October 1996
NSRP 0478

SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Shipyard Cost Model Using Activity-Based Costing Methods

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
National Steel and Shipbuilding Company
San Diego, California

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
OCT 1996	**N/A**	**-**

4. TITLE AND SUBTITLE	
The National Shipbuilding Research Program, Shipyard Cost Model Using Activity-Based Costing Methods	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Bldg 192 Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**104**	

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FINAL REPORT

SHIPYARD COST MODEL USING ACTIVITY-BASED COSTING METHODS

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In Behalf Of
SNAME SPC PANEL SP-5
on
HUMAN RESOURCE INNOVATION

Under the
NATIONAL SHIPBUILDING RESEARCH PROGRAM

October 1996

Task N5-92-2

PREFACE

This document was originally intended to be a pilot study of the hidden costs facing U.S. shipyards in the process of "economically converting" from almost entirely military ship construction to designing and building commercial ships for the international market. The project evolved after many budgetary and other delays, with Avondale as the U.S. Pilot yard and Kvaerner Masa Marine's access to the working structure of Northern European yards. The result was an analysis of North American shipyards compared with Northern European yards in the design, construction and overall management and work organization of building commercial ships for the international market.

Origin of Study:

- The need for a study is identified by The Shipbuilders Council of America (SCA) in August 1990 at a Shipbuilding Committee meeting.
- The SCA staff developed the NSRP Project Abstract.
- The SNAME Production Committee Panel SP-5 - Innovation in Human Resource Management, adopted the project.
- After long funding delays, American Management Systems (AMS) wins the study contract in 1995.
- AMS adds Kvaerner Masa Marine (KMM) and SPAR Associates to the team.
- Insights into Kvaerner's Finnish and Norwegian Yards is added.
- Avondale is the pilot shipyard partner.
- Saint John Shipbuilding Limited has been added to the study to provide a more North American perspective with a Canadian shipbuilding cost model.

Purpose: The overall objective of this study is to conduct an analysis and provide a pilot study report that identifies, measures and provides guidance to U.S. shipyards to reduce the hidden costs which are caused by bad practices instilled in the U.S. shipyards by previous government ship construction work. These difficult to evaluate costs are a legacy left to North American shipyards which in the U.S. have been constructing military ships for over 25 years operating under the regulations imposed by mostly government contracts.

In order to support the shipyard economic conversion analysis, the study has developed computer economic models of both a typical Northern European Shipyard and also a typical North American Shipyard. These models have been used to evaluate the impact upon shipbuilding costs from working for many years under the influence of government contract provisions. Furthermore, the management of human resources, along with cultural and management philosophical differences, have proved to be important factors affecting U.S. shipyards ability to compete successfully on the open commercial shipbuilding market.

The project team has focused upon "White Collar" office staff functions and activities that are:

- usually all charged to indirect cost accounts in international shipyards, and
- often partially, if not totally direct charged in U.S. yards.

However, the project team has evaluated direct and indirect production functions in order to provide a solid background to the study results. Included is an assessment of hidden white collar costs on production costs.

Study Team: The project team has involved the following parties:

AMS:	American Management Systems - Norfolk, VA (Prime Contractor)
KMM:	Kvaemer Masa Marine - Annapolis, MD (Naval Architects and Shipbuilding Consultants working with Kvaemer Masa Yards, Turku & Helsinki, Finland)
SPAR:	System Programming, Analysis & Research - Annapolis, MD (Shipbuilding Business Systems Consultant and Software Engineer)
Avondale:	Avondale Shipyards - Avondale, LA (Pilot U.S. Shipyard)
SJSL	Saint John Shipbuilding Limited - Saint Job New Brunswick Canada (Pilot Canadian Shipyard)

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INTRODUCTION

Activity-Based Costing, or "ABC", has become a popular subject within financial accounting circles. It is being implemented successfully across a wide spectrum of industries, from manufacturing to service providers. ABC can also benefit shipyards, especially those implementing changes from building combatants to becoming commercially competitive.

For the pilot study, an activity based cost accounting work breakdown structure has been developed for a computerized cost model for

- atypical Northern European shipyard building three (3) 40,000 DWT product tankers a year for the international market and

- a construed typical U.S. shipyard also building the same vessels for the international market at a rate of three (3) per year

Estimates have been provided of the hidden costs that U.S. shipyards have inherited from decades of building ships for the U.S. government:

- in total, and

- for individual major cost categories

Along with these estimates, this study provides preliminary guidance to U.S. shipbuilding managers on how to reduce or eliminate these hidden costs.

Types of U.S. Shipbuilding Costs: Figure 1 illustrates the various major types of U.S. shipbuilding costs:

- The "Pure Commercial Costs" are what is expected in a purely commercial competitive environment. This assumes that the shipyard competes on a "world class" basis and its operations have not been contaminated by doing government contracts.

- The "Hidden Costs" are those undocumented by procedures but added because shipyard professionals and managers have been working within a government contracting environment.

- "Company Driven Costs" are due to bad business practices written into company policies and procedures over and above FAR and other government contract requirements.

- "Dual-Use Requirements" are added costs for commercial contracts while the shipyard is also performing government contracts. These are operational costs that are largely impractical to avoid even though the commercial contracts do not specifically require them.

- "FAR Requirements" are costs due to meeting Federal Acquisition Regulations.

- "NAVSEA Requirements" are costs necessary to satisfy Q and military contracting business practices beyond those imposed by FAR.

- "Military Technology" costs are due to meeting military product technology requirements, such as MIL Specs, etc.

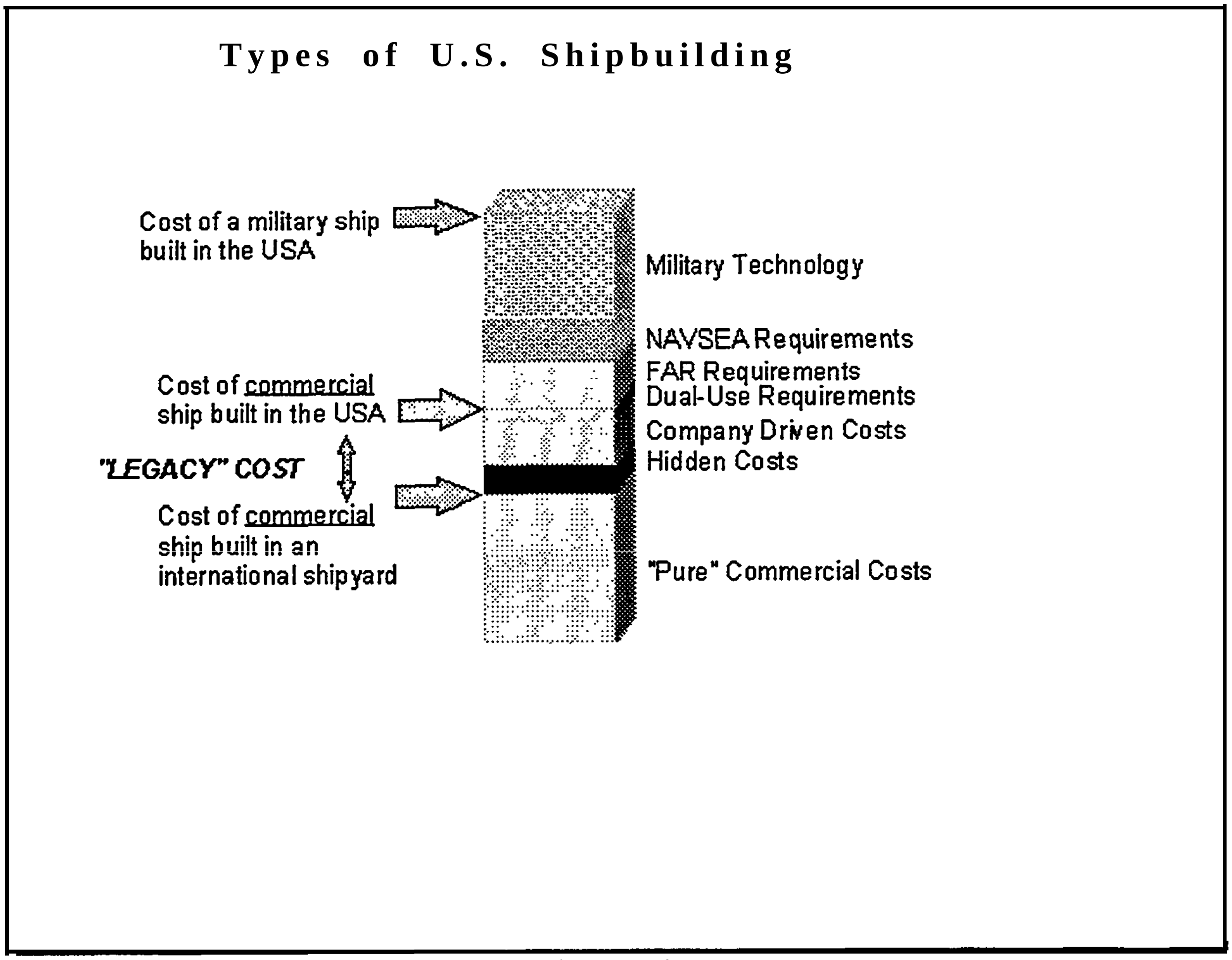

Figure 1

"gacy Costs"are the combined company-driven and hidden costs that represent the difference between building a commercial ship in the USA and at an international, world class shipyard. These are the added costs due to company imposed business practices and procedures and due to undocumented bad practices caused by years of building military ships under U.S. government contract terms and conditions.

These legacy costs are the primary focus of this pilot study project, and the approach taken to help identify them is an activity based cost analysis. A first-cut measure is to assess the U.S. shipyard indirect and non-production direct costs minus world class (Northern European) shipyard indirect costs.

Overall Tasks For Pilot Study: The following is a list of tasks undertaken by this pilot study

1. Develop a rough-order-of-magnitude ("ROM") estimate of the legacy costs in U.S. yards which are trying to economically convert from military shipbuilding to commercial shipbuilding (in whole or in part = "Dual Use").

2. Identfy/develop ROMs of some of the major individual legacy costs.

3. Based upon results from above, provide guidance to U.S. shipyard general managers on how to reduce and hopefully eliminate legacy costs.

Analytical Formatical The pilot study employs an activity based cost accounting work breakdown structure, which provides the basis for

- evaluating functions and personnel levels of the office staff to support a three (3) 40,000 DWT product tankers per year of shipbuilding operations, and for

- constructing a functional product tanker production plan that determines the manning of the planned operation.

In order to provide an analytical comparison between the U.S. shipyard and the "world class" shipyard, the study has developed cost models for each. The Kvaerner Masa Yards ("KMY") approach to ship design and construction forms the basis for the world class, Northern European shipyard model. The manning for this model has been developed from information provided by KMY and independently double checked using their "SEAKEY" software program. (Refer to Appendix I).

The U.S. shipyard model has been based upon detailed discussions with various staff members of Avondale Shipyards. These staff members represent the majority of senior managers from across the corporate spectrum of the shipyard's operations line managers and support personnel and were most helpful in providing information needed for the study.

To complement these models of the Northern European and the U.S. shipyards, a model of an equivalent Canadian shipyard has been developed for comparison purposes.

Finally, an actual case study is provided comparing two Norwegian shipyards, both of about the same size, but one building military vessels, the other commercial.

The cost models were then developed using SPAR's shipyard planning and operations modelling software.

ACTIVITY-BASED COST MANAGEMENT

Background: Free market competitors will always seek to ensure their hold on their market share. More aggressive competitors will strive for a greater share. The means to accomplish these goals is to offer a better product or service and to lower costs and shorten production schedules. Under these circumstances, other competitors had better follow suit and undertake similar improvements to their operations; otherwise, they eventually will be pushed out of business. For U.S. yards, no changes may also mean a closed door to new international marketing opportunities.

The shipyard's ability to compete and stay in business is greatly affected by its ability to know what it costs to do business. This information is necessary both for new contract proposals (contract estimating) and later for ensuring certain cost goals are being maintained during contract execution (performance measurement). As competition increases between shipyards, both here and abroad, the more accurate that these costs can be determined, the more confident a shipyard can be knowing that its bids are both competitive and mofitable. Contract performance measurement reporting, if done properly and consistently, will identify production activities and processes that need management attention to resolve various problems that threaten potential profits. These reporting functions also can identify high cost and high risk areas of production that should be examined for improvements. Measuring performance of these activities should enable the shipyard to better focus its limited resources towards those areas that promise the greatest return on investment for change.

Cost Categories: Costs come in various kinds: labor, material, sub-contract, facilities, cost of money, and many others. But fundamentally, costs traditionally are segregated into two distinct categories: direct costs and indirect costs. The latter are those associated with maintaining facilities and the personnel in support of those activities that are directly required for executing a contract.

Direct costs have traditionally been the target of management scrutiny and evaluation. Because of the products and services delivered, the business of a shipyard is complex. For most yards, new construction has always been managed by some variation of a work breakdown structure, whether by hull assembly and ship system and/or by transformed interim products and stage of construction. Ship repair remains dedicated to cataloging costs by job order or contract spec item, although a looser product-by-stage management style is gaining some popularity. The net result of these efforts to breakdown and catalog costs provides management with considerable strategic information with which to develop more confident bid estimates and for improving the management control of contracts that are under way.

Indirect costs, on the other hand, have not had the level of scrutiny they deserve. *Unfortunately, government contracts have not provided any incentive to make changes to minimize indirect costs: government cotracts allow profit to reapplied equally to both direct and overhead costs!* Nevertheless, shipyards understand very well that to stay competitive, these costs must be minimized. The conventional approach is to simply collect all indirect costs into one cost pool and apportion these costs uniformly across all contracts. Typically, the distribution is made on the basis of direct labor cost for each contract.

Sometimes, Government contracts require a second pool that segregates operations overhead from the indirect costs associated with general contract administration or "G&A". Federal contracts also limit what indirect costs can be included in these pools. If the shipyard is engaged in both government and commercial business, different pool costs may have to be managed.

The problem with having only one or two categories for pooling indirect costs is that it is very difficult to have the visibility to know what costs are truly necessary and what are not. Also, indirect costs can impact various contracts quite differently. For example, material control costs for new construction can be significantly greater per direct labor hour than what may be required for a ship repair contract. These costs can further be amplified for government contracts (Federal Acquisition Regulations requirements) vis-a-vis commercial contracts. If these indirect costs are uniformly applied across all contracts, some contracts may be unfairly burdened, while others are effectively subsidized for the extra cost of their operations.

These distinctions become important as the shipyard tries to reduce costs and improve its competitive position in the marketplace. With costs, both direct and indirect, better understood for the mix of products and services being rendered, adjustments to the operation and management of the shipyard may quickly prove very worthwhile. Then, redundant processes, unnecessarily complex procedures and other institutionalized bad business practices can be eliminated more easily.

Activity-Based Costing: Activity-based costing ("ABC") provides a means to collect indirect costs in multiple categories and then applies the results individually to the products and services (direct costs). Conventional accounting systems do not have the flexibility to perform multiple cost collections and then perform the application of these multiple cost pools to the products and services of the shipyard. There is no one best way to devise these categories, and there is a legitimate concern as to the extra costs probably required for the shipyard’s information systems to provide this additional information.

By using multiple overhead pools and cost drivers, activity-based costing can provide more accurate cost figures for costing and pricing shipyard products and services. ABC can help shipyard managers make better marketing decisions about what they offer. This process also encourages continual operating improvements.

It should be noted that ABC analysis as applied by KMM and SPAR to this comparison study of Northern European and North American shipyards has been applied at a more summary level of the functional organization and without the rigorous detail that AMS would apply to, say, a U.S. naval shipyard operation. It is believed that it is not necessary to get into the functional analysis detail normally done in ABC in order to identify the relatively gross differences between European and American practices.

Activity-Based Budgeting: By providing a better understanding of what it costs to do business at the process level, activity-based costing can help the shipyard develop and implement meaningful changes that enhance the shipyard’s ability to compete. Once business process costs are known, activity-based budgeting can set realistic goals for improving the processes and for identifying those processes that are no longer needed or are unprofitable. However, to gain maximum benefit from this, the shipyard should change the way in which it develops its budgets.

