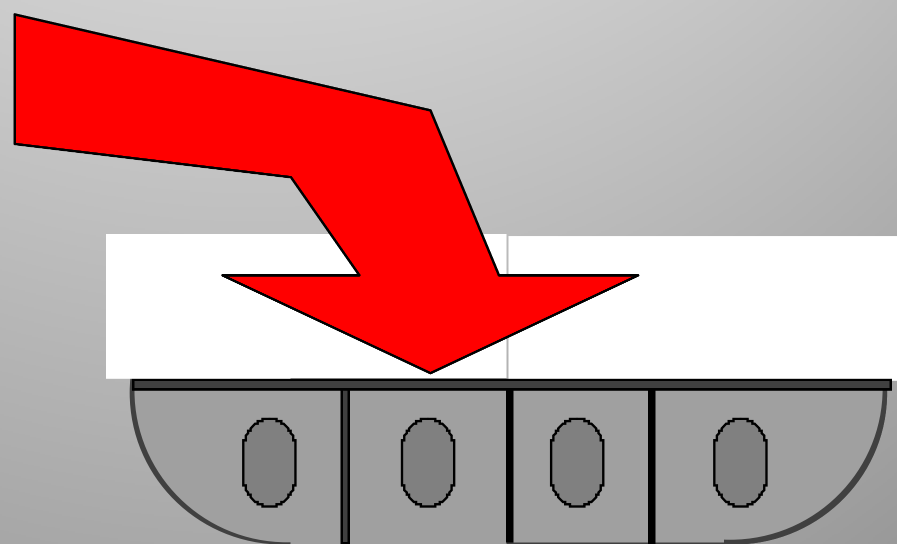
1. "Stick" build outfit materials on block
2. Assemble outfit module in shop, then install module on block.



"Stick" building outfit materials on block.



- Less productive work environment than in shop.
- Few opportunities for repeatable products cost savings.



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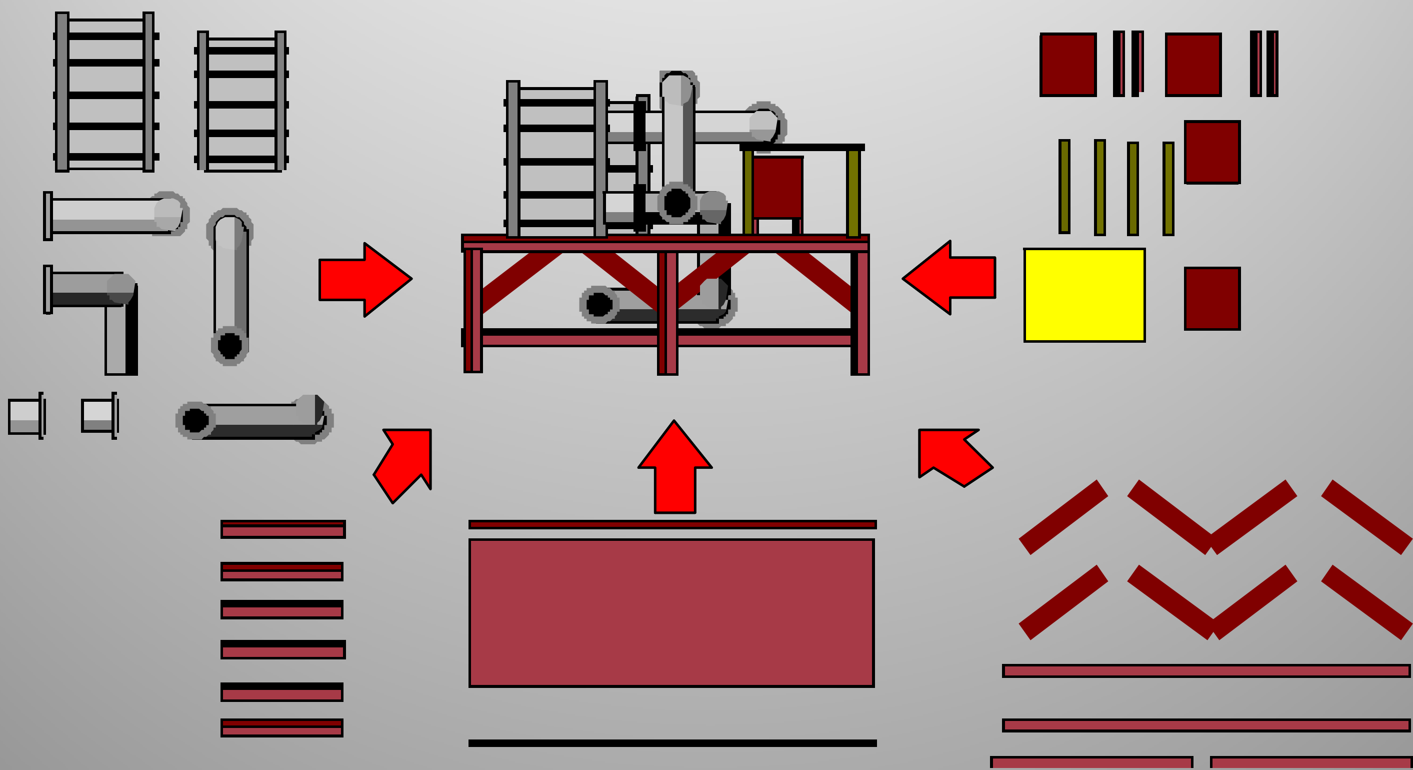
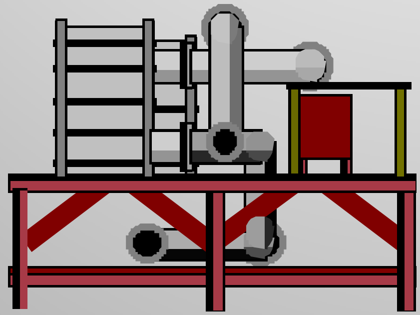
Building outfit module in shop.

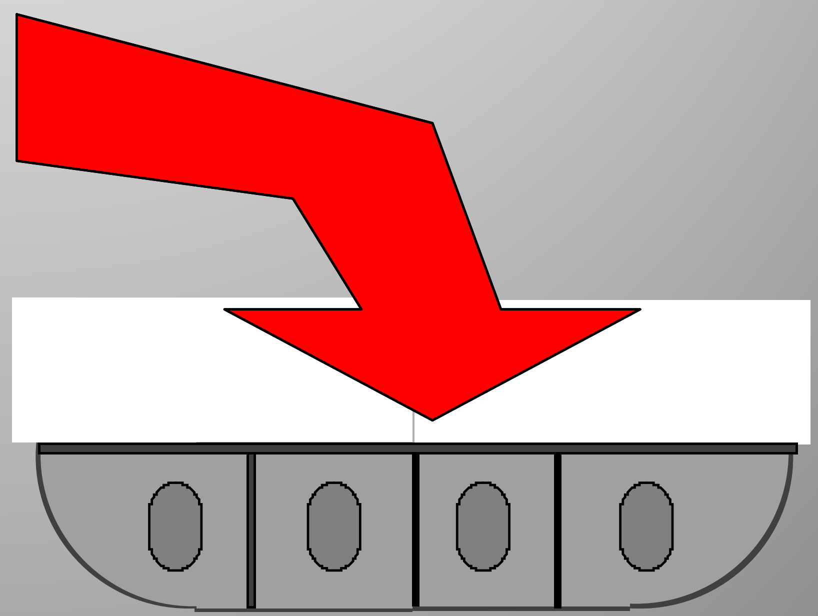
- More productive work environment
- Opportunities for repeatable products cost savings.



Installing outfit module on block (limited effort outside shop).



Net Cost Savings



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Productivity of Assembly On-Block also is dependent upon block size.

Productivity vs Block Size

The primary focus of planning must be to organize all work activities to support the major assembly operations:

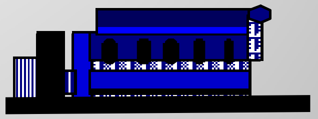
- **Outfit Units**
- **Hull Blocks**
- **On-Board Ship Outfit Zones**

Planning, Integrating & Managing Shipyard Resources

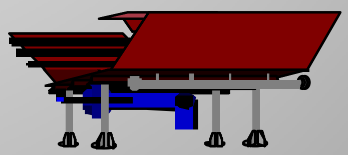
- Engineering
- Purchasing
- Planning
- Parts Manufacturing
- Shipyard facilities
- Sub-Contractors