The traditional approach is for the organization to generate budgets from the bottom up. This process tends to institutionalize a way of thinking of business-as-usual at the department level. Them with budget numbers passing through successive layers of the company, they finally come to rest at the top of the organization where senior executives already have in mind what figures are acceptable. At this point, much of the time and expense of the departments' efforts are usually wasted.

Unfortunately, those at the top have little understanding of how and where these budgets were derived, nor do they know precisely if the budgets truly move the company forward. When management dictates revised budgets, department managers scramble to make adjustments, but tend to focus mostly on money saving issues that may have little bearing upon satisfying the strategic goals of the shipyard.

Instead, the traditional "bottoms-up" method of budgeting should be eliminated and replaced with a top-down approach. Top management should set targets for revenue and profit growth, including fundamental pricing and product requirements for new business based upon market intelligence. Then, from these fundamental strategic goals, the departments should develop plans to achieve them. This forces departments to think more in terms of performance issues and be more focused on making management’s direction successful. The departments are closer to the detail business activities of the company and can have a better idea of what performance changes need to be made.

This top-down approach is more likely to inspire a company to be innovative and make meaningful changes that are necessary for the shipyard to remain competitive.

Support Costs Managed As Direct: Many North American shipyards charge a variety of shipyard support services (level-of-effort) directly against contracts. These typically include such services as temporary power, lights, air, material handling (cranes & rigging), supervision, planning and production control, etc. The reason shipyards have been managing each of these items as direct costs is not necessarily because government contract FAR regulations encourage them to do so. Traditionally, shipyards have recognized that these activities are very much related directly to production activities (in a similar way that support trades are related to lead trade work). These services are also expensive and need to be budgeted and managed along with other direct charges activities. This treatment is precisely the same concept of activity-based costing possible for other indirect costs.

ABC & Defense Contractor Shipyards: ABC for shipyards who traditionally have been engaged in U.S. naval ship construction and repair work should find it a worthwhile exercise to expand the overhead account pools with the following:

- Extra FAR Procurement Overhead Costs
- Extra DoD Subcontractor Regulation Requirements
- Extra DoD Record Keeping & Reporting Requirements
- Extra DoD Audit & Oversight Requirements
- Extra DoD Product Cost Data Requirements
- Extra DoD Socioeconomic and Mandatory Source Requirements Direct & Indirect) Costs
- Extra DoD Requirements for Rights In Technical Data
- Extra DoD Security Requirements
- Extra DoD -Unique Product & Process Specifications & Standards Costs
- Extra DoD Legal Process Requirements
- Extra DoD Quality Assurance Requirements
- Extra DoD Trade Skill Qualifications Requirements

Regardless if the above costs are managed as direct or indirect costs, budgeting and tracking them will help the shipyard determine the extent that government contracting has added to the cost of doing business. These costs are significant (contributing to at last one-half of the premium costs required to design and build military vessels) when compared to what is typically required for "Northern European" commercial shipbuilding and ship repair. Unless the shipyard fully understands the scope and nature of these costs and how they are relevant only to DoD contracts, commercial work maybe unnecessarily penalized, both in pricing and in actual execution.

The following (Table # 1) offers a selected listing of major cost drivers and what shipyard activities are directly affected.

COST DRIVER	SHIPYARD ACTIVITY
1. MIL-Q-9858A	QA
2. Truth in Negotiation Act (TINA)	Accounting & Finance
3. Cost/Schedule Control System (C/SCS)	Program Management
4. Configuration Management Requirements	Engineering
5. Contract Specific Requirements	Contracting & Purchasing
6. DCAA/DCMOA Interface	Accounting & Finance
7. Cost Accounting Standards (CAS)	Accounting & Finance
8. Material Management Accounting System (MMAS)	Material Management
9. Engineering Drawings	Engineering
10. Government Property Administration	Material Management

Table 1: Background Information On D.o.D. Level Regulatory Costs
The 10 Key Cost Drivers

There have been a number of studies already made that have determined the size and scope of these premium costs for the design and construction of military ships. The focus of this study, on the other hand, is to determine the size and scope of the legacy costs which exist within U.S. shipyards trying to compete in the international, commercial market.

NORTHERN EUROPEAN COST MODEL
(Three 40,000 DWT Product Carriers Per Year)

The best place to begin developing a shipyard cost model is to first model a "Northern European" shipyard, then proceed to formulate a proposed cost model for an American shipyard.

The general build strategy for a Northern European shipyard is to design and construct ships using modern pre-outfitted modular construction methods. The focus of these yards' build strategy can be outlined as follows:

- Maximize outfitting on block to reduce construction time and production costs
- Maximize work in shops where conditions are more suited for productivity; minimize work after launch
- Execute the hull production operation in one shop using structural department personnel, including the outfitting work which is done prior to block sweep blasting and painting
- Expand use of automation, especially some applications of robotics manufacturing
- Eliminate as much non-steel in-yard manufacturing as possible through the use of subcontractors for piping packages, modular machinery packages, complete modular cabins, cruise ship public spaces and other similar work
- Off-load responsibility for development of production drawings for non-yard activities to the subcontractors

> Note: The *Japanese estimate that the average work requtig one (1) hour in a shop takes three (3) houm on the dock and five (5) hours if done on the ship.*

The primary focus of the yard is towards maxirnizing productivity of the assembly processes:

- Maximize assurance that correct material is available on time to support production
- Minimize material handling and storage requirements
- Minimize number and complexity of parts

- Maximize longitudinal orientation of the hull structures to maximize use of the highly efficient panel line manufacturing facilities
- Eliminate all instances of non-value labor costs
- Maximize responsibility and problem-solving down to the worker level
- Maximize under-cover work
- Maximize access to work for not only the worker, but the supply of material for the worker

Supporting these objectives are facilities that have heavy investment in large assembly halls, modem automated shipbuilding equipment and highly-skilled, trained and responsible people having the same cultural values.

The Northern European Cost Model: The following (Table #2) is a breakout of the hull production processes required for the 40,000 DWT product carrier. Table #3 provides the production labor distribution of the work of this ship. The production throughput for a continuous annual production of three (3) of the ships is based upon a shipyard that has experienced a reasonable learning curve from building product carriers. The production cost figures represent what would be expected after building the fourth ship of a class.

Table 2:
Northern European Structural Production Characteristics For A 40K DWT Product Carrier

Steel Weight (Metric Tons)	8,500
Percent Of Total Steel Undergoing Each Production Process:	
% Prefab	100
% Flat Panel Line Operations	60
% 3-D/Curved Panel Construction	40
% Bow& Stern Assembly	16
% Mid-Body Block Assembly	84
% Block Erection	100

Table 3: Production Labor Distribution

Overall Work Breakdown:		
% Steel Man-Hours	40	Breakdown of Total Work
% Paint Man-Hours	10	
% Outfit Man-Hours	50	
% Outfit Steel	16	Breakdown of Outfit Man-Hours
% Outfit Pipe	42	
% Outfit Electrical	16	
% Outfit HVAC	5	
% Outfit Machinery	21	
% Yard Services Man-Hours	10	Percent of Total Direct Production

The following (Table #4) breaks out the estimated labor man-hour costs for each of the ships built per year with a total yard man-hours and equivalent production manpower requirement (an average figure of 1700 man-hours per man-year has been used to develop the manpower requirements). The steel, outfit and yard services content have been computed from the production requirements developed for each of the ships being built (Table #2 & 3).

Table 4: Shipyard Product WBS

	3-Ships	3-Ships	Ship #1	
	Total Hours	Total Man-Yrs	Hrs/Mtons	Hours
PRODUCTION:				
Steel Prefab:	102,000	60	4.00	34,000
Steel Panels:	45,900	27	3.00	15,300
Steel 3-D Curved Panels:	61,200	36	6.00	20,400
Bow & Stern Ass'y	57,120	34	14.00	19,040
Block Ass'y	107,100	63	5.00	35,700
Block Erection	127,500	75	5.00	42,500
Total Steel:	500,820	295	19.64	166,940
Block Paint Shop:	38,250	23	1.50	12,750
Onboard Paint:	86,955	51		28,985
			% Outfit	
Outfit Shop:	93,904	55	15.00	31,301
Pre-Outfit Hot:	93,904	55	15.00	31,301
Pre-Outfit Cold:	150,246	88	24.00	50,082
Ship Zone Outfit:	287,972	169	46.00	95,991
Total Outfit:	626,025	368	100.00	208,675
TOTAL PRODUCTION:	1,252,050	737		417,350
YARD SERVICES:	125,205	74		41,735
TOTAL OVERHEAD STAFF:	180,200	106		
TOTAL YARD:	1,557,455	916		459,085

The purpose of modelling production direct labor costs here is to establish the general size of the shipyard's manpower requirements. Once this is known, the overhead and other support staffing requirements can be determined.

From a more traditional ship systems work breakdown structure, the same labor content can be developed as illustrated in Table #5.

Table 5: Basis For Ship WBS

	40K DWT Product Carrier
Production Man-Hrs:	417,350
Structure:	166,940
Paint:	41,735
Outfit Steel:	33,388
Outfit Pipe:	87,644
Outfit Elect.	33,388
Outfit HVAC:	10,434
Outfit Mach'y:	43,822
Yard Services Man-Hrs:	41,735
Total Production:	459,085

Appendix I presents an independent cost study developed by ship systems using KMY's "SEAKEY" software program. It is in very close agreement with the above estimate of production man-hours developed by interim ship products.

Indirect Staffing: The overhead staffing requirements are the remaining pieces of the Northern European cost model. The following (Table #6) provides a breakdown of the various overhead functions needed to support the production program already presented.

Table 6: Indirect "White Collar" Staff Charging to Overhead

SHIPYARD OVERHEAD ORGANIZATION:				
	Total	Total	Manager*	Support**
	Man-Hrs	Man-Yrs	Professional	Technical
SHIPYARD GENERAL MGMT:	5,100	3	1	2
MARKETING:	3,400	2	2	0
LONG TERM FACILITIES PLAN'G				
Gen.Estimating&Planning	1,700	1	1	0
QA & ISO 9001	1,700	1	1	0
Facilities Development	1,700	1	1	0
MIS	3,400	2	1	1
STRATEGIC & OVERALL PLAN'G	1,700	1	1	0
PROJECT MANAGERS:				
Active Contracts	1,700	1	1	0
Assisting Marketing	1,700	1	1	0
ENGINEERING DESIGN:	3,400	2	1	1
Basic Design Projects:	8,500	5	4	1
Design Planning:	1,700	1	1	0
Design:	3,400	2	1	1
Machinery	6,800	4	1	3

	Total	Total	Manager*	Support**
	Man-Hrs	Man-Yrs	Professional	Technical
HVAC	3,400	2	1	1
Interiors	5,100	3	1	2
Deck & Outfit	5,100	3	1	2
Electric	5,100	3	1	2
PURCHASING & MATERIAL:	3,400	2	1	1
Purchasing:				
Senior Buyers	3,400	2	2	0
Buyers	1,700	1		1
Material Control:	1,700	1	1	0
Outfit	3,400	2		2
Steel Yard	1,700	1		1
PRODUCTION:	3,400	2	1	1
Planning:	5,100	3	2	1
Hull Planning				
Outfit Planning				
Estimating				
Hull Design:	22,100	13	11	2
Production:	5,100	3	2	1
Hull Mfg	3,400	2	2	0
Hull Ass'y & Erection	5,100	3	2	1
Painting	3,400	2	1	1
Pre-Outfit	5,100	3	2	1

	Total	Total	Manager*	Support**
	Man-Hrs	Man-Yrs	Professional	Technical
Machinery	5,100	3	2	1
Interior	3,400	2	1	1
Electrical	5,100	3	2	1
Maintenance:	3,400	2	1	1
Sub-Contractors:	3,400	2	1	1
PERSONNEL:	3,400	2	1	1
Training	1,700	1	1	0
Information Systems	1,700	1	1	0
Work Protection	1,700	1	1	0
Health Services	3,400	2	1	1
FINANCE:	3,400	2	1	1
Accountants	1,700	1	1	0
Accounts Payable	3,400	2	1	1
Accounts Receivable	1,700	1	1	0
Charge Number Manager	1,700	1	1	0
Payroll	1,700	1	1	0
LEGAL:	1,700	1	1	0
TOTAL YARD OVERHEAD STAFF:	180,200	106	68	38

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* Includes professional level as well as management or supervisory functions; almost always college graduate or post-graduate level.

** Includes clerical, drafting/designer, detail planner, etc. functions; usually, but not necessarily, non-college graduate level.

Chart 1 provides a graphical presentation of the major activities of the Northern European shipyard model.

Note that the overhead staff presented above in Table 6 includes professional planning, estimating, design and engineering services, which are more typically treated as direct charges by American shipyards. Table 7 breaks out from the European indirect personnel seventy-four (74) positions that are normally direct charged in the US.

Table 7: Summary Indirect White Collar" Staff Charging to Overhead

	Total Man-Hrs	Total Man-Yrs	Manager*	Support**
CONTRACT ORIENTED INDIRECT:				
Project Mangers:	1,700	1	1	0
Engineering & Design:	42,500	25	12	13
Purchasing/MatCon:	15,300	9	4	5
Production Plan'g/Mgmt	66,300	39	28	11
TOTAL SUBTOTAL:	125,800	74	45	29
GENERAL OVERHEAD:	54,400	32	23	9
TOTAL YARD OVERHEAD STAFF:	180,200	106	68	38

Northern European Shipyard Model

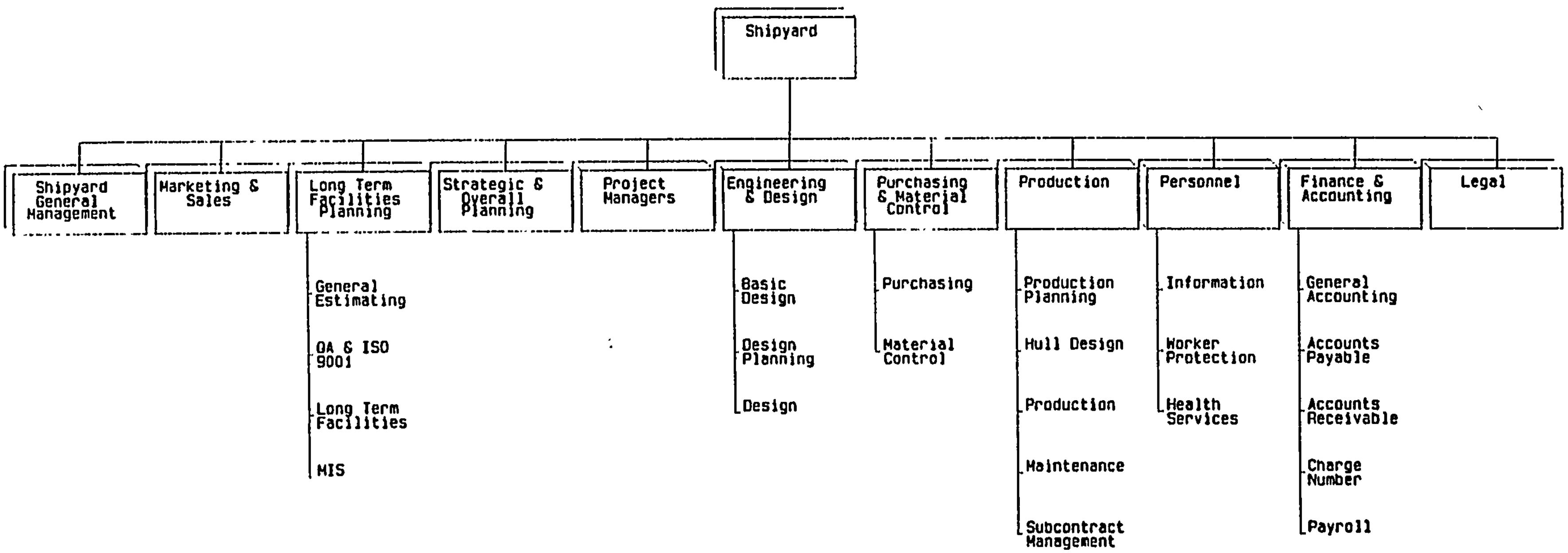


Chart 1

Project Technical Teams: Another important feature of the Northern European shipyard is its team orientation around each shipyard project. Table 8 outlines the basic project technical team organization:

Table 8: Primary Project Technical Team

	Man-Hrs	Persons
Project Manager	1,850	1
Senior Systems Designers		
Electrical	3,700	2
HVAC	1,850	1
Propulsion	1,850	1
Interior	5,550	3
Ship Zone Engineers		
Machinery Spaces	3,700	2
Deck Areas	3,700	2
Public Spaces	1,850	1
Subcon. Public Spaces	3,700	2
TOTALS:	27,750	15

European shipyards use a matrix approach to assigning responsibility. Design engineers are initially assigned responsibilities for managing the development of the various ship systems. Then, as hull blocks and ship zones are defined, additional responsibilities are assigned to manage these throughout the production process.

The following (Figure 2), illustrates this matrix approach. The designers responsible for the ship systems maintain configuration control over the systems as they are transformed into the hull block and zone outfit requirements.

Design Responsibility Matrix

		Hull Blocks							BLOCK ERECTION	Ship Zone Areas				
Ship System	**System Designer**	Block 201	Block 202	Block 203	Block 204	Block 301	Block 302	Block 401		Area 200	Area 300	Area 400	Area 500	Area 600
Bilge & Ballast	ABC	✓			✓		✓			✓	✓			
Fire & Wash	ABC	✓				✓	✓	✓		✓	✓	✓		
Salt Water Circ.	XYZ		✓											
Fr. Water Cool	XYZ	✓		✓						✓				
Fuel Oil Transf	XYZ					✓	✓				✓			
Lube Oil	QRS					✓		✓			✓	✓		

Figure 2

The technical teams are expected to include important elements from other areas of the shipyard: purchasing and production. Together, these teams focus upon the detail engineering, material and manufacturing process requirements for the interim shipyard products: pre-outitted hull blocks, outfit and equipment modules and zone-oriented on-board work.

NORTH AMERICAN SHIPYARD MODEL
(Three 40,000 DWT Product Carriers Per Year)

The following develops a cost model for an equivalent shipyard in North.America producing the same 40,000 DWT product carriers per year. Similar to the Northern European shipyard model, it is assumed that the production throughput is the result of a reasonable learning curve from building a series of these product carriers. The production cost figures represent what would be expected after building the fourth ship of a class.

It is further assumed that this shipyard performs only commercial work so that its operations have not been complicated with procedures required to perform government contracts. The shipyard successfully uses modem build strategies of advanced pre-outfitted hull blocks, zone outfit and group technology manufacturing methods to be competitive with world class international shipbuilders (Figure 3). Also, the shipyard employs a full range of modem CAD/CAM/CIM systems that are integrated with financial and administrative systems. The shipyard often employs outside technical services to augment its own technical work force. No assumptions have been made with respect to using outside manufacturing and turn-key services, although this shipyard would be exploiting these cost and schedule saving opportunities whenever they make sense.

North American White Collar Staffing Requirements: Table 9 provides a functional activity head-count of white collar employees for the hypothetical North American Shipyard.

The general method employed to determine these white collar staffing levels was to work extensively with the management of Avondale Shipyards. The KMM/SPAR team spent many days during frequent visits to the shipyard. Time was taken to carefully brief all Avondale managers on the study objectives, the approach to be taken with Avondale and the lessons learned and the team’s results from the several weeks long study of Kvaener Masa-Yards in Finland. Then, in-depth quality time was spent with each key operational and staff support organization/department to determine how they would organize for a purely commercial three 40,000 DWT product carriers per year program for ships to be operated by non-U.S. Flag operators (international market). Working with this extensive database of information, the KMM/SPAR study team then developed what appeared to be the staffing requirements for a U.S. shipyard operating in the international commercial market. This yielded a total white collar staffing level of 176 people.

This study team’s organization and functional analysis was reviewed in detail by the Avondale managers originally interviewed. Their thinking and direction was then applied to create the first column of Table 9, NASY-1. It is a breakdown of the 266 white collar staffing for the North American Shipyard resulting from this detailed review. The relatively high staffing requirements reflects years of living with the many organizations that must deal with the varied problems of lower work force skills and government employment safety and environmental regulations as well as government contract requirements.

One senior Avondale manager interviewed has had many years of ship design, quality assurance, and shipbuilding experience reaching back to the time when Avondale was a leading U.S. yard in building commercial cargo ships. He was kind enough to evaluate all the functions of a three 40,000 DWT product carriers per year shipyard. Based on his knowledge of building ships for commercial customers without U.S. government shipbuilding contract requirements, he organized a yard requiring a white collar staff of only 138 personnel. The second column, NASY-2, is his breakdown.

The third column, NASY-3, is the result of re-interviewing Avondale managers to further clarify commercial versus military (government contracting) business practices, and to ensure that the proposed personnel were really necessay. This resulted in 172 people as shown on Table 9, compared to 106 for the Northern European shipyard, NESY, shown at the end of the table in the fourth column. No further breakdown is provided in this table, because the Northern European shipyards are organized quite differently from the traditional American activity breakdown. The American model uses the traditional separation of engineering and production activities, while the European model combines many of these activities into product teams. In addition, the American model typically organizes production activities according to separate trade or craft. The European model, on the other hand, organizes activities as basically steel work versus outfit; the identity of the individual trades or crafts tends to disappear as much of the outfit manufacturing work is out-sourced. This reduces the shipyard's activities to mostly product assembly and installation efforts that can be performed by more generalized skill groups.

Shipbuilding Production Process

Primary Shipyard Work Centers

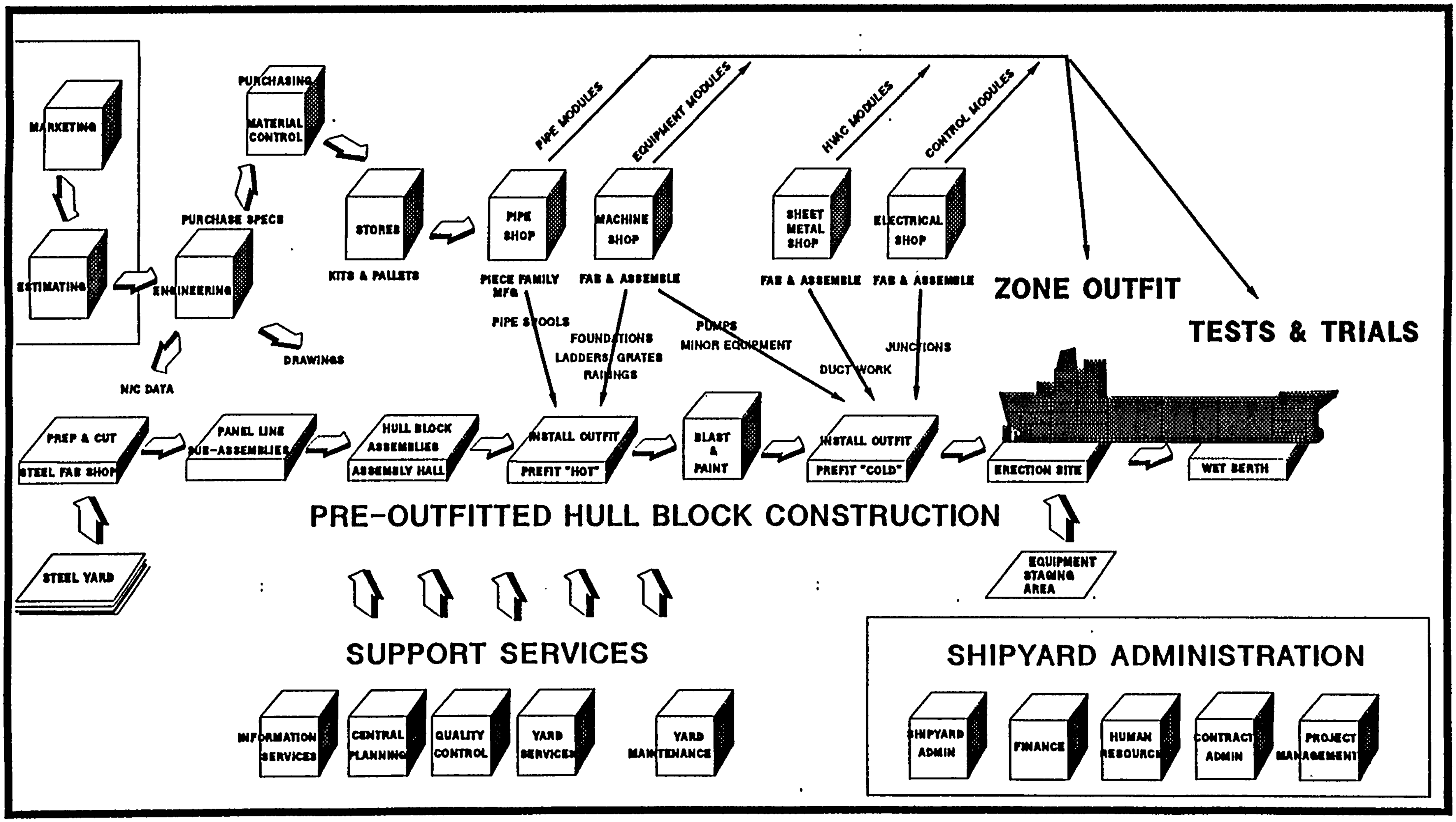


Figure 3

At the bottom of the table are totals for each shipyard "model". The white collar totals are combined with estimated blue collar totals. The Northern European model has been developed for maximum labor productivity. Estimates for the 40,000 DWT product carrier is for a total 460,000 production man-hours (includes supports services, but does not include "white collar"). The American models have been developed to be somewhat less productive: 655,000 man-hours. Some of the differences are judged to be that the American shipyard does not have the same opportunities for out-sourcing outfit manufacturing work as is typical in Europe. This out-sourcing to highly efficient manufacturers of various kinds has proved to reduce costs significantly, even when converted to equivalent shipyard labor man-hours.

Table 9: "White Collar" Staffing Requirements

	NASY-1	NASY-2	NASY-3	NESY
ADMINISTRATION	6	3	6	
CEO	1		1	
Fast Track Assistant	2		2	
Secretary	1		1	
Office Manager	1		1	
Clerk	1		1	
MARKETING	3	4	3	
Marketing Manager	1		1	
Secretary	1		1	
Proposal Managers	1		1	
CONTRACT/LEGAL ADMINISTRATION	10	2	7	
ESTIMATING	5	1	5	
Manager/Lead Estimator	1		1	
Hull Estimator	1		1	
Mechanical Estimator	1		1	
Outfit Estimator	1		1	
Clerk	1		1	
Change Orders				

	NASY-1	NASY-2	NASY-3	
CONTRACT ADMINISTRATION	4	1	2	
Contracts Manager	1	1	1	
Assistant Contracts Manager	1			
Special Claims	1			
Secretary	1		1	
LEGAL	1	0	0	
Attorney	1			
PROJECT MANAGEMENT	14	6	10	
PROJECT MANAGERS	5	6	4	
Program Managers	2	2	2	
Assistant Program Managers	2	2	1	
Secretary/Clerk	1	2	1	
CENTRAL PLANNING	7		4	
Planning Manager	1		1	
Resource Analyst	1			
Key Event Scheduling	1		1	
Block/Zone Scheduling	1		1	
Design Scheduling	1		1	
Material Scheduling	1			
Work Progressing	1			
TECHNICAL SUPPORT	2		2	
Project Engineers	2		2	

	NASY-1	NASY-2	NASY-3	
ENGINEERING	53	59	52	
PRE-CONTRACT DESIGN	7	5	6	
Manager	1	0	1	
Secretary	1	0	1	
Ship Designers	5	5	4	
Hull Technical	1	1	1	
Structural	1	1	1	
Mechanical	1	1	1	
Outfit	1	1	1	
Other	1	1		
CONTRACT ENGINEERING	42	50	42	
Manager	1	0	1	
Secretary	1	0	1	
Engineers & Designers	40	50	40	
Ship Design	3	3	3	
Weights	1	1	1	
Steel Take-Off	1	1	1	
Outfitting	4	5	4	
Hull Development	4	5	4	
Electrical	5	7	5	
HVAC	2	2	2	
Piping	4	5	4	
Machinery	3	4	3	
Planning	1	1	1	
Miscellaneous Support	0	0	0	
Specifications Control	1	1	1	
Accuracy Control	2	2	2	
Cost Analysis	1	1	1	
Reproduction (Files)	2	2	2	
Loft	6	8	6	

	NASY-1	NASY-2	NASY-3	
PROVISIONING	3	3	3	
TEST PLANS	1	1	1	
MATERIAL:	33	21	25	
PURCHASING	13	6	8	
Manager	1	1	1	
Secretary	1	1	1	
Requisition Clerk	3	2	0	
Steel & Metals Buyer	1	1	1	
Electrical & Mechanical Buyer	2	1	1	
General Material Buyer	1	0	1	
Maintenance Buyer	1	0	0	
Expeditors	2	0	2	
Cost Analyst (see Engin'r'g)	0	0	0	
Traffic Coordinators	1	0	0	
MATERIAL CONTROL	20	15	18	
Manager	1	1	1	
Secretary	1	1	1	
Receiving Clerks	2	4	3	
Warehouse Clerks	4	4	4	
Steelyard Clerks	6	4	4	
Outside Pipe Clerks	2	1	2	
Outside Machinery Clerks	0	0	0	
Small Tools Clerks	2	0	2	
Fabricated Parts Storage	1	0	0	
Vendor Services	1	0	1	

	NASY-1	NASY-2	NASY-3	
PRODUCTION:	73	20	29	
PRODUCTION ADMINISTRATION	5	5	5	
VP, Production	1	1	1	
Secretary	1	1	1	
Clerical	1	1	1	
Steel Superintendent	1	1	1	
Outfit Superintendent	1	1	1	
PRODUCT'N PLANN'G & ENG'RING	6	3	4	
Manager	1			
Secretary/Clerk	1			
Planners	2	1	2	
Production Engineers	2	2	2	
PRODUCTION DEPARTMENTS:	62	12	20	
STEEL ADMINISTRATION	2	1	1	
STEEL PRE-FAB & FAB	11	1	4	
WELDING DEPARTMENT	4	1	1	
ELECTRICAL DEPARTMENT	3	1	2	
MACHINE SHOP	5	1	2	
PAINT DEPARTMENT	3	1	1	
PIPE (Incl. Module Shop)	5	1	2	
RIGGING DEPARTMENT	2	0	0	
SHEET METAL (Incl. Engraving)	4	0	1	
SHIPFITTING (Ass'y & Erect)	13	2	2	
SCAFFOLDING & CLEANING	2	0	0	
OUTFIT	3	1	1	
DRYDOCK	2	1	1	
TESTS & TRIALS	3	1	2	

	NASY-1	NASY-2	NASY-3	
QUALITY ASSURANCE	16	2	10	
Manager	1			
Secretary/Clerk	1			
INSPECTIONS GROUP:	12 1/2	2	8	
Manager	1		1	
Erection & Unit Fab	4		1	
Ship Completion	3		1	
Material Receiving	1		1	
Steel Inspection	2			
NDT Testing	1		0	
Test Lab	0		2	
Equipment Calibration	1/4		0	
Quality Deficiency Reporting	0		0	
Statistical Process Control	1/4		1	
PROCEDURES GROUP:	1 1/2	0	2	
ISO Audit Manager	1/4		1	
Secretary/Clerk	1		1	
Procedures Development	0		0	
Training Certifiers	1/4		0	
PLANT ENGINEERING & MAINTENANCE	8	7	8	
MAINTENANCE:	3	3	3	
Manager	1	1	1	
Secretary/Clerk	1	1	1	
Electrical				
Heavy Equipment				
Pipe & Hose				
HVAC				
General Facilities				
Computers & Communications	1	1	1	

	NASY-1	NASY-2	NASY-3	
Scrap Yard				
SECURITY	2	2	2	
Security Manager	1	1	1	
Secretary/Clerk				
Security Officer	1	1	1	
FIRE DEPARTMENT	1	1	1	
ENVIRONMENTAL	2	1	2	
Manager	1	1	1	
Secretary/Clerk	1		1	
Hazardous Waste				
Water Quality				
Air Quality				
FINANCE & ACCOUNTING:	26	10	12	
FINANCE:	4	3	3	
CFO	1	1	1	
Treasurer/Comptroller	1	1	1	
Secretary	2	1	1	
ACCOUNTING:	19	5	6	
Accountants	4		1	
Payables Clerks	5	2	2	
Receivables Clerks	1			
Payroll Clerk	2	1	1	
Time Keepers	3	1	1	
Clerks	4	1	1	
Insurance				
ESOP/Retirement Plans				

	NASY-1	NASY-2	NASY-3	
INFORMATION RESOURCES:	3	2	3	
Manager	1	1	1	
Secretary/Clerk				
Network Management	1	1	1	
Database Administration	1		1	
Financial & Accounting Systems				
CAD/CAM Systems				
Production Control Systems				
Office Systems				
HUMAN RESOURCES:	26	4	10	
HR ADMINISTRATION:	2	1	2	
Manager	1	1	1	
Secretary	1		1	
EMPLOYMENT & TRAINING:	7	1	5	
Benefits	2		1	
Employment	3		2	
Compensation	1			
Affirmative Action	1		1	
Training	0	1	1	
HEALTH & SAFETY:	17	2	3	
Medical Services	7	1	1	
Safety & Hygiene	10	1	2	
ILS:	0	0	0	
SHIP REPAIR DEPARTMENT:	0	0	0	
INDUSTRIAL PRODUCTS DEPARTMENT	0	0	0	

	NASY-1	NASY-2	NASY-3	NESY
OTHER:	0	0	0	
TOTAL "WHITE COLLAR":	266	138	172	106
TOTAL PRODUCTION "BLUE COLLAR":	1,050	1,050	1,050	737
PRODUCTION SERVICES:	105	105	105	74
TOTAL "BLUE COLLAR":	1,155	1,155	1,155	811
% "WHITE COLLAR":	23.03	11.95	14.89	13.07

Chart *2* provides a graphical presentation of the major activities of the North American shipyard model.