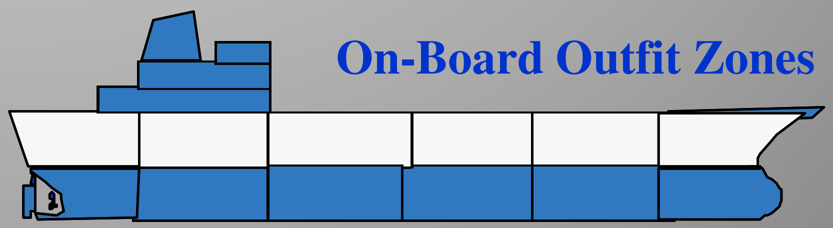
Shipyard Products

Equipment & Outfit System Modules



Pre-Outfitted Hull Block Construction





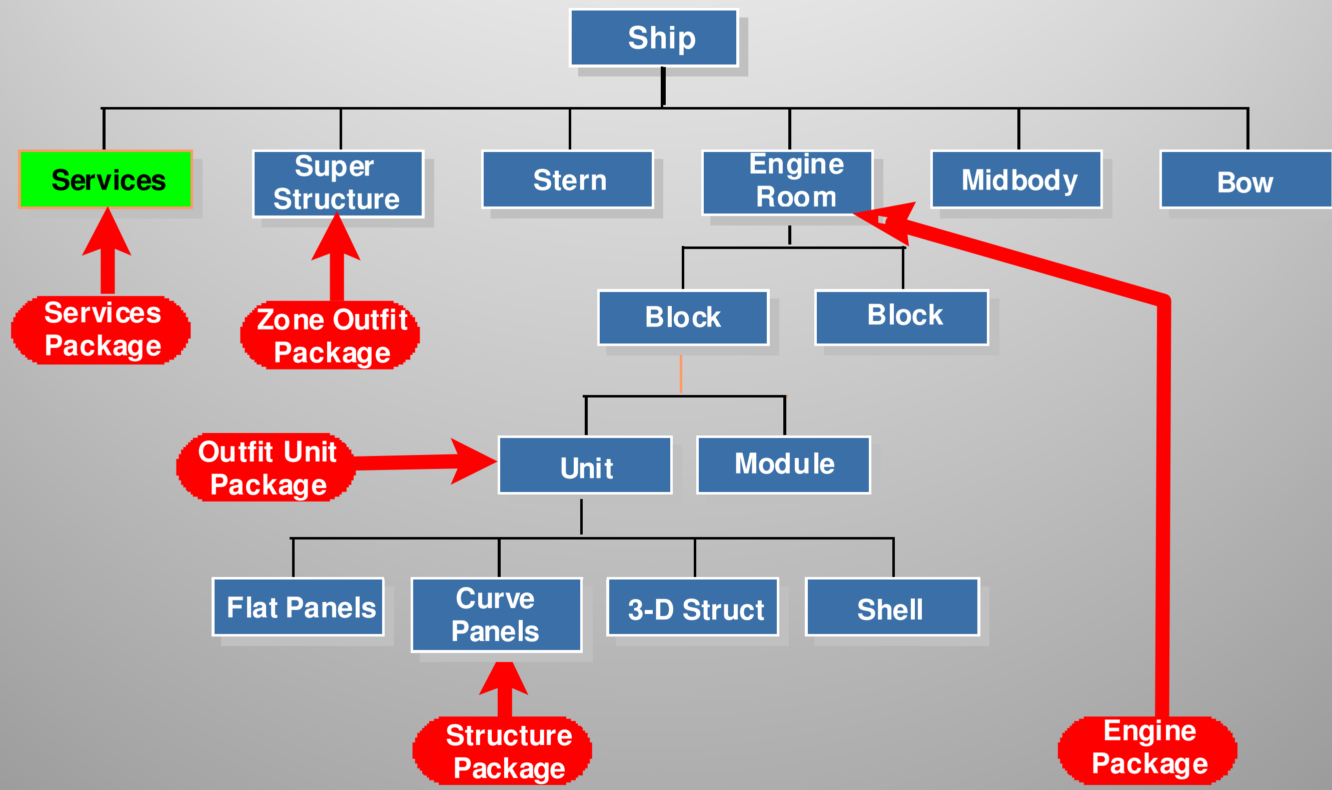
On-Board Outfit Zones

Develop the Performance Management Plan

- Product Work Breakdown Structure (PWBS)
- Process Work Centers & Work Stations (Cost Codes)
- Systems Work Breakdown Structure (SWBS)

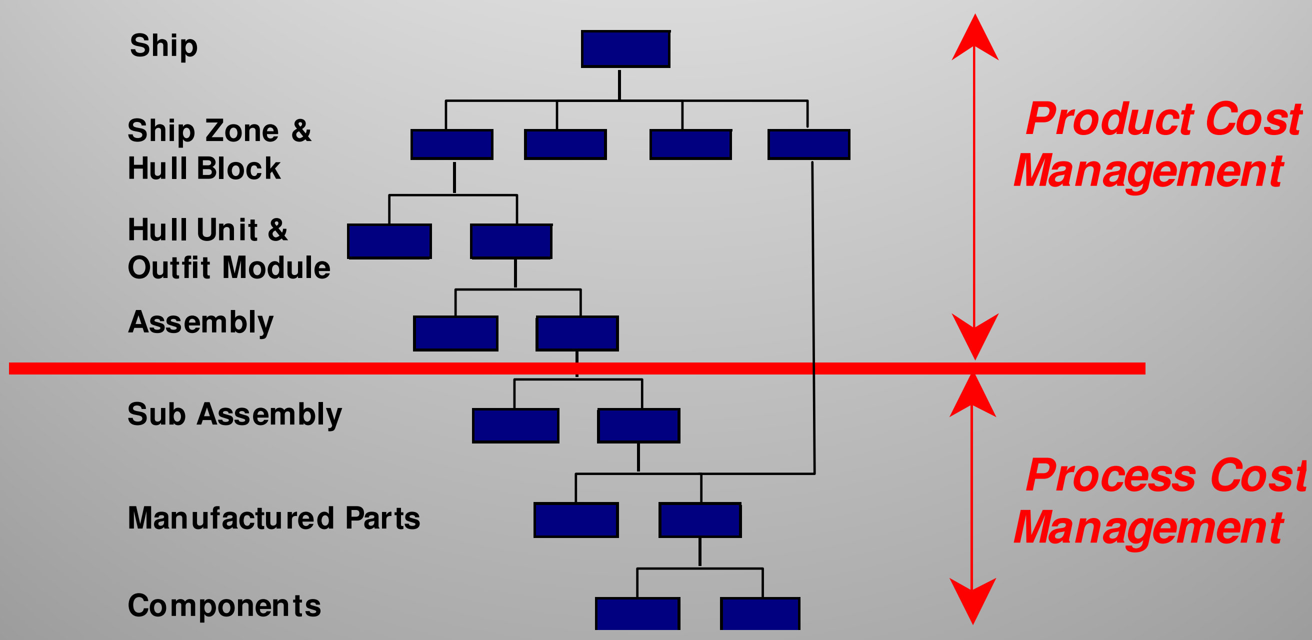
Product Work Breakdown Structure

PWBS

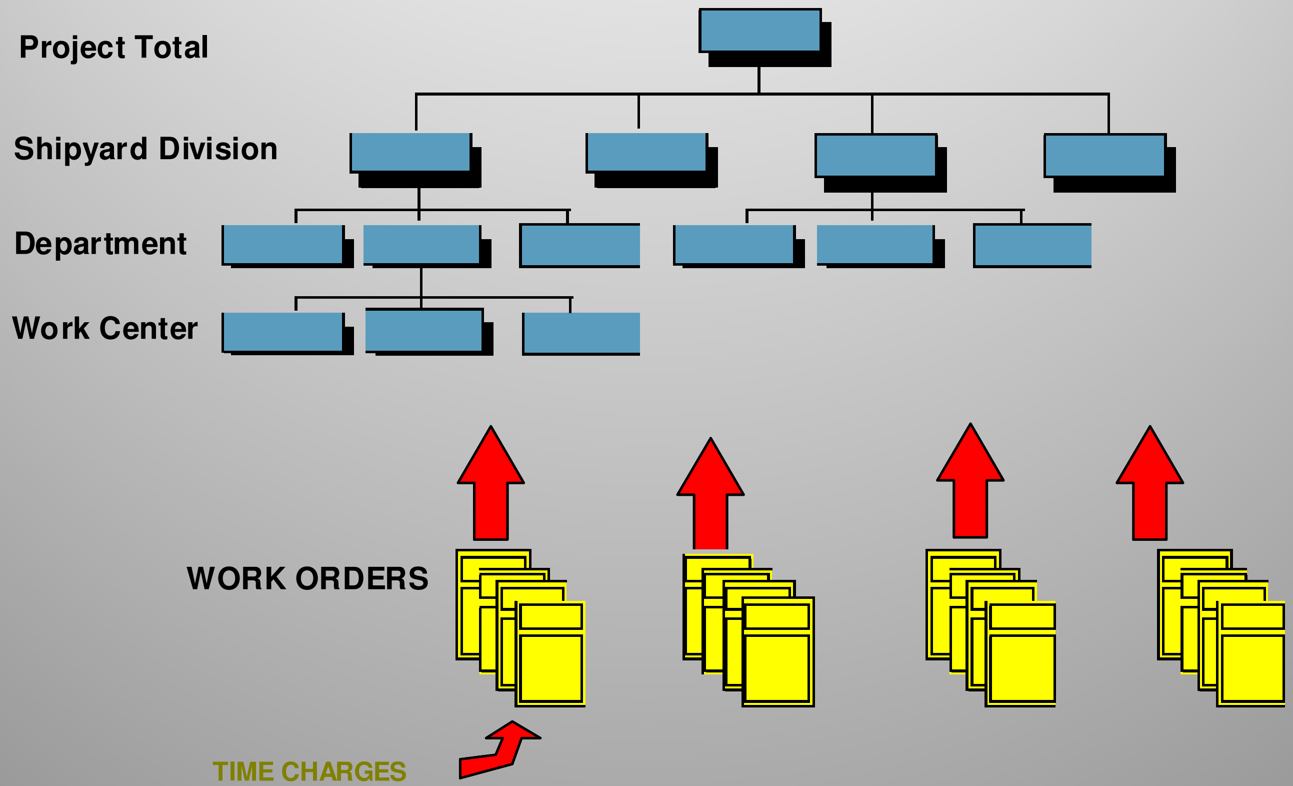


Product Work Breakdown Structure

PWBS



Shipyard Process Cost Codes



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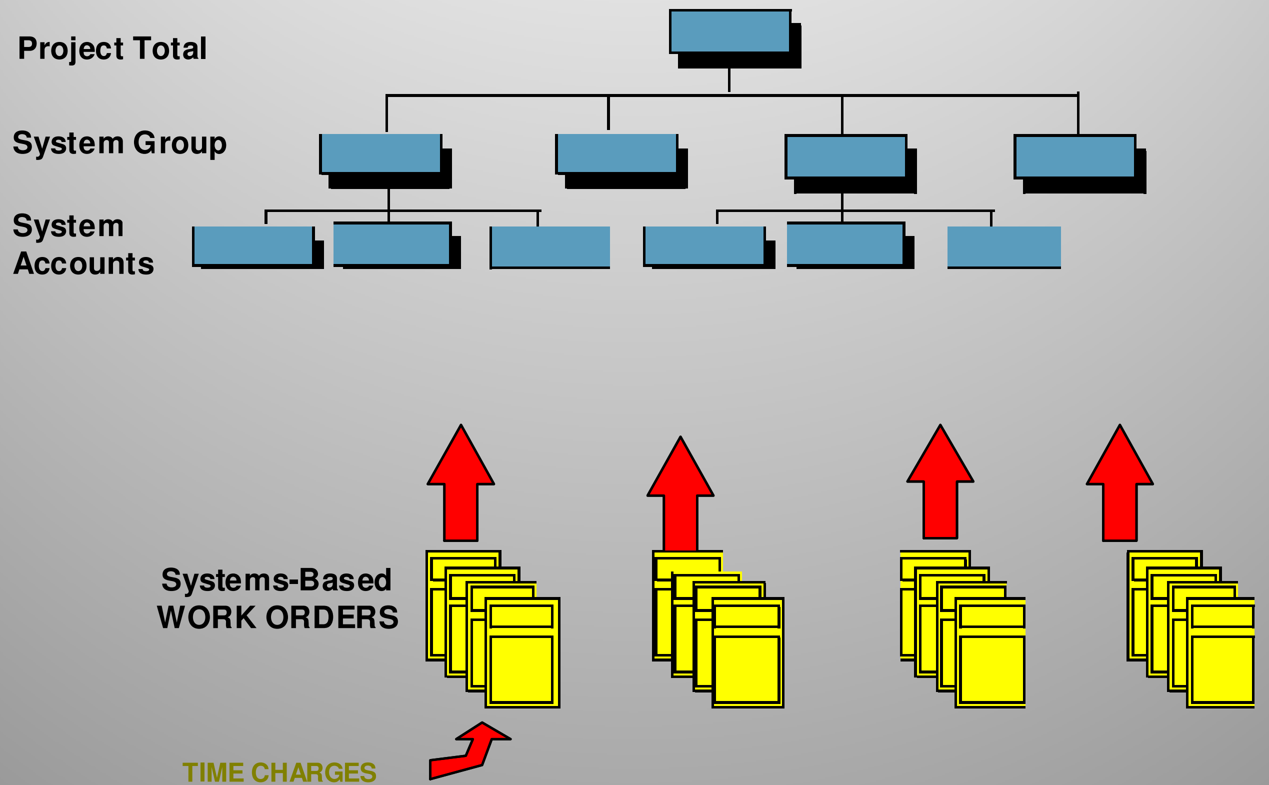
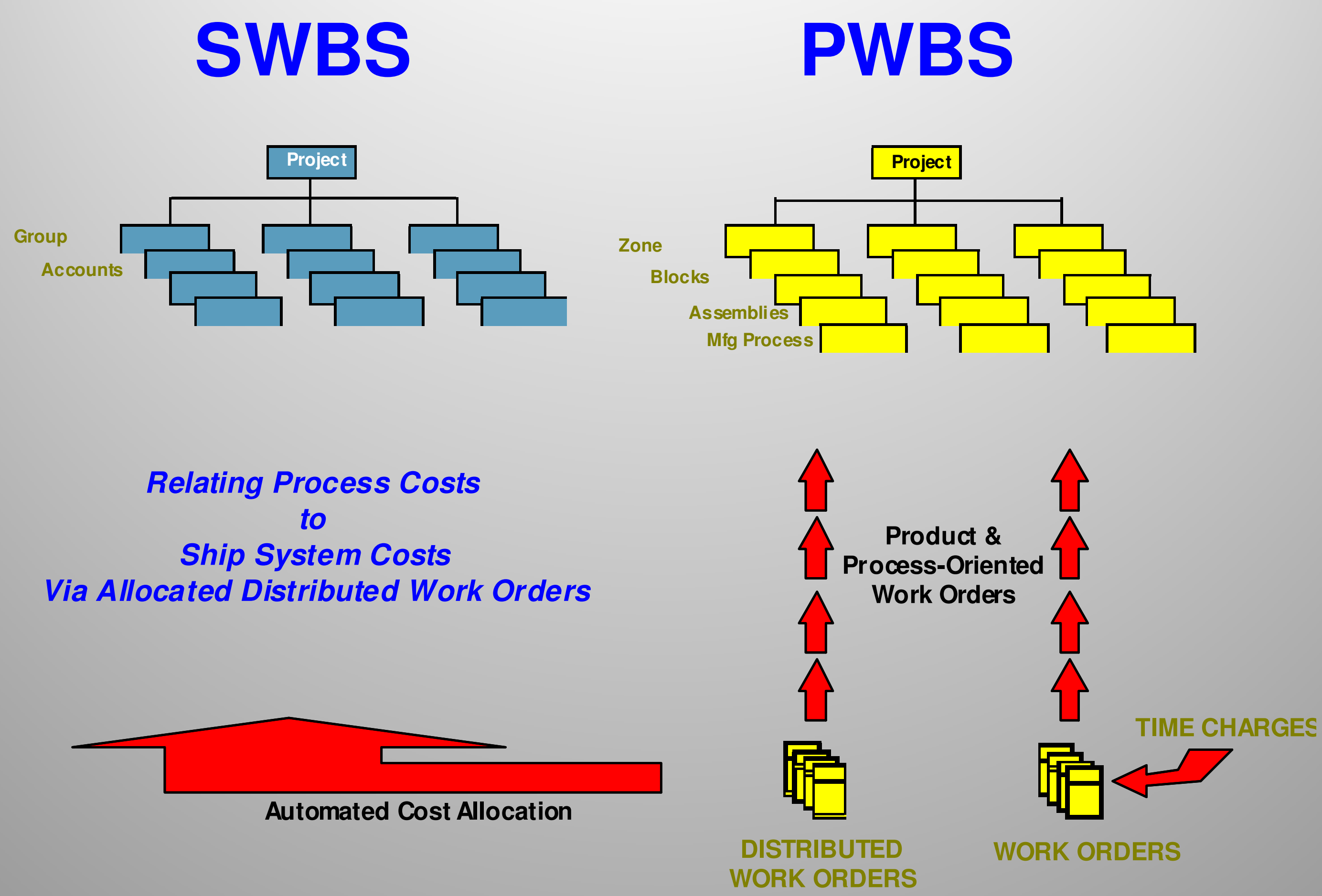
Systems Work Breakdown Structure

SWBS




SWBS
PWBS
Project
Group
Accounts
Project
Zone
Blocks
Assemblies
Mfg Process
Relating Process Costs
to
Ship System Costs
Via Allocated Distributed Work Orders
Product &
Process-Oriented
Work Orders
TIME CHARGES
Automated Cost Allocation
DISTRIBUTED
WORK ORDERS
WORK ORDERS

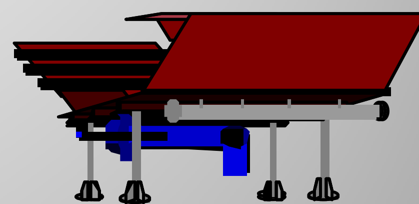
Develop the Build Strategy

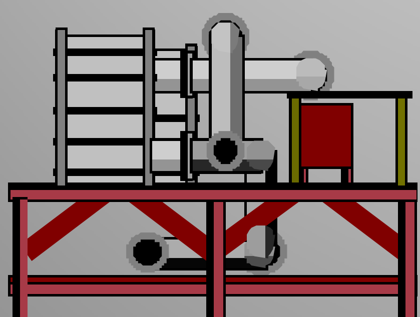
- Production Engineering Plan
- Manufacturing & Assembly of Structural Parts Plan
- Manufacturing & Assembly of Outfit Systems Plan
- Hull Block Construction Erection Sequence Plan
- Assembly & Erection of Equipment & Outfit Modules Plan
- On-Board Zone Outfit Plan
- Tests & Trials Plan