Shipyard Manpower Model: To model the manpower requirements, a man-hour distribution curve (Figure 4) was applied to a 12-month build cycle. The distribution assumes that the first 70% of the ship can be completed in the first 6-months of its build cycle (a slightly heavy start-up schedule); the remaining 30% is completed over the remaining 6-months.

Figure *5* illustrates the single ship production manpower. It presents the man-hour distribution curve converted to equivalent men (1700 man-hours per man-year). Figure 6 provides a monthly averaging of this manpower requirement.

Figure 7 illustrates a staggering of ship schedules with a delivery planned every four (4) months.

Figure 8 illustrates a total shipyard production manpower requirement that reflects the staggered schedules, including a carry over of remaining work from a prior year. A monthly averaging of the total manpower is provided in Figure 9.

North American Shipyard Model

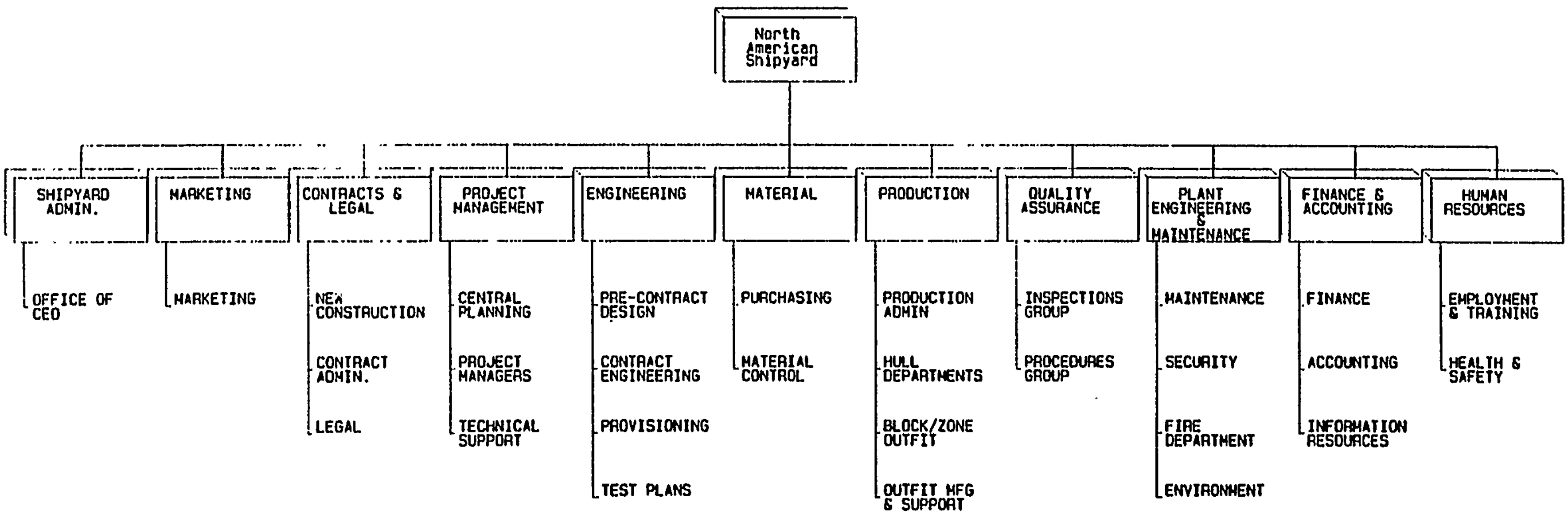
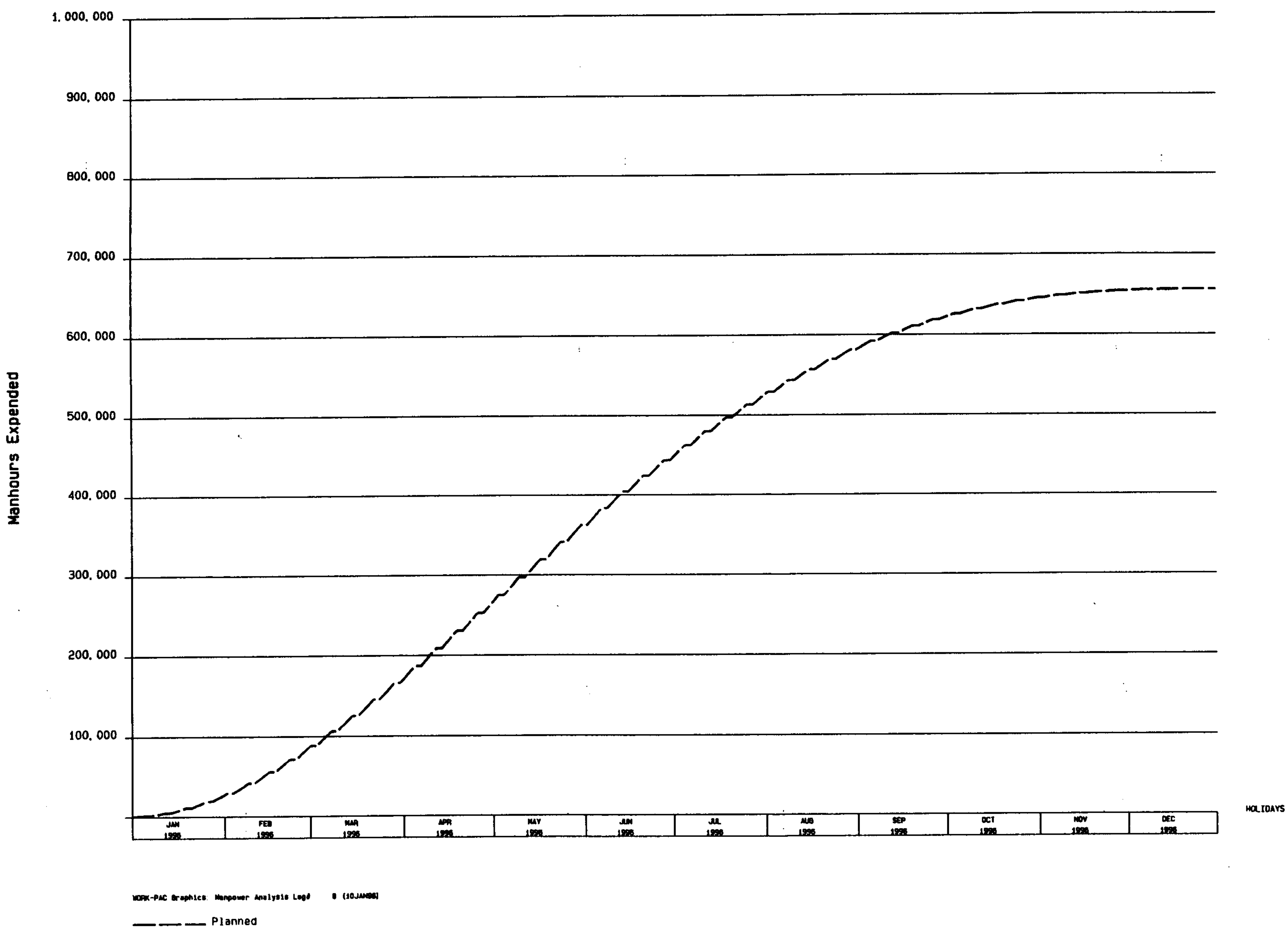