Plan Manufacturing & Assembly Processes

Pre-Outfitted Hull Block Construction

ENGINEER / PLAN → PREP → FAB → ASS'M → P/O HOT → BLAST PAINT → P/O COLD → ERECT →

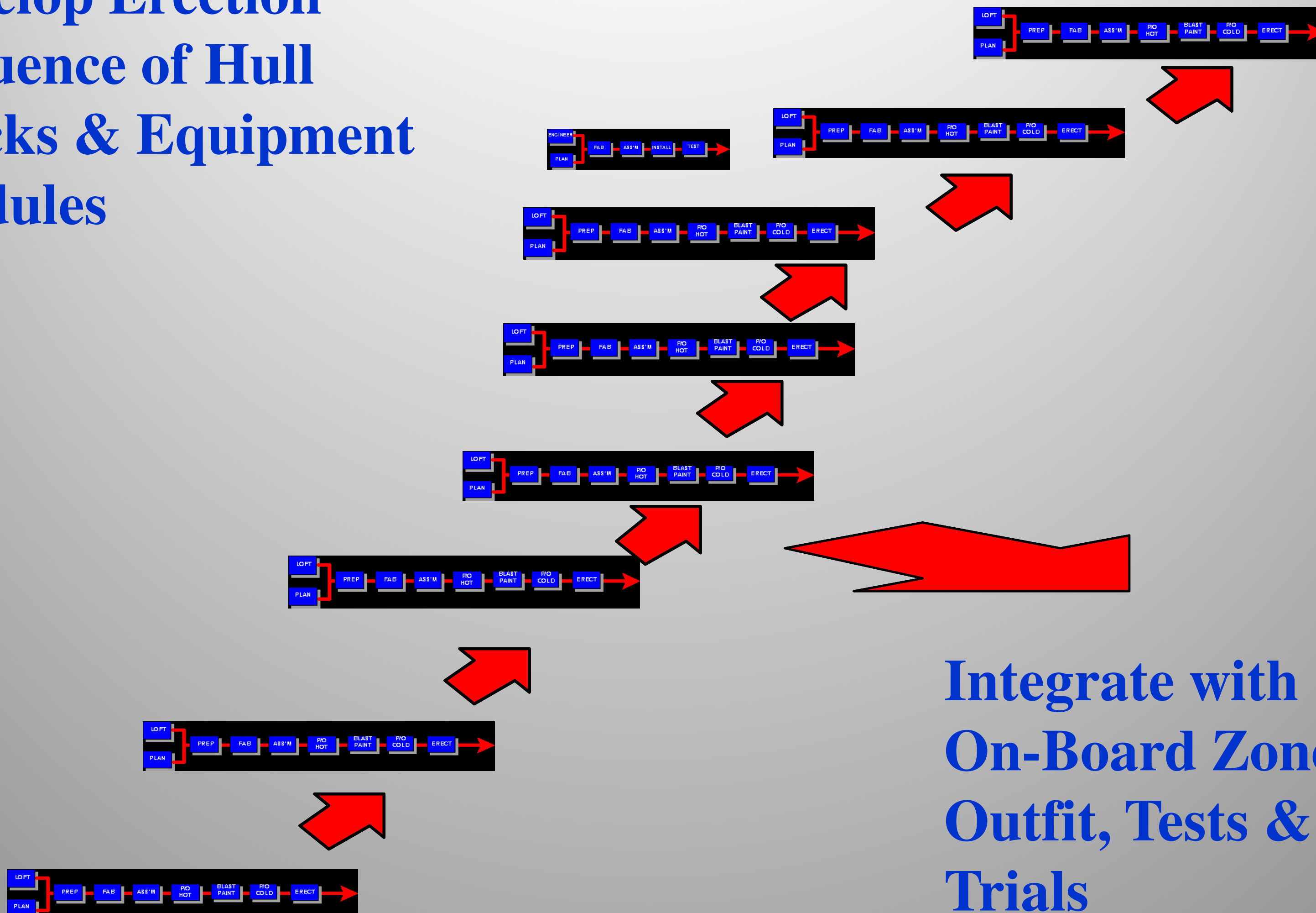




Equipment & Outfit System Modules

ENGINEER / PLAN → FAB → ASS'M → INSTALL → TEST →

Develop Erection Sequence of Hull Blocks & Equipment Modules



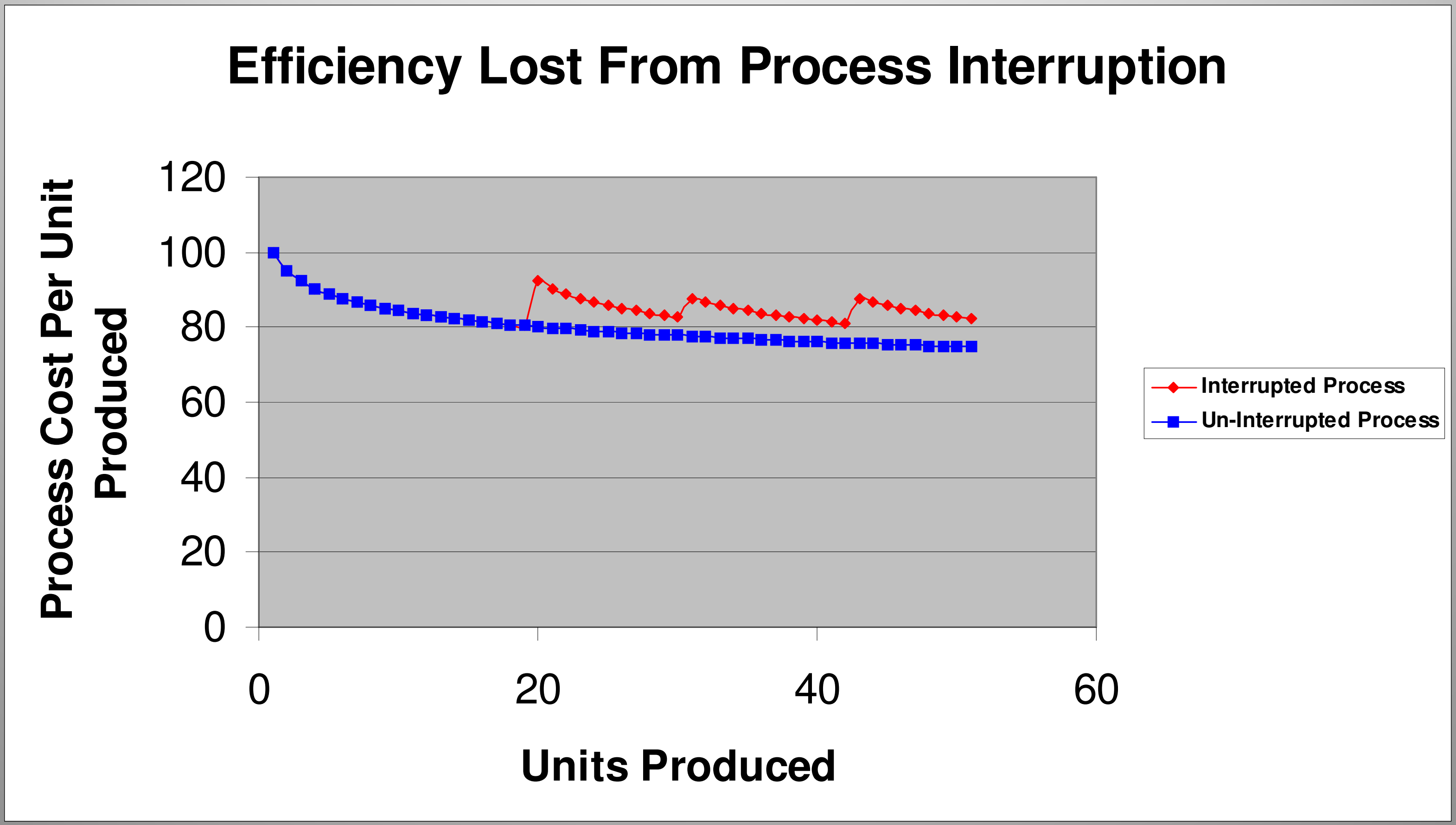
Integrate with On-Board Zone Outfit, Tests & Trials

Criteria for Maximizing Efficiency

- Maximize work during most productive stages of construction (On-Unit & On-Block)
- Minimize work during less productive stages of construction (On-Board)
- Maximize work under cover
- Maximize access to work
- Minimize material handling
- Minimize non-productive activities

- **Maximize productivity of available manufacturing processes**
- **Ensure all necessary resources are readily available at work times scheduled**
  - **drawings,**
  - **materials,**
  - **tools & facilities, and**
  - **manpower**
- **Exploit benefits of engineering, material and production standards**

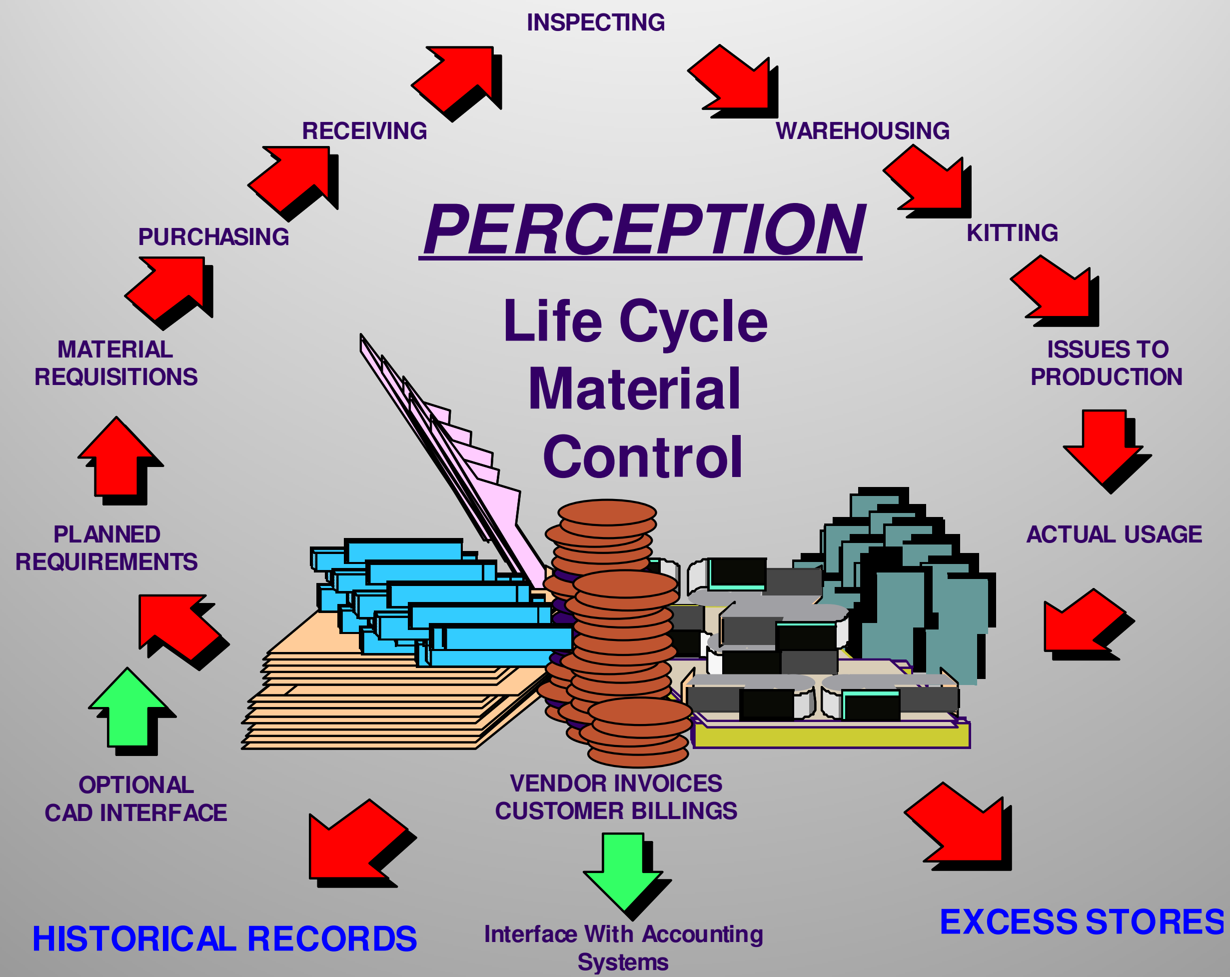
Maximize Productivity of Available Manufacturing Processes



Develop Material Management Plan to Support Production

- Purchase Order Management
- Sub-Contract Management
- Warehouse & Inventory Management
- Production Work Order Kitting Management

Managing Material From Engineering to Production



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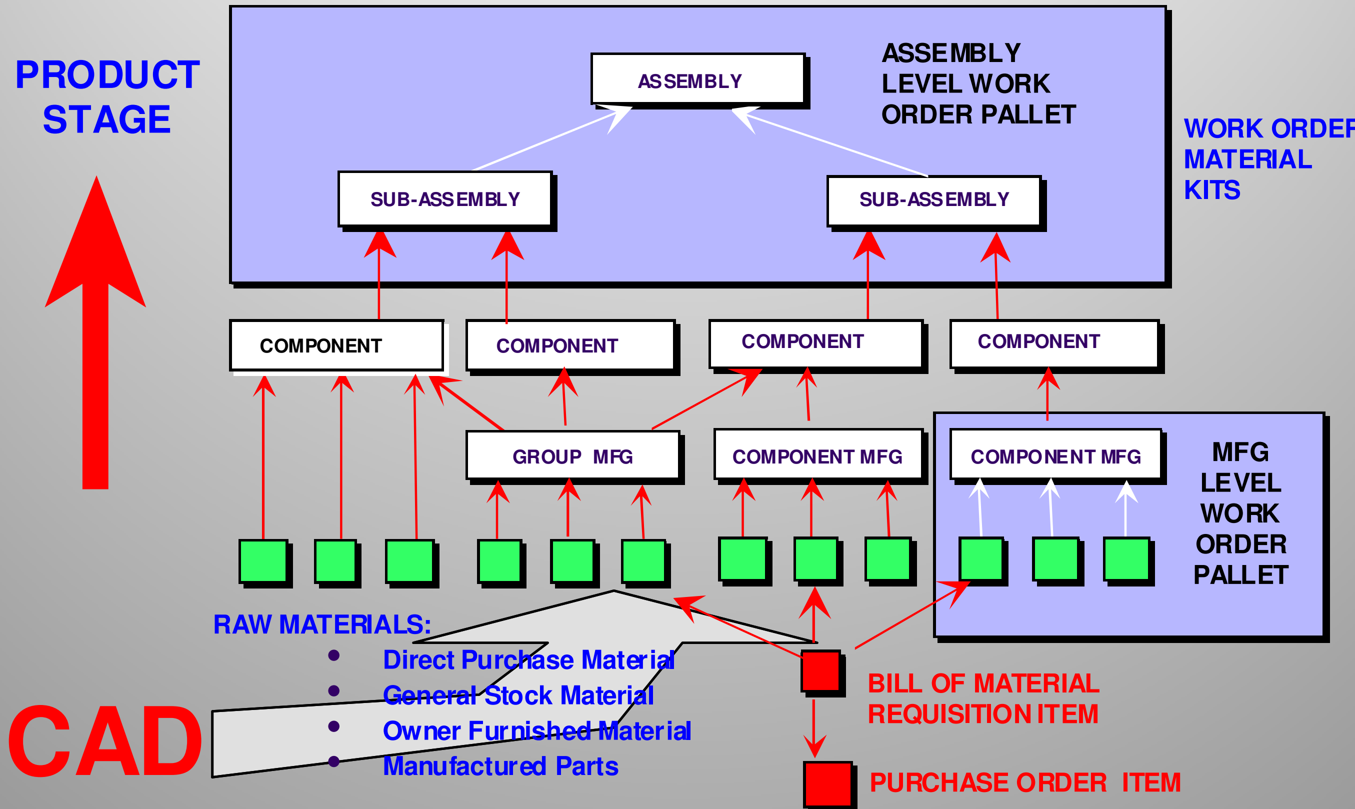
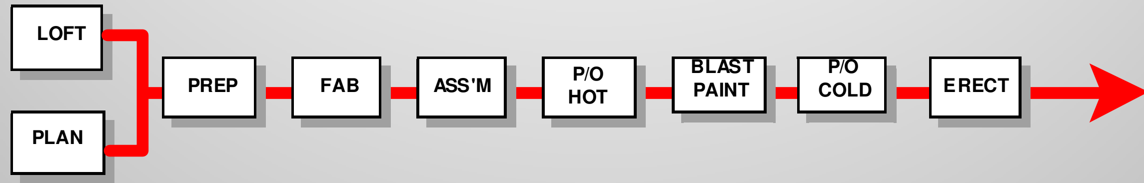
Packaging Work for Stages of Construction



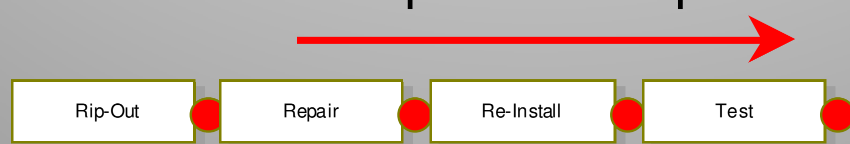
Develop Production Work Orders

Process Sequence: Pre-Outfitted Hull Block Construction



Process Sequence: Outfit Fabricate & Install

Process Sequence: Repair & Install



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A Work Order

A work order is a distinct and definable unit of work that can be started and completed without significant interruption under the direction of a single work center.

Size of Work Orders

The size of work orders will vary, depending on scope.

Generally, large work orders are more difficult to manage than smaller work orders.

Large work orders that are open and in-process for a long period of time <u>always</u> collect more costs than necessary. Actual progress is i<u>mpossible</u> to measure.

However, work orders too small also are difficult to manage. They require more overhead to plan and manage. They increase opportunities for time charge errors.

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A good rule of thumb for new construction work orders:

Average 250 man-hours of labor

Average 2 weeks duration

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Time Charging

PERCEPTION **provides functions for entering and validating authorized work order time charges**

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The recording of time charges against authorized work orders is of major importance to the shipyard.

Correct and complete time charging against contracts is often the basis by which the shipyard bills its customers.

Without accurate and timely information, billings can be incomplete or late causing considerable problems with the ability of the shipyard to make a profit.

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Completing Work Orders

Every work order should be authorized so that it can be completed without undue delay.

PERCEPTION provides a formal closing out procedure that indicates to the system that the work order is finished.

From completed work orders, *PERCEPTION* measures, tracks and forecasts cost variances automatically.

Work orders that are held up for QA inspections may have a QA & Pick Up work order created, with appropriate budget, that allows the bulk of the work to be closed out.

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Suggestion: **Work orders that require additional scope of work due to short-comings of preceding work orders should be reimbursed with budget transferred from those earlier work orders.**

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PERCEPTION offers 4 Primary Types of Work Orders for Different Operations Requirements

- Discrete Work Order
- Distributed Work Order
- Time-Phased Work Order
- Process Work Order

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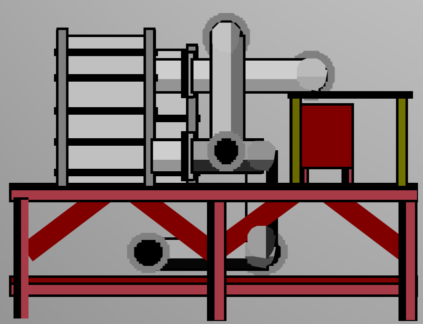
1. **<u>The discrete work order</u> identifies work that can be catalogued easily within a given work breakdown structure.**

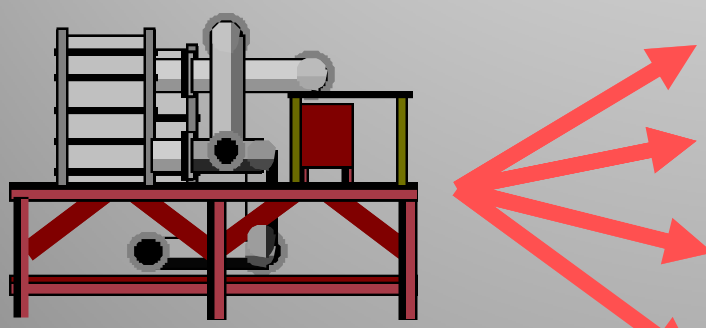
The discrete work order identifies work that ultimately produces a definable interim or end product.



Equipment & Outfit System Modules

2. <u>The distributed work order</u> identifies work across multiple elements of the work breakdown structure.

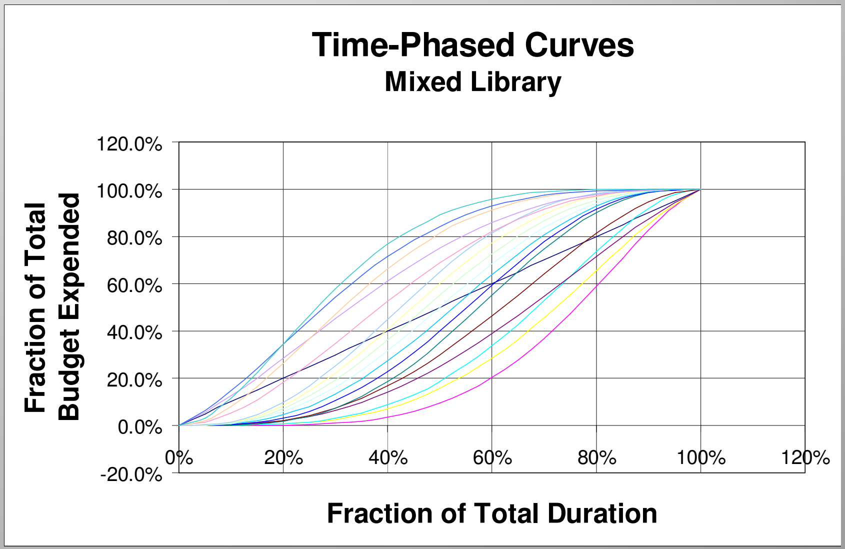
The distributed work order is useful for collecting costs by unit module, ship zone or group manufacturing process and allocating the costs automatically to individual ship systems.



- Potable Water System
- Sanitary Waste System
- HVAC
- Foundations

3. <u>The time-phased work order</u> identifies a level of effort activity that has no clear end product. Examples include supervision and shipyard support services.

The time-phased work order manages time charge budgets on a monthly basis with no changes in the work order charge number.



Support Services Packages

4. <u>The process work order</u> measures actual production rates for specific manufacturing processes. Performance is measured not only in terms of labor hours and costs against budgets, but also in terms of planned versus actual production throughput units of measure (feet of weld, tons of steel, etc.).

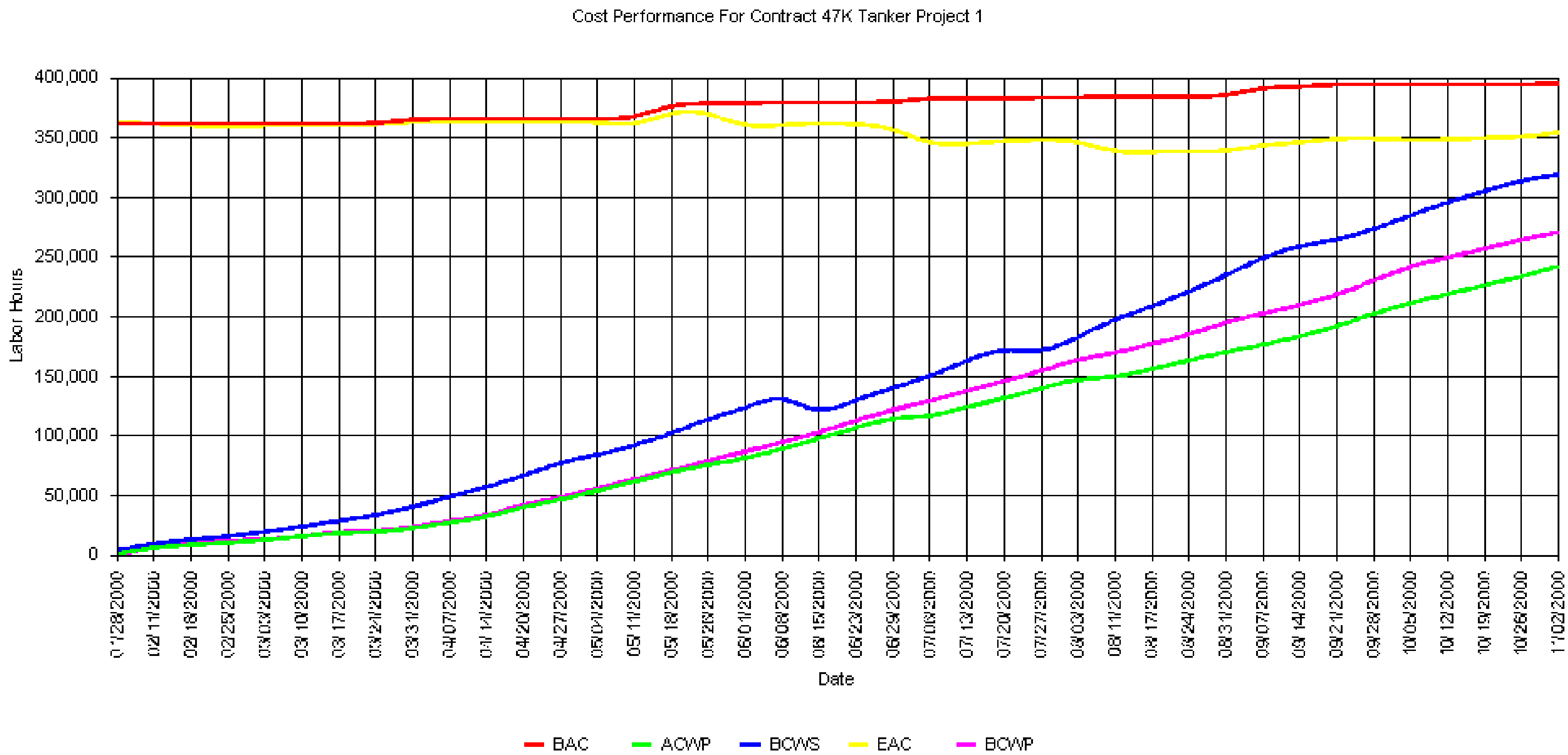
The system generates forecasts of these throughput rates as learning becomes evident and efficiency improves.