Chart 2

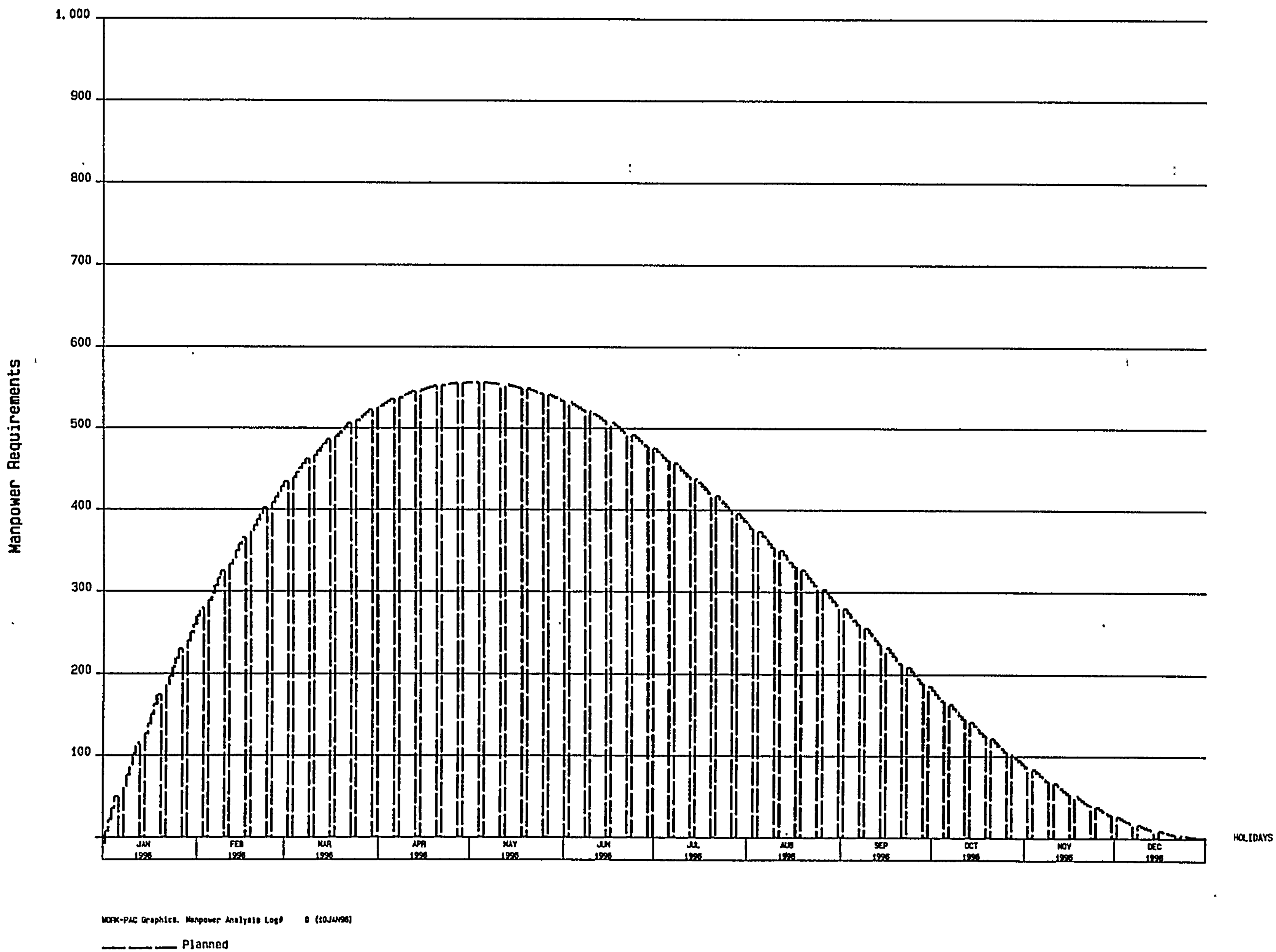
Total Manhours

Figure 4: Single Ship Production Hours



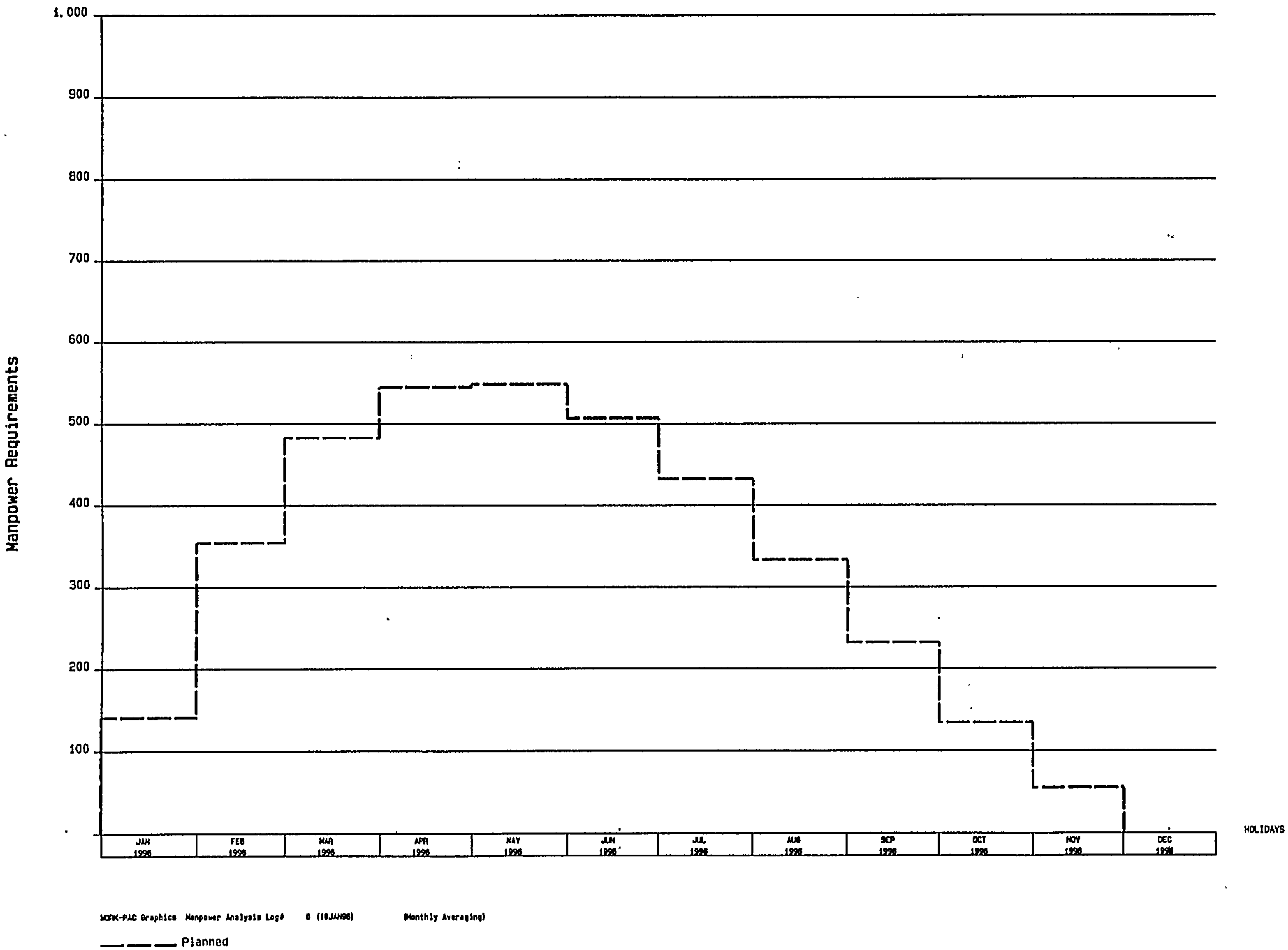
Total Manpower

Figure 5: Single Ship Manpower



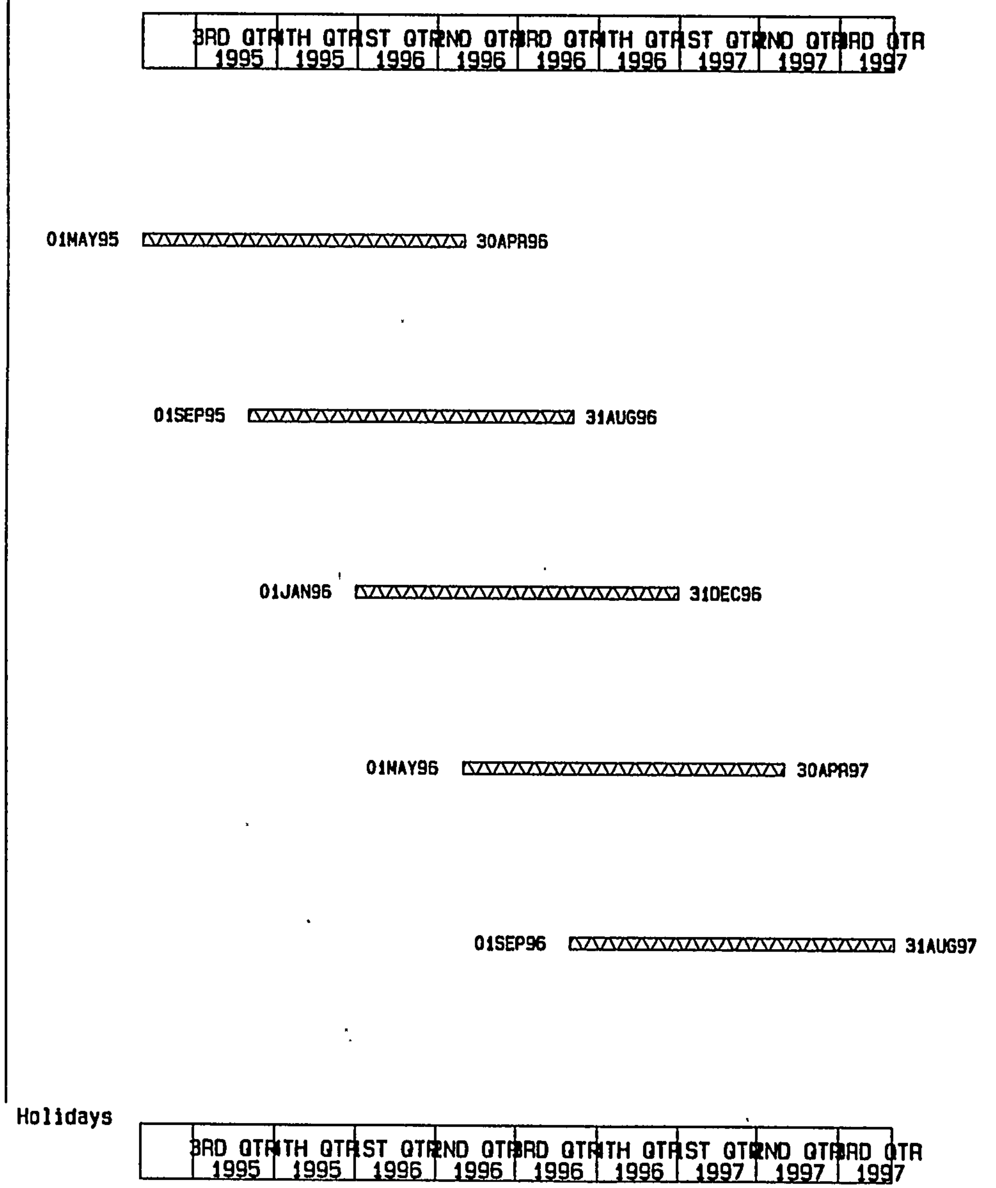
Total Manpower

Figure 6: Single Ship Averaged Manpower



Package Definitions

Project	W/C	Package	Description	Zn	Unit
1996	0	5	1995 40k DWT ship		0
1996	0	4	1995 40k DWT ship		0
1996	0	1	40k DWT Product Carrier		0
1996	0	2	40k DWT Product Carrier		0
1996	0	3	40k DWT Product Carrier		0



WORK-PAC Barchart

Shipyard

Section 1 of 1 (10JAN96)

= Current Plan
= Actual Dates
= Earned Plan

Figure 7: Production Schedule

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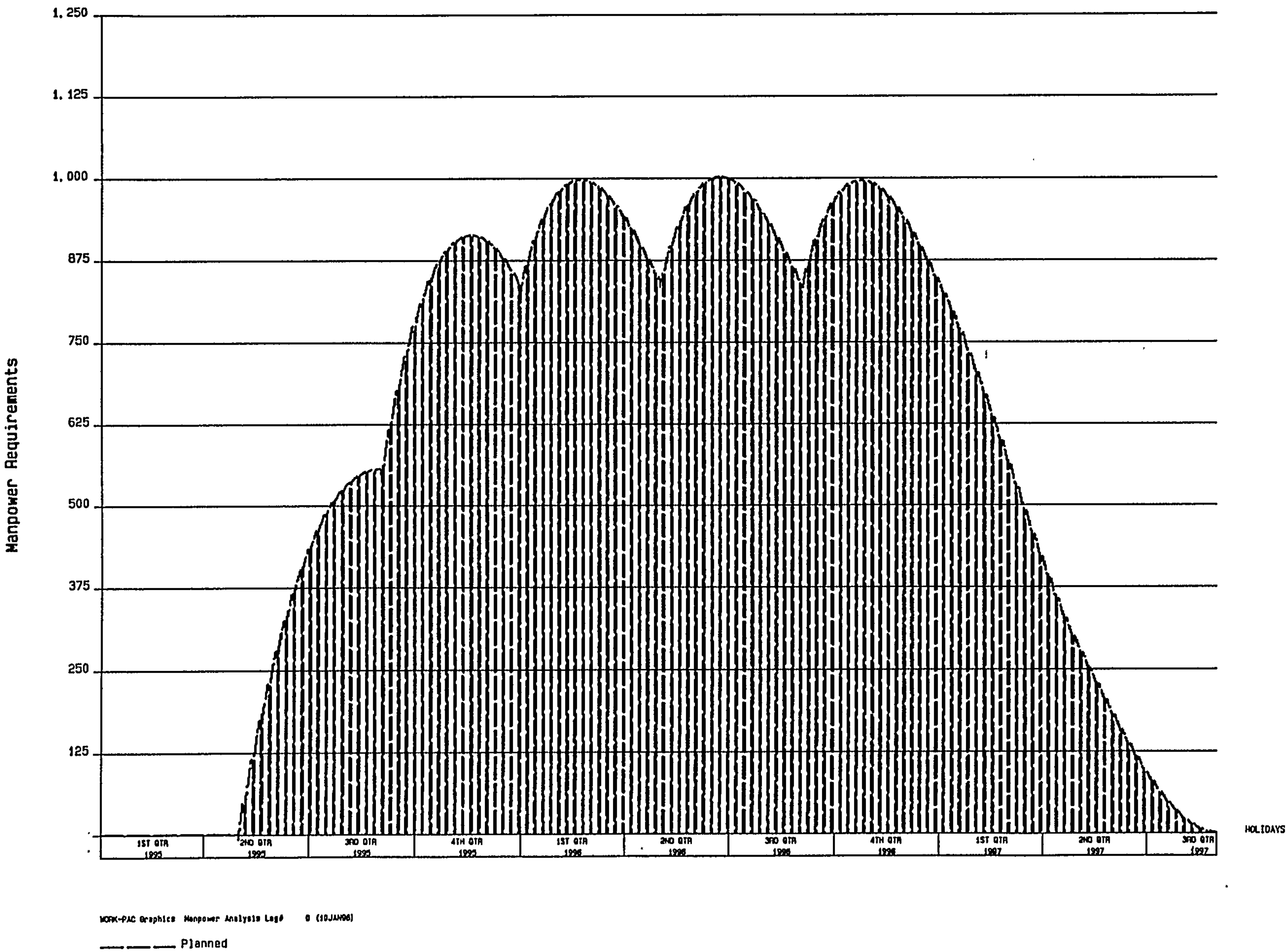
Total Manpower

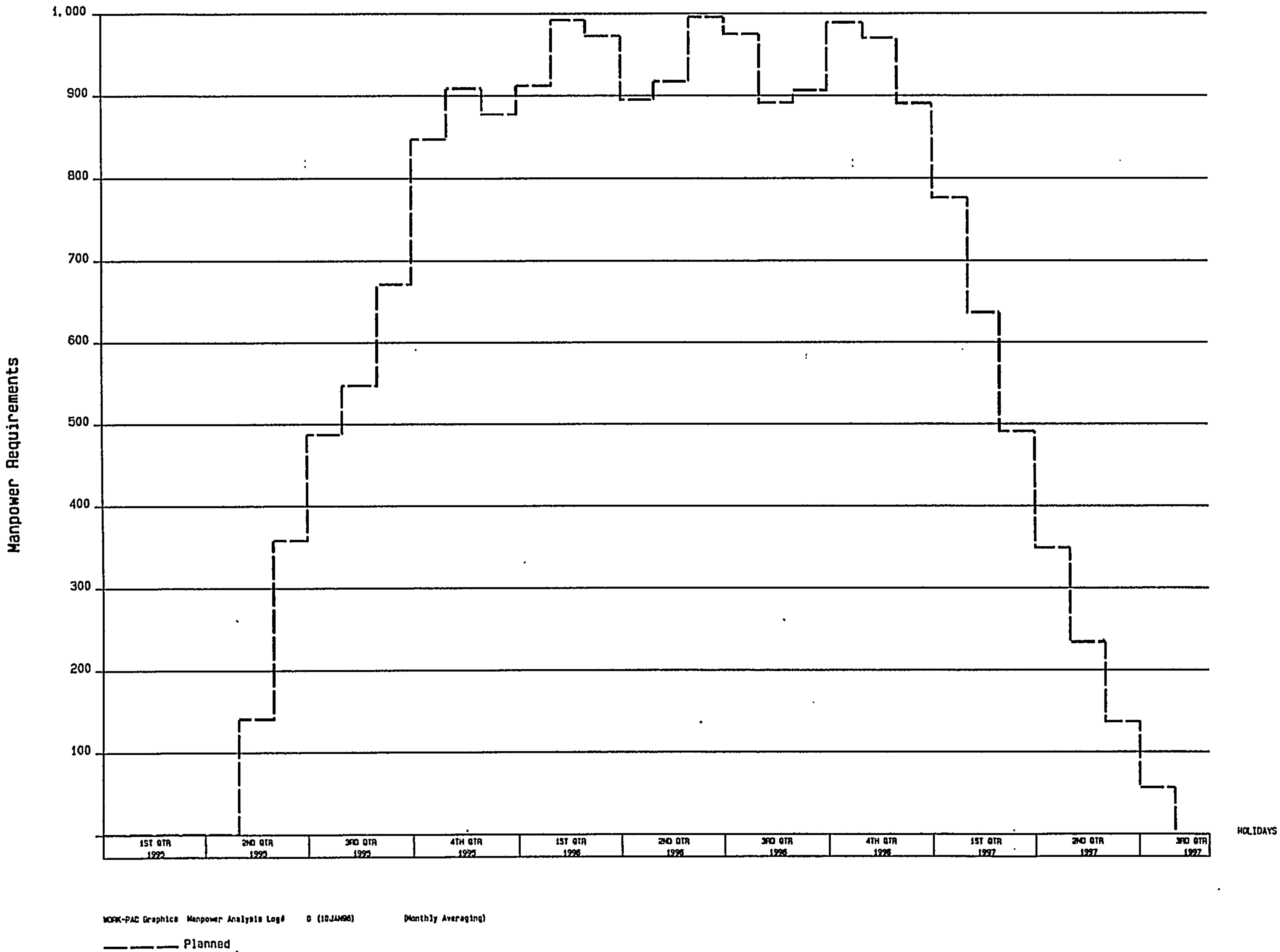
Figure 8: Total Yard Manpower



WORK-PAC Graphics Manpower Analysis Lag# 0 (10JAN96)

Total Manpower

Figure 9: Averaged Total Yard Manpower



HIGHER COSTS FOR AMERICAN SHIPYARDS

North American shipyards are likely to be burdened with additional costs of doing business that are not evident in most Northern European shipyards. These added costs can be attributed to a variety of circumstances:

1. Less efficient facilities and less aggressive implementation of automation technologies

2. Failure to implement emerging new technologies

3. Cost factors outside the control of the shipyard

4. Less effective organization and build strategies

5. Added costs required to undertake duel-use (commercial and government) business

6. Inefficient and unproductive business practices

7. Additional added cost factors

Facilities & Automation Technologies: From a facilities and production capability point of view, the U.S. yards are generally not as well equipped and will require capital investment to be on an equal footing with the more advanced shipbuilders of Europe.

ManufacturingFacilities: In comparison to many European shipyards, American shipyards do not have the same level of modern manufacturing facilities that provide high throughput, low unit cost production capability. Examples include numerically controlled plate cutting and marking and panel fabrication and assembly. Various yards also have been implementing automated robotics systems for parts picking, placing, and welding. While these facilities have a high capital cost, their benefits to the shipyard's ability to compete successfully on the international market are well documented.

Working Environment: These older facilities also are much less attractive as a working environment and are not conducive in attracting a skilled work force. U.S. yards have a difficult time competing against not only foreign shipbuilders, but other manufacturing and service industries in the U.S. as well.

Consolidated Operations: American shipyards, in many cases, tend to be sprawled out over large areas of real estate. More real estate use to be regarded as a requirement for shipyard business growth. However, European shipyards have tended to consolidate their operations to maximize material and interim product flow and minimize handling, transfer and other non-value added production costs:

- Yard management and supervisory activities are located close-by production particularly during on-board phases of construction, to increase their opportunity to recognize problems early and to maximize the coordination of all work efforts.

- Foreman and engineering supervisory offices, complete with computer stations for communicating material and technical inforrnation, are located close by work sites.

- To expedite fabricating make-up pieces between block assemblies, any necessary support shops are located close by the work site.

Facilities that are more concentrated also tend to be easier and less expensive to manage. For example, a single manager is more likely to be able to supervise multiple facilities if they are not located large distances apart. Otherwise, additional management personnel will probably be needed, even if their efforts may not be fully utilized or effective.

Computer Technologies: U.S. yards utilize fewer sophisticated computer technologies than do their European counterparts who use many more automated design, engineering and business processes. CAD/CAM/CIM systems have proved immensely beneficial. In the more advanced yards, CAD generates 100% of the working drawings and at least 50% of the assembly drawings.

In addition, European shipyards have begun to integrate these processes to speed the flow of information throughout the design, purchase, and build cycles. Integrated systems eliminate considerable non-value added labor costs, eliminate sources of erroneous information and confusion, and streamline the decision-making process.

Emerging New Technologies: New production technologies beginning to be implemented both here and abroad are additional automated systems for interim product manufacturing, assembly, and welding.

New information technologies beginning to be implemented also include the following:

- Enterprise integration: the standardization of the computer environment for all application systems (design engineering, estimating, purchasing, material and labor planning and control, administrative and financial) that then can be fully integrated to exploit the maximum benefits of state-of-the-art information technologies.

- Expanded conceptual design and estimating analysis that reduce the shipyard's time to respond to prospective customer requests for proposals and that allow the shipyard to produce better information, including options that might place the shipyard higher on the list of qualified bidders. Such improved conceptual design systems also establish more design and production details very early. This ultimately compresses the engineering and bidding process time.

- Agile manufacturing technologies, including electronic commerce, linking the shipyard on-line with vendors, suppliers, partners, customers, regulating agencies, etc.).

- Smart systems that operate within the enterprise of integrated systems employ multiple discipline application analysis to optimize design and production processes.