Manufacturing Process
Work Packages

Managing the Project Execution

- Time Charging Procedures
- Material Issue Procedures
- Technical Package Issue Procedures
- Budgets & Integrated Schedules
- Performance Reporting

Tracking Performance Costs



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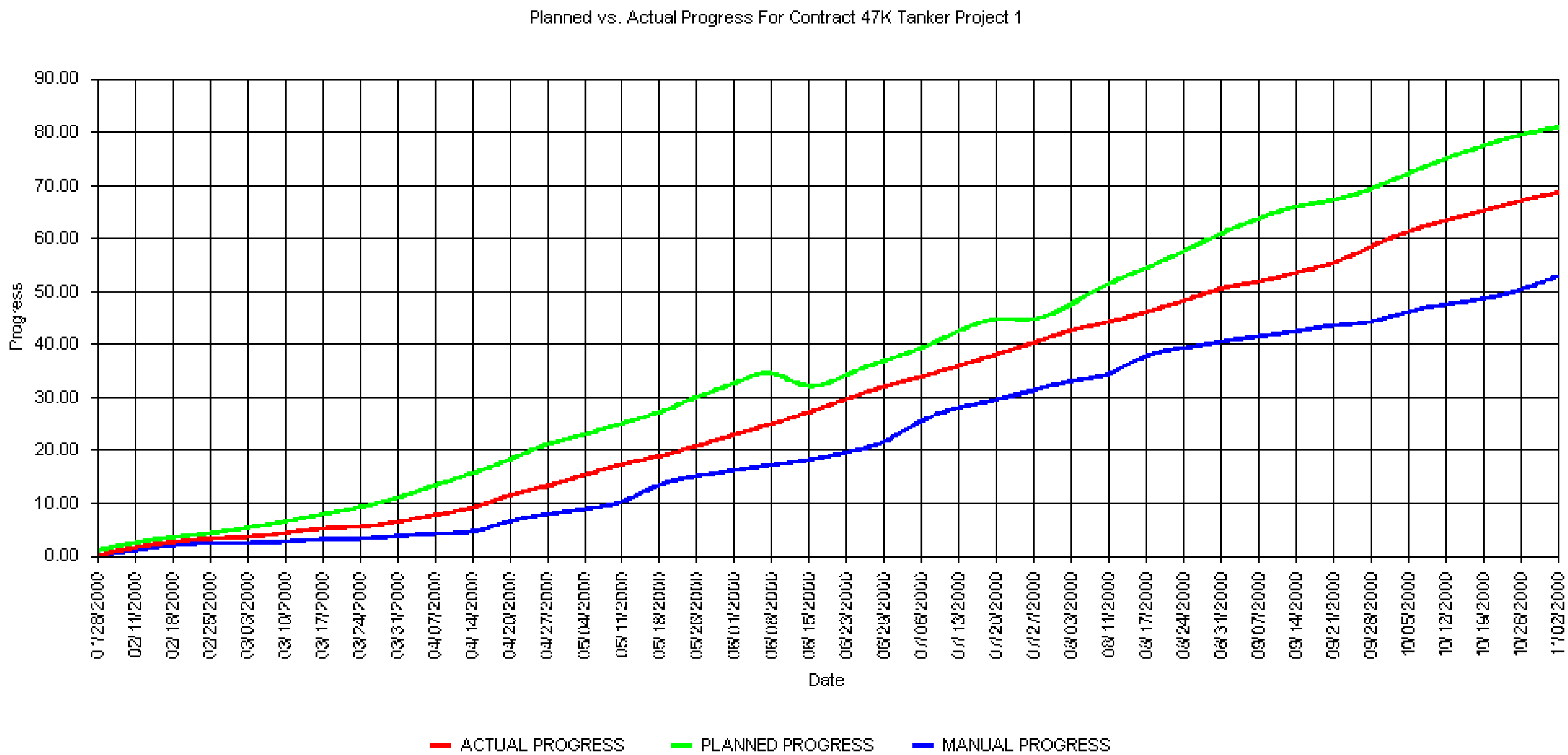
Tracking Progress



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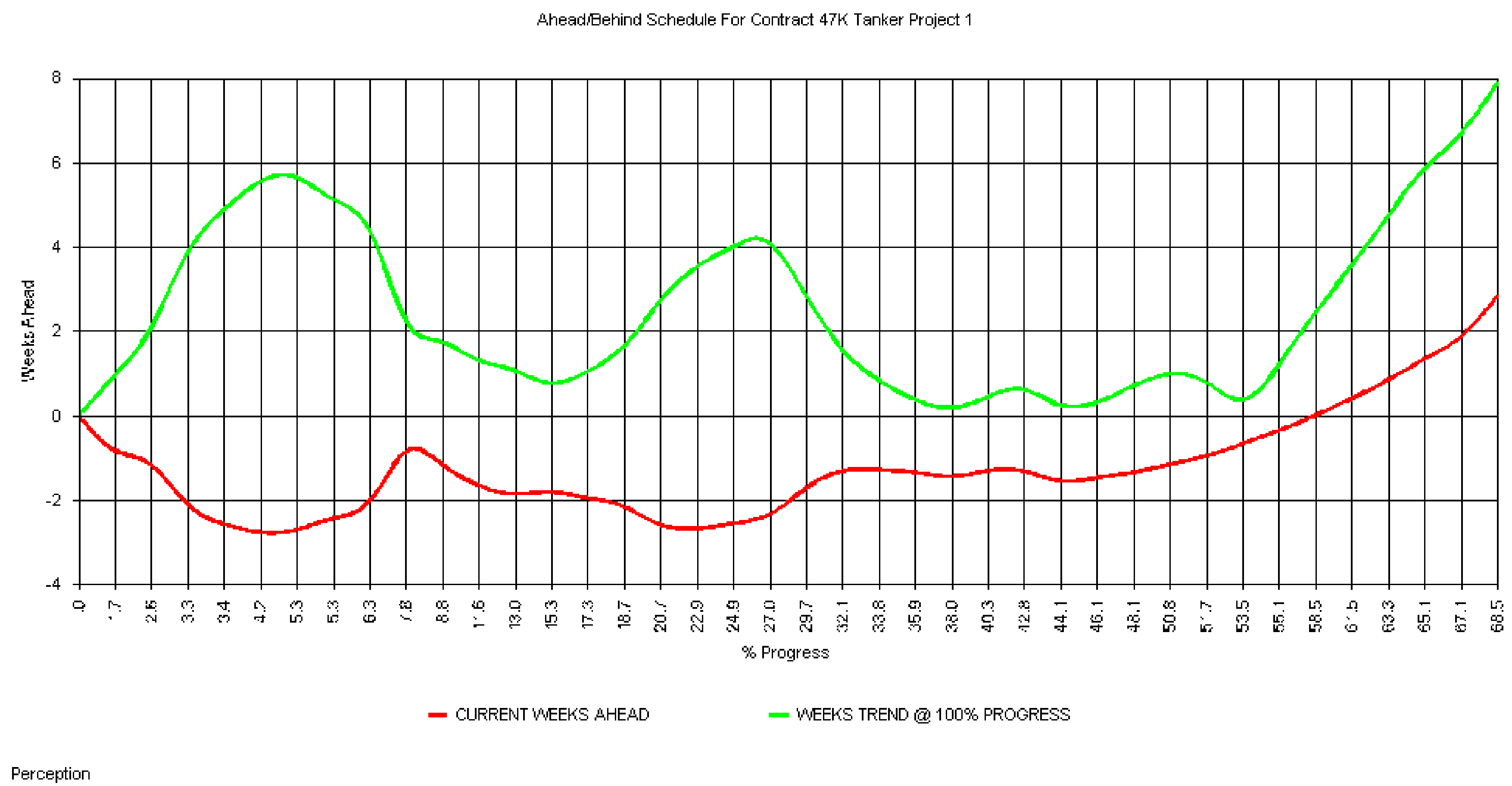
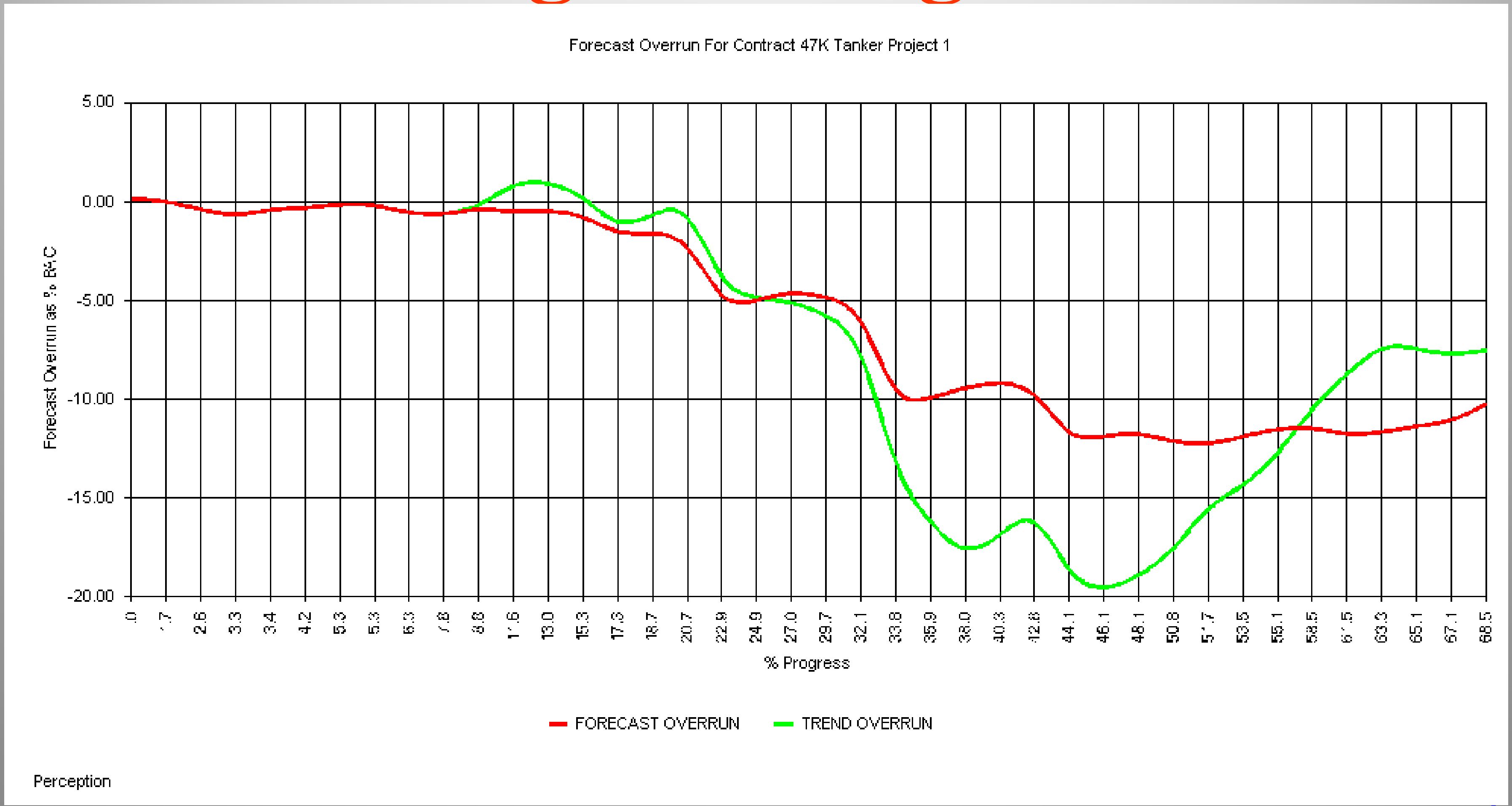
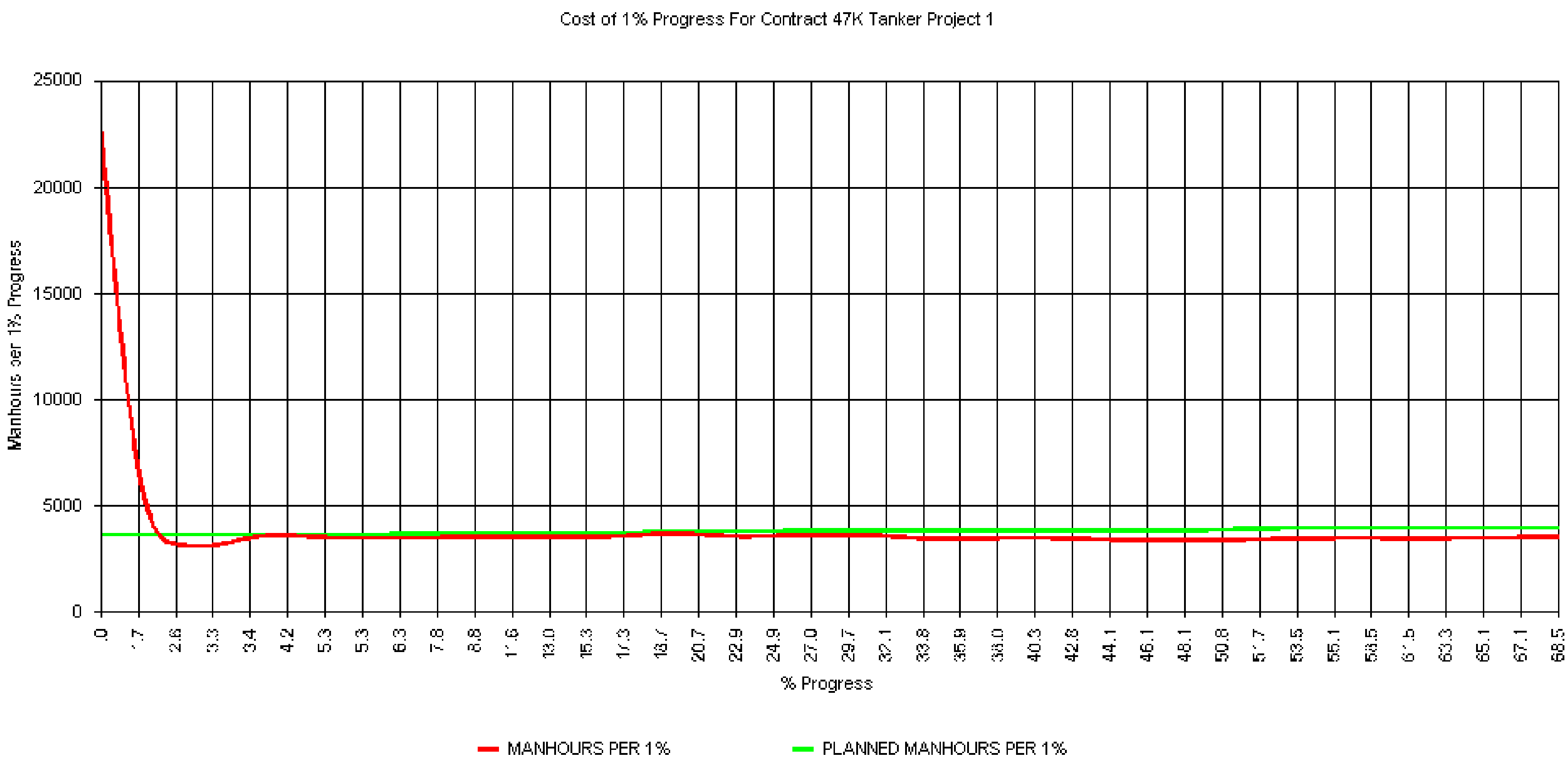
Tracking & Forecasting Schedule Variance