Organization & Build Strategies: There are added costs due to less efficient shipyard organizations and build strategies. These are costs that can be reduced without sigificant capital investment:

Product Teams: American shipyards tend to follow traditional craft-oriented resource management. In contrast, European shipyard management focuses less upon the craft resource than upon the interim product (hull block ship zone, outfit module) being built. Rather than departmentalizing their organization the European shipyard promotes product teams that include a full range of crafts and expertise: engineering, purchasing, and production. These teams have proved more effective in being able to coordinate various activities and identify more easily cost and schedule saving opportunities. It has been estimated that a least 80% of production problems can be resolved by these teams prior to production actually being impacted.

It should be noted that Avondale is putting a major effort into both product and process team work using the formal techniques of Integrated Product and Process Development (IPPD). This incorporates Integrated Product Teams (IPT) working in an Integrated Product Data Environment (IPDE). The IPDE is the electronic information network that team members use to rapidly and accurately exchange technical data and other information.

Avondale plans to apply IPPD to the new LPD-17 Navy Assault Ship Program, and is developing and testing IPPD practices and procedures on a Maritech project using a commercial vessel (Pure Car Truck Carrier - PCTC) as a test design.

Northern European yards apply IPPD principles and practices without the formality of the IPPD system approach. The results of applying formalized IPPD should yield similar benefits as experienced in Northern European yards.

Engineering and Material Standards: *American* shipyards have developed and exploited far fewer engineering and material standards than their European counterparts. These standards have yielded significant savings both in terms of producibility of manufactured parts, expanded cost benefits of bulk purchasing, and improved communications of technical data from engineering to production and material control. Not only do use of standards reduce engineering time and associated costs, but any standard that can be improved will likely generate benefits across a wide spectrum of the ship design detail requirements.

Change Orders: While change orders in European yards are relatively few, representing only 1-3% of the total ship cost, change orders in the U.S. are far more prevalent and therefore, much more costly. Europeans spend more time and effort up front detailing the ship systems and their requirements with the ship owner. This eliminates many problems later with detail engineering and production activities.

Pre-Outfitted Hull Block Construction While American shipyards have begun to reap the cost and schedule benefits of pre-outfitted hull block construction, the extent that pre-outfitting is actually implemented still lags from what is being accomplished overseas (80% is regarded as the optimum by Northern European yards). This is due to a series of problems: much less developed engineering and material standards which have created serious problems for implementing concurrent engineering necessary to support these earlier outfitting activities; the lack of using effective outfit CAD systems that can expedite the generation of systems engineering and product detail requirements; and the lack of product teams that can expedite the development of successful pre-outfit plans.

Zone Outfit: While the norm for European shipyards, zone outfit is not a universal approach in the U.S. for planning, managing and controlling on-board work. Zone outfit methods enhance the ability to coordinate all work within a ship zone, eliminate conflicts, and improve material flow into and through the zones. These steps ultimately reduce costs for on-board work and eliminate many opportunities for rework and lost production schedules.

Group Technology Manufacturing: Group technology manufacturing in the U.S. is rarely executed to nearly the same level of effectiveness as is done in Europe. Again, this is due to much less developed engineering and material standards and not using production oriented outfit CAD systems that can expedite the generation of systems engineering and product detail information.

Accuracy Control: European, as well as Far Eastern, shipyards have been at the forefront of accuracy control technologies. These include use of precise CAD/CAM systems capable of producing dimensionally accurate component parts, eliminating the need for extra stock at hull block erection butts and seams and the associated added costs to production. Additional laser measurement devices linked to CAD systems further control dimensional accuracy. Few U.S. yards are employing these systems that save costs and time of erection fits.

QualityAssurance: European shipyards carry out quality assurance activities primarily at the worker level. In the U.S., QA is carried out by a separate department in the shipyard. Unfortunately, there are perceptions from the shipbuilding customer base that U.S. yards do not have the necessary skills, discipline and motivation to ensure consistent quality work; therefore, a separate watch-dog organization outside the production department is considered a requirement, but at an extra cost to the operation of the shipyard. Considerable costs have been associated with the processing of waivers, deficiencies and *other* errors and omissions. Some would argue that a separate watch-dog causes workers to be less responsible to ensuring that the work is done properly the first time.

Out-Sourcing: American shipyards do not out-source as much work as do European shipyards, which have made specific studies (activity based costing analyses) to identify what shipyard functions are the least profitable and can benefit from an out-sourcing alternative. With few exceptions, European yards are eliminating their in-house manufacturing capabilities and becoming primarily an assembly operation. In a few Dutch shipyards, the yard operation's have been reduced to only assembly and final outfitting. All structural piece fabrication and outfit manufacturing are subcontracted. Few U.S. yards have undertaken such studies and continue to employ under-utilized and oftentimes obsolete and unproductive manufacturing facilities. It is also true that U.S. yards have fewer quality, reliable and cost effective out-source supplier options. U.S. yards must work to develop a bigger and better supplier base.

Material Handling: European shipyards have taken many positive steps to eliminate as much non-value added material handling costs as is physically possible. Vendors and suppliers deliver their products directly to the specific job site material buffer storage areas. Their deliveries are scheduled within a comfortable time margin to ensure that the material is always available to satisfy production schedules, yet not too early to create storage (and accounts payable) problems for the shipyard. Material is stored so that it can be immediately picked up with a fork-lift to minimize handling costs. All material is properly tagged by the vendor according to shipyard specifications so that it is easily identified by production personnel.

Automated Data Collection: More European yards, than U.S. yards, are employing automated data collection systems that save costs and improve the communication of accurate and timely business information. Bar code and other data reader devices are being applied in material control, labor attendance and time charging, technical data and document management, small tool control, etc.

Cross-Trade Agreements: Cross-trade agreements are very slowly becoming part of U.S. shipbuilding. European yards, on the other hand, have successfully enabled production workers to perform a multitude of task assignments that traditionally would have required separate trades to exercise. For example, Northern European yards have trained hull department outfitters to install such items as pipe, duct, and insulation during the pre-outfit block stage prior to block paint. This work is done by the steel trades in the steel fabrication building.

Professional Work Force: Shipbuilding is a complex business requiring a cadre of professionals to continually improve upon the performance of the shipyard operations. World class shipyards continue to make significant investments in maintaining a highly skilled and trained work force. Most top levels of management and supervisory staff are university-gradate naval architects and engineers trained to be analytical and problem solvers. Foreman are required to have at least three (3) years of technical schooling. By comparison, U.S. yards lag far behind in infusing this same degree of professional skills throughout their organizations.

Employee Incentives: Various employee incentives are being pursued both here in the U.S. and abroad. Yards that do not provide incentives have a difficult time obtaining employee loyalty and an aggressive mind-set to develop new and better ideas that will make the shipyard ever more productive and competitive. Besides bonuses based upon performance, a major incentive is job security and reasonable working conditions.

Added Costs For Dual-Use Business: Dual-use (commercial and government contracts) shipyards carry additional burdens of government-required procedures, even for commercial contracts, because using separate sets of procedures are not likely to be practical. An example is stringent government-regulated time charging procedures requiring workers or their foremen to manually sign each and every time card. Government contracts also require that the same overhead rates be applied to both government and commercial contracts, and the procedures for managing the overhead costs may very well be more burdensome than normally required for a shipyard that performs only commercial work.

Figure 10 illustrates a comparison of commercial versus government contract purchasing costs. Not only do the latter contracts typically require significantly more staff personnel to handle the complex procurement functions, but production schedules also are extended.

U.S. yards that are dual-use will likely have to bear some of these added costs that yards doing only commercial work will be able to eliminate.

An Example of Added Costs Due to Government Contract Requirements

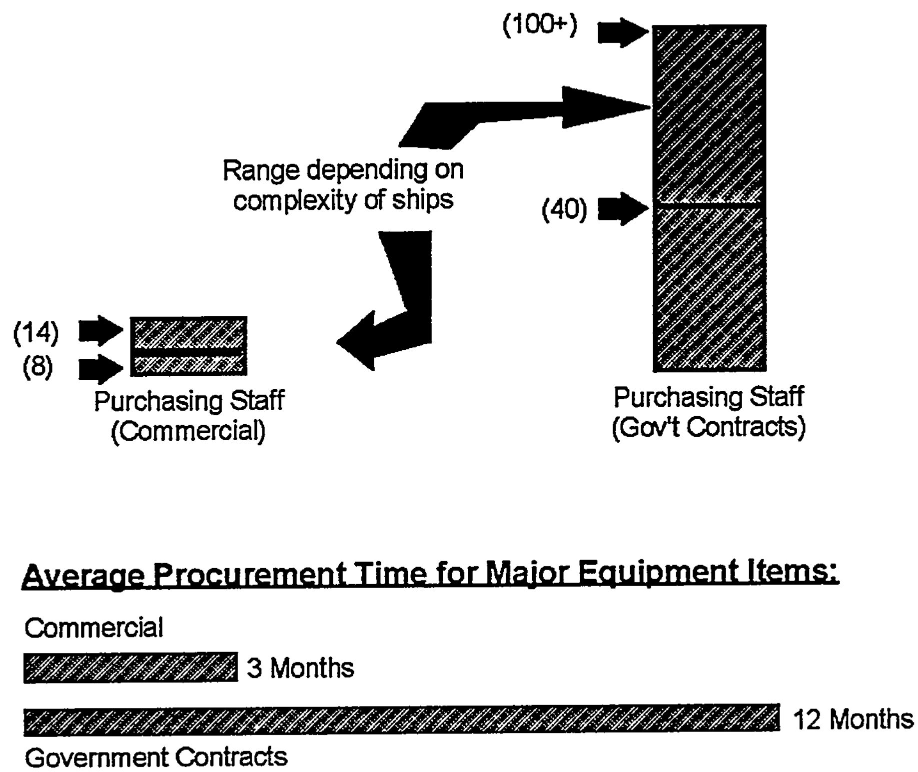


Figure 10

Inefficient & Unproductive Business Practices: Among the added costs caused by decades of working under U.S. Government contract rules and regulations are the following.

- Over documentation of the engineering process
  - Engineering drawings
  - Configuration and data management
  - Engineering and change proposals
- Constricted, while at the same time redundant procurement processes carried over from past operation under FAR;
  - Creating false price competition
  - Redundant make-buy analyses
  - Overburdening subcontractor regulations
  - Socioeconomic and mandatory source requirements
  - Restricted communication between shipyard engineering and equipment suppliers
  - Vendor furnished information processing and approval status
- Improper emphasis in quality assurance programs
  - Relieving end product producers from responsibility for quality
  - Emphasis on the watchdog approach
- Burdensome financial record keeping and reporting retained from government (DCAA), and oversight contracting practices
  - Retention of audit mentality
  - Product cost data requirements
  - Material management accounting systems
- Continuance of litigious contract administration practices
- Poor work ethics caused by years of past paper shuffling rather than accomplishing value added work (designing and building the ship)

There are additional cost factors due to generally redundant, confused and unproductive business practices. These are costs, especially redundant paper work that U.S. shipyards need to understand and need to purge from their operations.

Ineffective Management: This can be endemic if management personnel lack the skills necessary to fully undertake commercial business responsibilities. Managers who have been brought up in a government contract environment are conditioned to respond to the detail terms, conditions, and referenced procedures of the contract. Senior management energy also is dissipated on government affairs issues, as opposed to focusing on better shipbuilding practices. In commercial shipbuilding, management must meet the demands of the real world marketplace such as emerging new commercially sensitive technologies, knowledge of ships as the yard's product, knowledge of shipbuilding processes and practices, human relations motivational factors and other pragmatic commercial business considerations.

Poor Work Ethics: Years of meeting detail and often unnecessary government requirements often not directly associated with building the ship permeates down through the professional staff and into the work force. Workers can survive by only shuffling paper, thereby discouraging good work habits by skilled producers.

Poor Planning and Coordination This almost always results in high cost of rework wasted materials, and failures to exploit efficient build strategies.

Poor Engineering: Engineering is the process that sets the stage for how well or how poorly the manufacturing and construction processes can perform. Poor engineering will result in difficult and costly products to manufacture and assemble, driving up production costs and lengthening the production time cycle. Engineering changes are inevitable to a certain degree. However, unless the changes are customer-inspired and can be charged off as additions to the contract, changes that affect procurement (for example, restocking fees, excess material and higher unit and transportation costs) and production functions already in process are particularly expensive (rework and unrecoverable material waste as well as missed opportunity to do work at optimum production cycle).

Poor Material Management: Material delivery delays impact production costs directly, even to the extent that efficient build strategies may have to be sacrificed by shifting work to less productive stages of the production cycle. These problems can be due to mismanagement at various phases of the material management process:

- Failure by engineering to provide detail material requirements in time for the procurement functions to be successful. Such delays can void opportunities for bulk purchase price economies, among other added costs further down the line in production.

- Inordinate and complex procurement procedures often create unnecessary delays with little value added to the overall operation of the shipyard.

- Delays by vendors are always a problem and can happen with both the material ordered as well as for vendor furnished information ("VFI"). The latter will impact engineering schedules to complete engineering processes dependent upon this information. European shipyards use a limited number of vendors and suppliers with whom they have established long term relationships for price, quality and reliability.

- Delays can also come from lax or overly complicated receiving and inspection functions.

- Delays in completing the marshalling of correct material requirements for production clearly creates cost and schedule problems for production.

- Delays in locating material or transferring it from storage areas creates added costs for the shipyard.

Poor Quality Control: This results in excessive rework and supervisory costs, not to mention damage to the reputation and credibility of the shipyard in the marketplace.

Unnecessary Legal Costs: Dissatisfied customers who seek legal remedies may be a clear indication of problems within the shipyard organization. On the opposite side of the court room, there have been too many instances whereby U.S. shipyards attempt to legally obtain "just rewards" and reimbursement for claims that should have been resolved and/or avoided by more prudent business practices. Many of these claims have proved to have been due to the shipyard's inability to properly and profitably manage its resources and the conduct of its own operations.

On the world markets, there is an unfortunate perception that U.S. shipyards are too quick to sue in order to cover their own mistakes.

Cost Factors Outside The Control Of The Shipyard: There are higher costs for doing business in the United States that are not controllable directly by the shipyard

American Education System: The American education system is in dire distress and lags far behind those of most European countries. While European shipyards are easily characterized by a highly educated work force, American yards must deal largely with an entry level work force barely averaging even a high school level of education. This leaves the U.S. shipyards unable to execute work as productively. This limits their ability to introduce innovation and a sense of creativity and responsibility throughout all levels of the organization that is so evident in foreign shipyards.

The education problem is especially serious in the southern states. It is very difficult, if not impossible, to implement a world class operation with employees who too often cannot read, nor write. Shipbuilding is a complex business, which requires skilled workers to execute quality work right the first time, and to be capable of solving the many problems of the shipbuilding process.

To deal with these problems, shipyard costs for recruiting and training (Human Resources) and for general supervision are quite high. Low skill problems also lead to an increase in costs for quality assurance activities and worker safety problems.

Marginal Market Opportunities: Due to marginal market opportunities, employment levels in the U.S. fluctuate radically, and this creates considerable stress in the work force, limits employee loyalty, and reduces one's motivation for innovation. These circumstances make it very difficult for the U.S. shipyard to remain productive and competitive by international standards. This highly variable work force also increases the shipyard's overhead to process layoffs and re-hires. European shipyards, on the other hand, benefit from not only a skilled work force, but also a work force that is very stable, with low employment turnover relative to U.S. statistics.

This stability is enhanced by a management policy which keeps a solid, permanent core of skilled workers and purposely subcontracts work not vital to the yards core operations. Decreases in workload then primarily affect contract workers, not employees.

Environmental Regulations: American companies must comply with stringent environmental regulations, both Federal and State. European shipyards also have tough regulations, but it would appear that these have much less documentation requirements which have proved to be a costly, and not particularly fruitful series of exercises. In addition, the American regulations have been distributed across a range of government agencies, Federal and State, while the European counterparts appear to be more consolidated and easier to satisfy.

Worker Safety Regulations: American companies must comply with stringent worker safety regulations. European companies have similar regulations, but they appear to be less burdensome. OSHA has been particularly onerous and adversarial in the past, and U.S. shipyards have had to take extreme measures to avoid costly sanctions. The relatively unskilled and very transient work force, combined with sometimes antiquated facilities, contribute to high costs for the American shipyards.

<u>It should be noted</u> that good progress is being made to correct this situation. The *Ihnovationa In Human Relations* Panel (SP-5) of the SNAME Production Committee and the Shipbuilders Council of America have taken active roles in working closely with OSHA to make safety programs more effective in U.S. yards.

U.S. shipyards at the operating level can implement changes that directly affect the costs of both satisfying work safety regulations and actual costs of accidents themselves. Rather than posting larger safety instructions and signs on shipyard walls or spending relatively large amounts of money and time on safety-related seminars and indoctrinations, European shipyards spend time eliminating the root causes of safety problems from their operations. For example, maintaining clean and neat working areas has become a major daily working habit for everyone in the shipyard. Another is the engineering of production to eliminate as much need for staging as is absolutely necessary. Maximizing down-hand work rather than encouraging risky and expensive overhead work, and applying other better production methods remove most of the opportunities for the majority of shipyard accidents.

Equal Opportunity Employment Regulations: American shipyards must comply with equal opportunity employment regulations, Federal and State, and these carry not only additional costs to recruit and train prospective employees, but government-imposed quotas for minorities and the disadvantaged burden the shipyard's ability to maximize productivity. By contrast, European countries are generally more heterogeneous as a people, so these same problems are virtually non-existent.

American Vendor/Supplier Base: The American vendor/supplier base is not nearly so well organized to support the needs of any major shipbuilding enterprise by providing extensive, "world class" manufacturing and other support services like what is readily available in Europe. Many believe that the vendor base is typically undisciplined and suffers from low quality performance compared to their European counterparts. With the decline of shipbuilding in the U.S., shipyards no longer enjoy a significant portion of business for this vendor/supplier base to stimulate significant cost and schedule advantages normally available to major market players. This problem is exacerbated by a limited range of quality marine products that can be incorporated within a world class ship product offering. Instead, many products must be procured off shore, and the added costs to U.S. shipbuilders contributes to the problem of challenging international competition. It is readily recognized that the perceived limited future demand for U.S. built commercial ships plus the misconception that Jones Act ships are richly priced have created numerous instances of inflated prices imposed by foreign suppliers during the early nineties. These prices were often higher than can be justified by only the added costs of transportation to America/and or U.S. flag requirements for Jones Act Ships. This situation is being corrected as more U.S. yards enter the commercial vessel building market and get to know and deal with foreign suppliers.

European shipyards have established strong business relationships with their vendors and suppliers, providing significant steady business for all. These relationships are critical for shipyards to exploit the cost and schedule saving potential from out-sourcing major segments of manufacturing and support services as well as significant quantity unit cost reductions.

Imperial Units of Measure: Unlike European shipyards who deal almost exclusively with metric measures, U.S. shipyards suffer from the anachronism of the imperial units of measure for parts and raw materials. This has given rise to relatively large inventories of goods to satisfy both requirements. There is still a very large segment of American manufacturing that has not yet changed over to international standards. To make matters worse, shipyards that are engaged in both new construction and ship repair must address the needs of an existing American fleet of ships that still maintain imperial parts and equipment. There remains a very large market for imperial spare parts, and this contributes to the slow rate of change.

ISO 9000: ISO 9000 certification has become a requirement for many American companies to do business in Europe. While the exercise to document the shipyard business processes can provide cost savings by exposing processes that are not productive and that need to be revised or eliminated, this program does incur costs to setup and to maintain certification. Also, bad practices codified in ISO 9000 procedures can make performance improvement more difficult.

Many European shipyards gain the advantages of compliance to ISO 9000, but do not undertake the work and costs to maintain formal certification. This is a case where European yards use the good discipline of ISO 9000 process reviews and careful documentation of good practices without the added burden of outside audits.

Litigious Society: Being a more litigious society than most other countries, American business is normally required to maintain a more active (and costly) legal presence within its operation. Typical legal issues facing U.S. shipyards include patent protection, insurance, bonding and workman's compensation disputes. Legal work is normally involved with change order work and various contract negotiations.

Taxes: Taxes in the U.S. vary born state to state and have a direct impact upon the shipyard. Tax regulations (IRS, state and local) have gotten so complex that the costs to collect, report and maintain shipyard financial information is quite high. In addition, the complex and ever-changing tax rules create added accounting activities that seek to minimize taxes and protect profits and operating cash assets. As presently written, few tax rules provide incentives for capital investment for U.S. industries. Without capital investment, shipyards cannot compete in the long run. This is one area where creative shipyard government affairs efforts might create long term benefits by legislating tax credits and other incentives for both shipowner customers and the yards.

International Economics: International economics also play a very large role in the ability of U.S. shipyards to bid successfully price-wise against foreign competitors. Sometimes unfavorable currency exchange rates and poor financing terms and conditions nullify shipyard production efficiency.

Other Added Costs: For the American shipyard, there have been other factors adding to the cost of doing business such as inadequate financial capital. This can cause the shipyard to take short-cuts that result in subsequent disputes and a dissatisfied ship owner.

An inability to maintain facilities, to purchase new, needed equipment, to pay vendors and suppliers on time, all lead to problems that will prevent the shipyard from becoming a competitive, world class business successful on the international market.

The following is a case study of a Canadian shipyard going through its own conversion from government shipbuilding back to commercial.

Saint John Shipbuilding, Limited ("SJSL"), Saint Job New Brunswick, Canada was a successful commercial shipbuilder during the 1970's and early 1980's. Then, starting in the early and mid eighties the shipyard operations were focused exclusively on the Canadian Patrol Frigate ("CPF") program that has been active well over ten years in the design and construction of a total of twelve (12) ships. SJSL built nine (9) ships. Three follow ships were built at MIL-Davie. Appendix II presents a breakdown of the shipyard's staffing requirements during this period of time.

Now at the end of the frigate contract SJSL is making dramatic changes so that it can compete in the international commercial shipbuilding market. They are marketing a small 1,000 TEU container ship and handy size product tankers. SJSL has invested heavily in its manufacturing facilities (over $100 million Canadian) with the major items being an in-door module shop to outfit very large hull blocks, additional lifting capacity to accommodate 1,000-1,200 metric tons of pre-outfitted hull blocks, a new panel line and a multiple welding process station.

The shipyard has completed the down-sizing from CPF to much reduced levels of manpower. Major emphasis has been placed upon reducing the levels of management, from seven (7) during the CPF program to four (4) for their commercial business.

SJSI-CPF

1. Senior VP & General Manager
2. Vice Presidents
3. Directors
4. Managers
5. Superintendents & Assist. Mgrs
6. Supervisors & Foremen
7. Workers

SJSL Commercial

1. VP & General Manager
2. Department Heads
3. Team Leaders
4. Workers

Figure 11A illustrates the changes in manpower from CPF (two 5,000 ton frigates per year) levels down to the levels estimated for the steady-state three 40,000 DWT tankers per year rate of production. SJSL'S actual manpower requirements for building the anticipated container ships are close to what this study requires for the tanker shipyard, and the Canadian Shipyard Model ("CANSY") includes these small adjustments.

Figure llB presents the same comparison of the down-sizing as reflected in the percentage of white collar staff to blue collar production manpower. The new, commercial staffing levels have been reduced to about one quarter of that required for the government contracts as apercent of blue collar!.

The shipyard is actively negotiating new work rules with the labor unions so that these new facilities can be more effectively and competitively used according to international world class capabilities. SJSL has been implementing an entirely new management structure featuring the team approach to planning and managing by ship products and manufacturing process. Table 10 presents a comparison of this new staffing configuration with that of the Northern European Shipyard model. The Canadian shipyard model applies to a steady state production of three 40,000 DWT product carriers per year. This requires a management staffing of 113 for blue collar employment of 950.

NOTE While the Northern European Shipyard model assumes that front line supervisors are working, blue collar, SJSL treats them as part of the management staffing requirement. Therefore, the table provides an adjustment under Production so that the two models can be compared more equally.

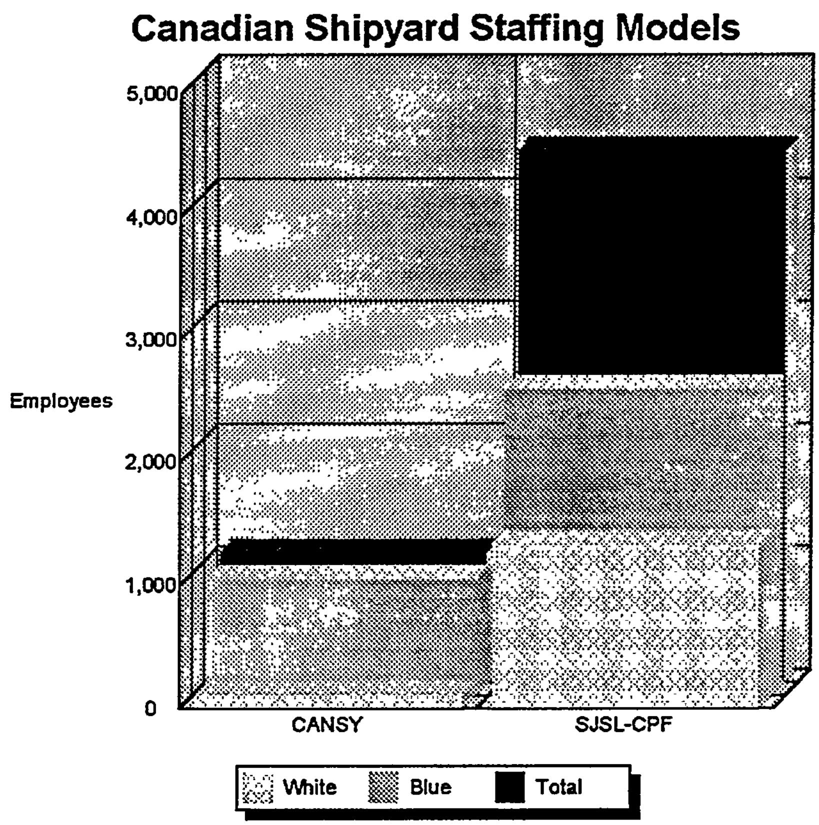

Canadian Shipyard Staffing Models
5,000
4,000
3,000
2,000
1,000
0
Employees
CANSY
SJSL-CPF
White
Blue
Total

Figure 11A

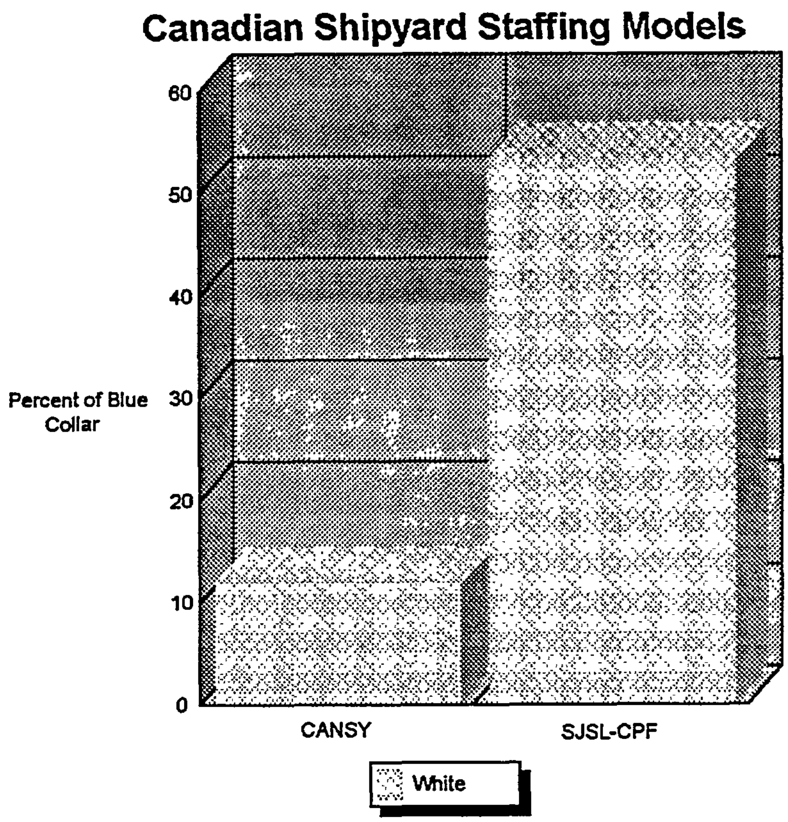

Canadian Shipyard Staffing Models
60
50
40
30
20
10
0
Percent of Blue Collar
CANSY
SJSL-CPF
White

Figure 11B

Table 10:
Canadian Steady State Production for Three 40,000 DWT Product Carriers Per Year

SHIPYARD OVERHEAD ORGANIZATION:	Northern European Shipyard Model			Canadian Shipbuilding Model		
	Manager/ Professional	Support/ Technician	Total Man-Yrs	Manager/ Professional	Support/ Technician	Total Man-Yrs
SHIPYARD GENERAL MGMT:	1	2	3	1	5	6
MARKETING:	2		2	1	1	2
LONG TERM FACILITIES PLAN'G						
Gen.Estimating&Planning	1		1		4	4
QA & ISO 9001 Certif.	1		1		3	3
Facilities Development	1		1	0.25		0.25
MIS	1	1	2	1	4	5
Sub-Totals:	4	1	5	1.25	11	12.25
STRATEGIC & OVERALL PLAN'G	1		1		1	1
PROJECT MANAGERS:				1		1
Active Contracts	1		1			
Assisting Marketing	1		1			
Sub-Totals:	2		2	1		1

SHIPYARD OVERHEAD ORGANIZATION:	Northern European Shipyard Model			Canadian Shipyard Model		
	Manager/	Support/	Total	Manager/	Support/	Total
	Professional	Technician	Man-Yrs	Professional	Technician	Man-Yrs
ENGINEERING DESIGN:*	1	1	2	1		1
Basic Design Projects:**	4	1	5	6		6
Design Planning:	1		1			
Design:	1	1	2			
Machinery	1	3	4	1	7	8
HVAC	1	1	2			
Interiors	1	2	3			
Deck & Outfit	1	2	3	2	5	7
Electric	1	2	3		4	4
Sub-Totals:	12	13	25	10	16	26
PURCHASING & MATERIAL:*	1	1	2	1		1
Purchasing:				1	8	9
Senior Buyers	2	0	2			
Buyers		1	1			
Material Control:	1	0	1	1	6	7
Management				0.5		0.5
Outfit		2	2			
Steel Yard		1	1			
Sub-Totals:	4	5	9	3.5	14	17.5

* This line is for the management staff of this line function.

** Naval architects and marine engineers who support marketing with concept, preliminary and contract design plus follow-through to support the functional design stage of detail designs.

SHIPYARD OVERHEAD ORGANIZATION:	Northern European Shipyard Model			Canadian Shipyard Model		
	Manager/	Support/	Total	Manager/	Support/	Total
	Professional	Technician	Man-Yrs	Professional	Technician	Man-Yrs
PRODUCTION:*	1	1	2			
Planning:	2	1	3	2	5	7
Hull Design:	11	2	13	1	6	7
Production:	2	1	3			
Hull Mfg	2	0	2	2	5	7
Hull Ass'y & Erection	2	1	3	3	8	11
Painting	1	1	2	1	1	2
Pre-Outfit	2	1	3	1	2	3
Machinery	2	1	3	2	8	10
Interior	1	1	2	2	7	9
Electrical	2	1	3		1	1
SJSL Adjustment:***				-8	-30	-38
Maintenance:	1	1	2	2.5	2	4.5
Sub-Contractors:	1	1	2			0
Sub-Totals:	30	13	43	8.5	15	23.5
PERSONNEL:	1	1	2	1		1
Training	1		1		1	1
Information Systems	1	0	1		5	5
Work Protection	1	0	1		1	1
Health Services	1	1	2	1		1
Sub-Totals	5	2	7	2	7	9

*** The SJSL Adjustment removes front line supervisors from management staff, since they also can do production work. This facilitates a more realistic comparison with Northern European Shipyard staffing.

SHIPYARD OVERHEAD ORGANIZATION:	Northern European Shipyard Model			Canadian Shipyard Model		
	Manager/	Support/	Total	Manager/	Support/	Total
	Professional	Technician	Man-Yrs	Professional	Technician	Man-Yrs
FINANCE:	1	1	2	1	1	2
Accountants	1		1	3	3	6
Accounts Payable	1	1	2		2	2
Accounts Receivable	1		1		1	1
Charge Number Manager	1		1			
Payroll	1		1		3	3
Sub-Totals:	6	2	8	4	10	14
LEGAL:	1		1	1		1
TOTAL YARD OVERHEAD STAFF:	68	38	106	33.25	80	113.25

It is interesting to note that the Canadian organization team approach is based on adopting a business structure and practices from industries completely different from shipbuilding. SJSL'S own operations management team applied it to their own shipyard operations as discussed below.