Tracking & Forecasting Over-Budget/Savings Variance



Tracking Cost/1% Progress



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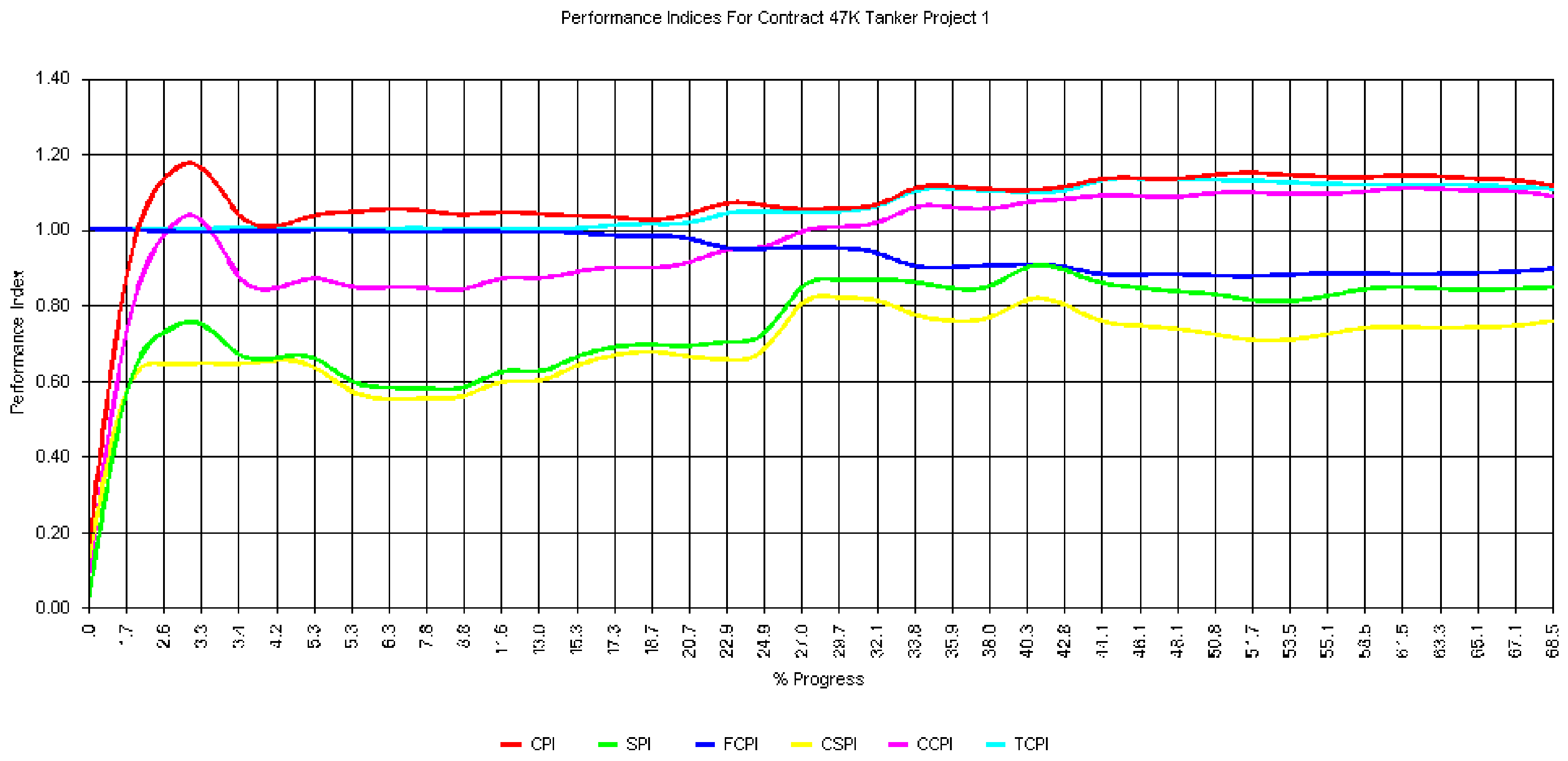
Tracking Performance Indexes



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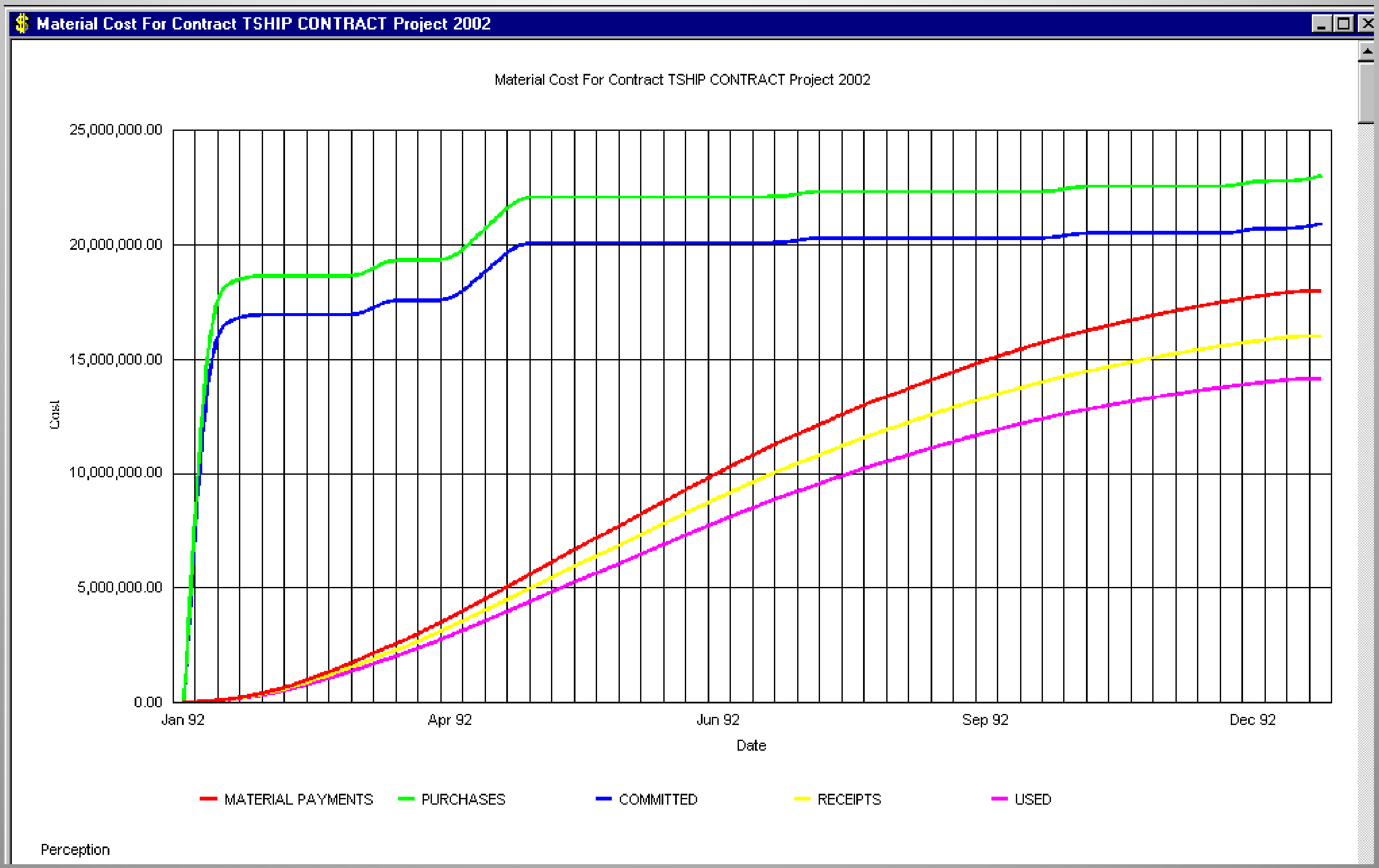
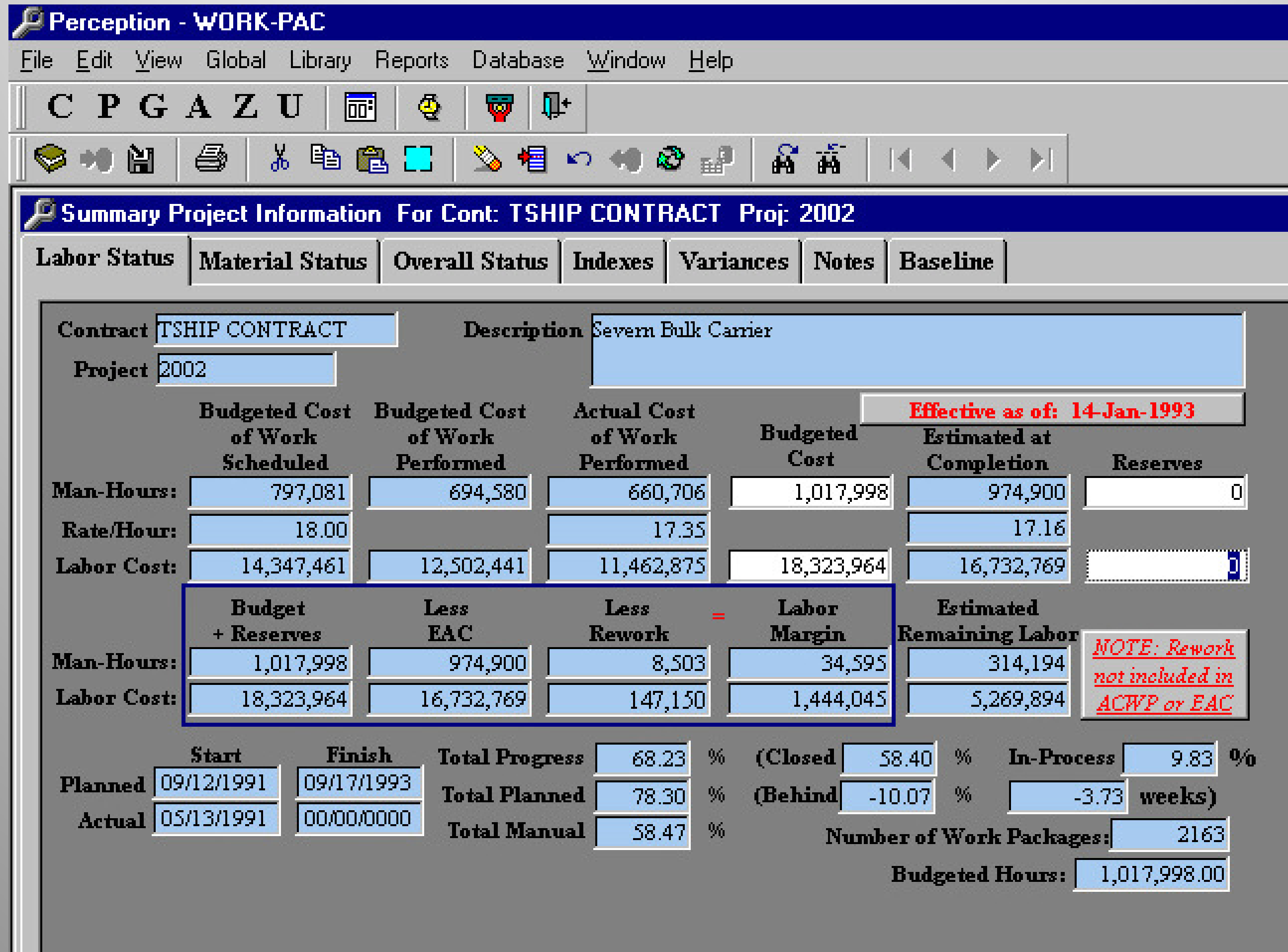
Tracking Material Costs



On-Line Cost & Schedule Status Reporting



Hard Copy Cost & Schedule Status Reporting

Perception - WORK-PAC

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C P G A Z U

Reports

12-Apr-1999 | **SPAR Associates, Inc** | Page 1 of

PWBS Zone Progress Report

Contract ID: TSHIP CONTRACT -T-SHIP Series Contract

Project: 0 to ZZZZZZZZ Zone: 20 to 29

		Percent Progress				Current Labor Hours				Final Hours			
Zone		**Planned**	**Actual**	**Ahead**	**Weeks Ahead**	**BCWS**	**BCWP**	**Actual Hours**	**Schedule Ahead**	**Budget**	**EAC**	**ETC**	**Sav**
Project 2002	**Effective Date: 01/14/1993**	**Severn Bulk Carrier**											
		78.30	**68.23**	**-10.07**	**-3.73**	**797,081**	**694,580**	**660,706**	**-102,501**	**1,017,998**	**974,900**	**314,194**	**4**
20	ENGINE RROM	47.24	32.66	-14.58	-13.86	10,102	6,985	6,394	-3,117	21,386	19,579	13,185	
21	ER BELOW FLOOR PLTS	100.00	100.00	0.00	4.14	4,211	4,211	4,394	0	4,211	4,394	0	
22	ER ABOVE FLOOR PLTS	82.19	48.10	-34.09	-19.86	27,380	16,024	13,279	-11,356	33,314	27,608	14,329	
23	ER MACHINERY DECK	86.17	25.19	-60.98	-15.00	16,684	4,877	4,352	-11,807	19,361	17,276	12,924	
24	ER MAIN DECK	68.42	30.80	-37.62	-5.29	15,375	6,921	6,741	-8,453	22,472	21,887	15,146	
25	ER CONTROL RM FLAT	37.08	9.50	-27.58	-10.29	312	80	80	-232	842	842	762	
26	H.F.O. TANK	37.01	0.00	-37.01	-13.86	123	0	0	-123	331	331	331	
27	ER CASING	55.67	18.77	-36.90	-6.43	2,175	733	635	-1,442	3,907	3,383	2,748	
28	FUNNEL	77.94	75.52	-2.42	0.86	261	253	511	-8	335	673	162	
29	MAIN CONTROL ROOM	18.66	11.27	-7.39	-0.43	65	39	39	-26	346	346	307	

Ready

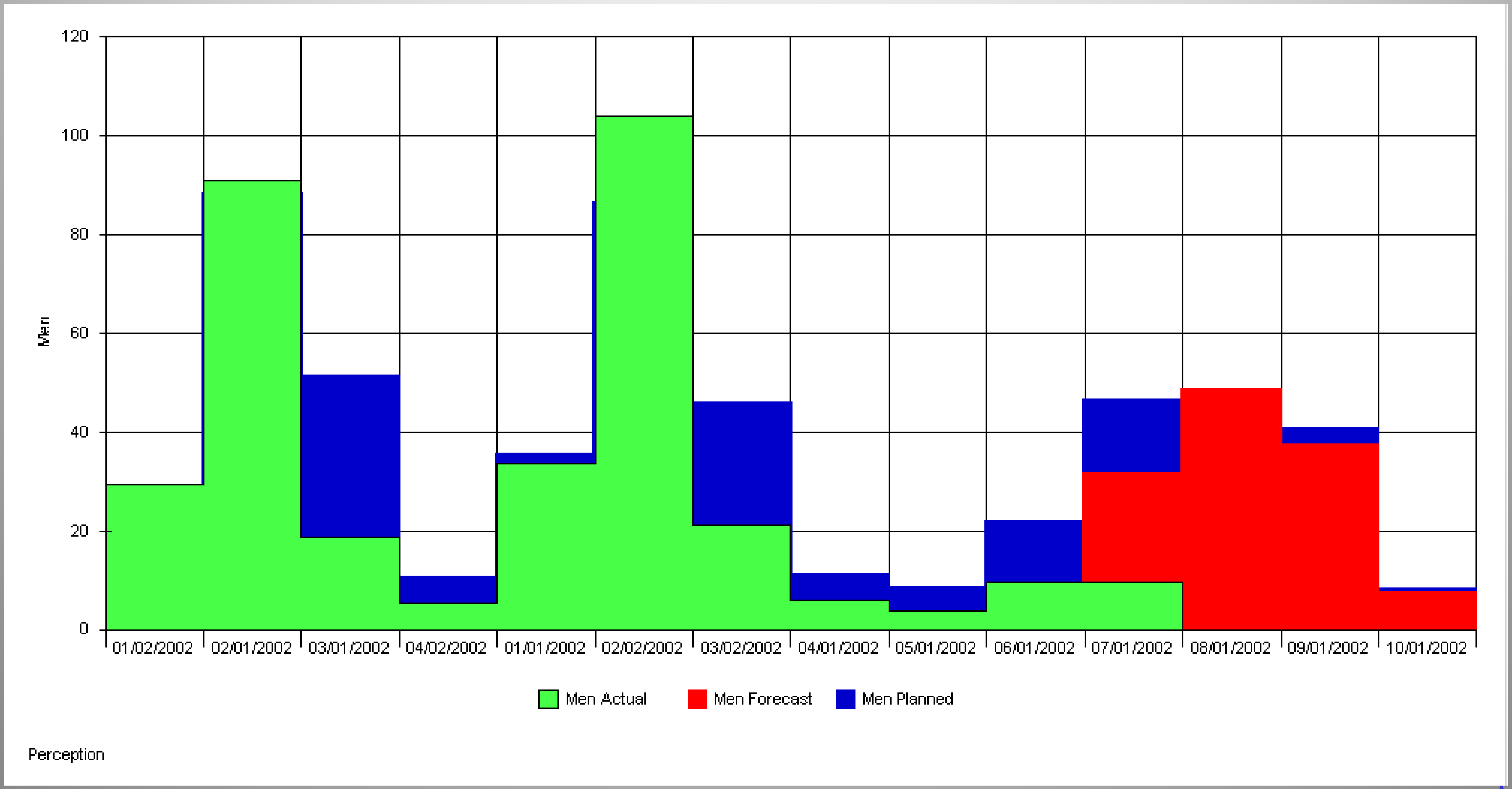
Tracking Manpower Requirements

- As Planned in Baseline
- As Currently Planned
- As Actually Expended To Date
- As Forecast to Complete

Manpower can be evaluated by WBS, by shipyard work center, for one project or across multiple projects.

The analysis can combine current back-log with proposed new work.

Tracking Manpower Requirements (Planned Vs Actual Vs Forecast)



New Work Manpower Modeled On Top Of Active Work Manpower