Figure 12A provides a comparison of the Canadian model ("CANSY") with the Northern European ("NESY") and the North American (U.S.) models ("NASY-1,2, & 3") discussed earlier in this study. Figure 12B presents the same comparison, but in percentage terms of white collar to total blue collar.

In comparing the U.S. models with the Canadian, the Canadian model requires approximately 17% fewer blue collar employees. The sizeable investment in SJSL facilities improvements should be reflected in these savings. In addition, SJSL has progressed its pre-outfit on block techniques considerably over the past years, and has made significant reductions in production man-hours (about 50%); their goal is to maximize work in this stage of construction in order to maximize its cost and schedule savings potential.

The Canadian model also requires fewer white collar staff, even on a percentage basis of the blue collar work force. These savings range from 18%- 57%, depending upon the U.S. model ("NASY-1, 2, & 3"). SJSL has totally re-engineered its management structure to gain the cost and quality benefits possible with product and process teams.

It is interesting to note from Figure 12B that the independent analyses have been done from points of views completely different from shipbuilding cultures. Nevertheless, each has developed an organization for an efficient ship design and construction operation using about the same percent ratio of white collar staff to blue collar work force; between 14 and 16 percent.

Team Structure: SJSL has developed a team approach to planning, managing and executing work in the shipyard. These teams are product or process oriented and include participants from across different shipyard departments (called strategic business units, or "SBU"S and sub-strategic business units, or "SSBU"S; refer to Figure 13). The task teams maybe short or long term, depending upon the team objectives. For example, build strategy teams are relatively short term, while continuous improvement teams provide a long term purpose.

Quality Assurance: SJSL believes that by setting very high standards for quality assurance (including accuracy control), the shipyard has been able to reduce production costs over the long term to about half of what was possible ten years ago. However, realizing that commercial standards are challenging but far less involved and procedural than those for government construction, SJSL has out-sourced the majority of its quality assurance support work to an allied company that specializes in providing such services to not only the shipyards, but also other manufacturing industries. (The core of this company, Atlantic Quality & Technical Services, LTD originally evolved from within SJSL to support the CPF program).

Material Costs: During the CPF program SJSL had to re-deploy its business process to suit the contract requirements imposed by the Canadian government. One of these requirements, called Industrial Benefit (WY), is a very strict allocation of procurement and spending plans to specific Canadian provinces. While the objectives to handle the work to equipment suppliers not only had to compete on COSt, performance and delivery, but also on the benefits they could offer to Canada and the provinces. SJSL maintained a small staff to manage this program.

Another source of higher material costs were due to government requirements for configuration control for the in-service support of the frigates. When the manufacturer of steering gear was unable to provide equipment for later ship sets, the steering gear for the earlier ships had to be back fitted with the alternate equipment vendor’s product.

Additional costs in time and dollars were incurred from having to deal with complex quality assurance purchasing requirements that are not necessary for commercial shipbuilding.

In changing to a strictly commercial enterprise, SJSL recognizes that there remains more work to eliminate legacy "red tape" from the existing procurement process. These added costs were noted especially when requesting for quotations from vendors and suppliers.

However, despite the efforts to streamline the shipyard’s procurement process, SJSL still must confront problems of material costs due to adverse foreign exchange rates. Since foreign prices use the U.S. dollar as the basis, the shipyard’s costs increase when the Canadian dollar suffers in comparison to the U.S. dollar. The high cost of goods is a significant problem when competing on the open international market.

Multiple Shipyards: Over the past number of years, SJSL has expanded its shipbuilding operations beyond its Saint Jolun, NB facility. It maintains a small manufacturing facility in East Isle, Prince Edward Island, where pre-outfitted engine room hull units for the frigates were built and barged to Saint John for erection. Recently, SJSL purchased the larger facilities of Halifax Shipyards, Ltd ("HSL"), in Halifax, Nova Scotia. HSL is engaged in building mine counter-measures ships for the Canadian government and with commercial and naval ship repair. A smaller facility at Dartmouth, Nova Scotia is also operated by SJSL, primarily for small ship conversions and repair.

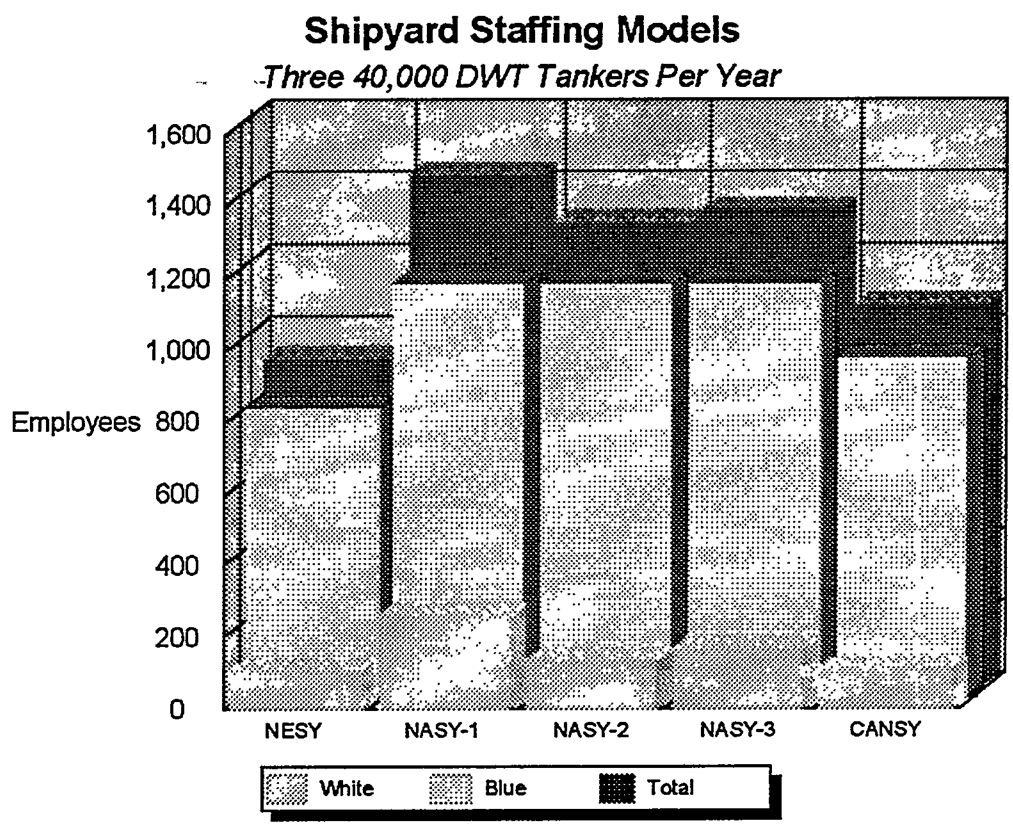

Shipyard Staffing Models
Three 40,000 DWT Tankers Per Year
Employees
0
200
400
600
800
1,000
1,200
1,400
1,600
NESY
NASY-1
NASY-2
NASY-3
CANSY
White
Blue
Total

Figure 12A

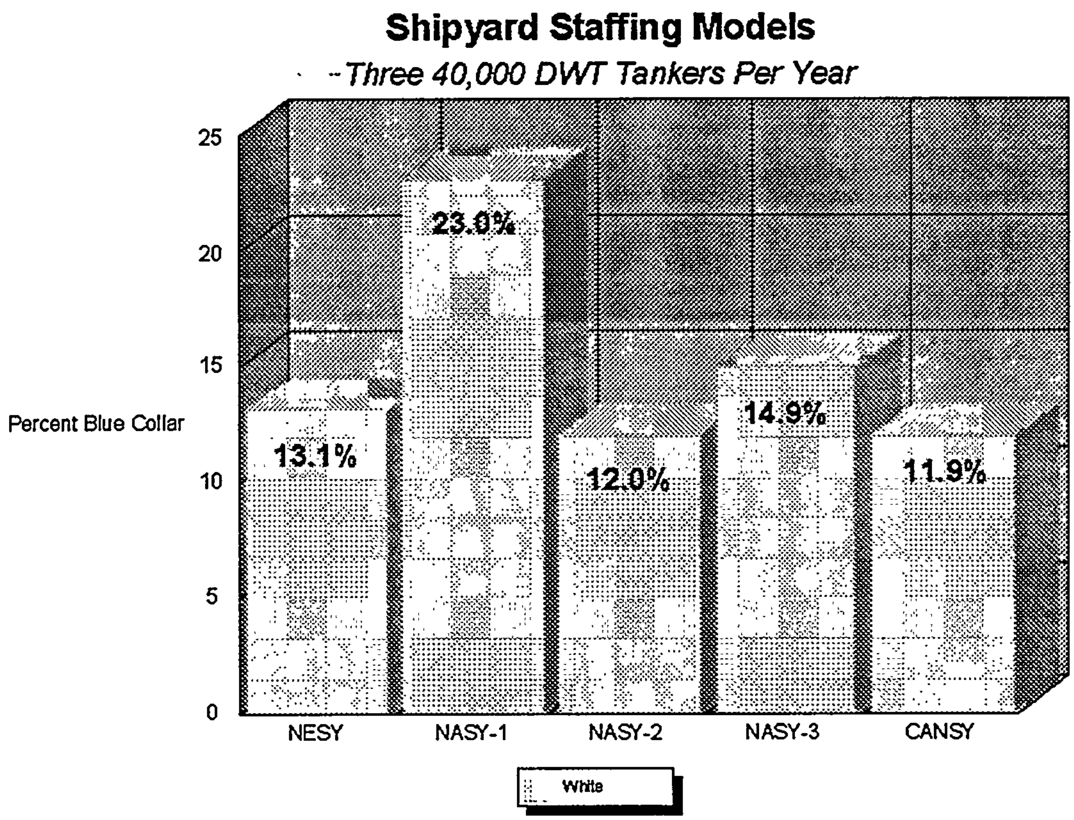

Shipyard Staffing Models
-Three 40,000 DWT Tankers Per Year
Percent Blue Collar
25
20
15
10
5
0
13.1%
23.0%
12.0%
14.9%
11.9%
NESY
NASY-1
NASY-2
NASY-3
CANSY
White

Figure 12B

TEAM LEADER PRESENTATION

TEAMS

TYPE OF WORK BY SSBU	SBU 0	SBU 1	SBU 2	SBU 3	SBU 4	SBU 5	SBU 6	SBU 7
PRE–PRODUCTION:								
EXECUTIVE	■							
PRODUCIBILITY	■							
ADMINISTRATION	■							
EMPLOYEE RELATIONS		■						
HEALTH/SAFETY		■						
HUMAN RESOURCE PLANNING		■						
FACILITIES/MAINTENANCE			■					
MATERIAL CONTROL			■					
PRODUCTION CONTROL			■					
DOCKMASTER/SERVICES								■
PROCESS/PRODUCT ORIENTED:								
DRAW/NC/PLAN STEEL				■				
STEEL FABRICATION					■			
FLAT PANEL ASSEMBLY					■			
SOUTH STEEL SHOP					■			
SUB ASSEMBLY						■		
CURVED ASSEMBLY						■		
BLOCK ASSEMBLY						■		
MEGA JOINS/ERECTS							■	■
OUTFIT COMPLEX WORK							■	
MACHINE SHOP WORK							■	
PAINT							■	
DRAW/PLAN/OUTFIT ENGINE ROOMS				■			■	■
DRAW/PLAN/OUTFIT DECK MODULES				■			■	■
DRAW/PLAN/OUTFIT ACCOMODATION				■			■	■
OUTFIT ELECTRICAL								■
SET TO WORK & TRIAL								■

Figure 13

FINAL CASE STUDY:
A MILITARY VERSUS COMMERCIAL MARKET
SHIPBUILDING STAFFING EXAMPLE

As another measure of the cost of meeting government contract requirements, the study team evaluated two Norwegian shipyards; one in the purely international commercial shipbuilding market and the other totally in the military shipbuilding market. Both yards are part of the Kvaerner Fast Ferries subgroup of shipyards within the largest shipbuilding group in Europe. The commercial yard has designed and built high speed aluminum catamaran ferries for the international shipbuilding market for decades. The military yard has pioneered the development design and construction of composite military ships like surface effect ship mine hunters and patrol boats for the NATO military market. Both yards design and build a high technology product, although of different material. Both operate in the same country culture under the same company subsidiary management, and in turn the same group management (Kvaemer). The major difference between the yards is that one operates in a purely international commercial environment and the other has only government (military) contracts and must meet NATO contract business and technical regulations/requirements.

Table 11 provides an overall description of the characteristics of these yards and a listing of the yard' staffing. Please note that both yards have about the same production employees (140-200 range). In contrast the military shipyard has a non-production staff of 130 versus 55 for the commercial yard (136% more indirect personnel). Refer to Figures 14 and 15.

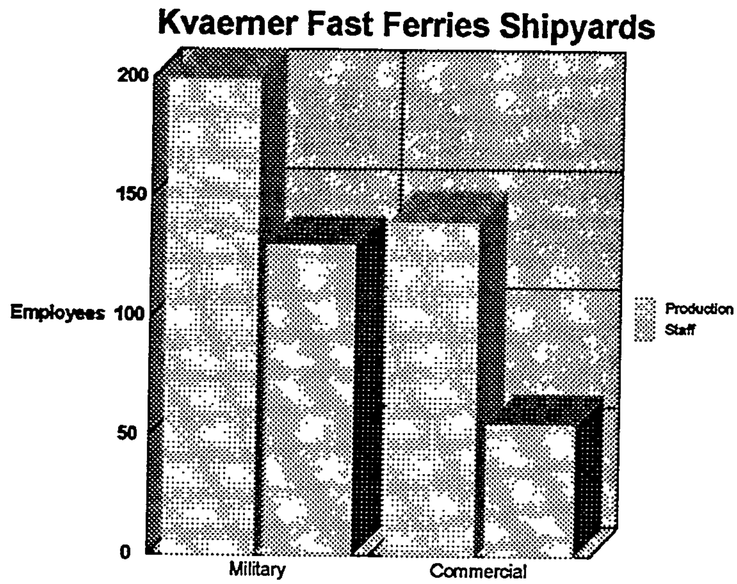
Table 12 displays the indirect staffing in more detail to determine how military requirements affect the staffing levels. Eighteen staff positions can be identified an "extra". Data, contract administration and QA/QC functions drive most of the excess.

Table 11: A Military Vs. Commercial Market European Shipyard Staffing Example

General Description Of Yards & Yard Functions	Military Shipyard Fast Patrol & Mine Hunters	Commercial Shipyard Fast Passenger & Car Ferries
1) Products/Avg. Annual Output	MCM (55m) - 3/year or Patrol Boat (55m) 3/year or 40m Fast Patrol Boat	40m mk2 - 12/year or 40m mk3 - 18/year or 75m - 3/year 40% of Market
2) Annual Turnover at Capacity	50 million USD	70 million USD
3) Material Flow MT/year	600 to 700 tons of FRP	750 tons of aluminum
4) Covered Shipyard Area	11,000 square meters	
5) Total Employees	Number of Employees	
	330	195
6) Production Employees	200 including working supervision & technical support	140 including working supervision
7) Design & Engineering	70 Note: Management believes 30 would be required for pure commercial	22
8) Project Admin. & Contract	10	2
9) Purchasing	4	2 reducing to 1
10) Stores & Material Admin.	10	8 reducing to 4
11) Strategic Planning	2	Managing Director P.T.
12) Detail Planning (schedules & work orders)	10	0 increasing to 1 + computer support= 3
13) Accounting	4	4 reducing 2
14) Marketing & Sales	4	5
15) ILS	Included in 7 & 8 above	0
16) QA + QC	7	0 to 1 + P.T. from departments
17) Other: Secretaries, Clerical Support, Cafeteria, etc.	9	12
Total Non Production	130	55 reducing to 52

Note: Data obtained during summer of 1993 - Reductions in commercial yard were targets set by the yard's management to further reduce product costs.

Figure 14



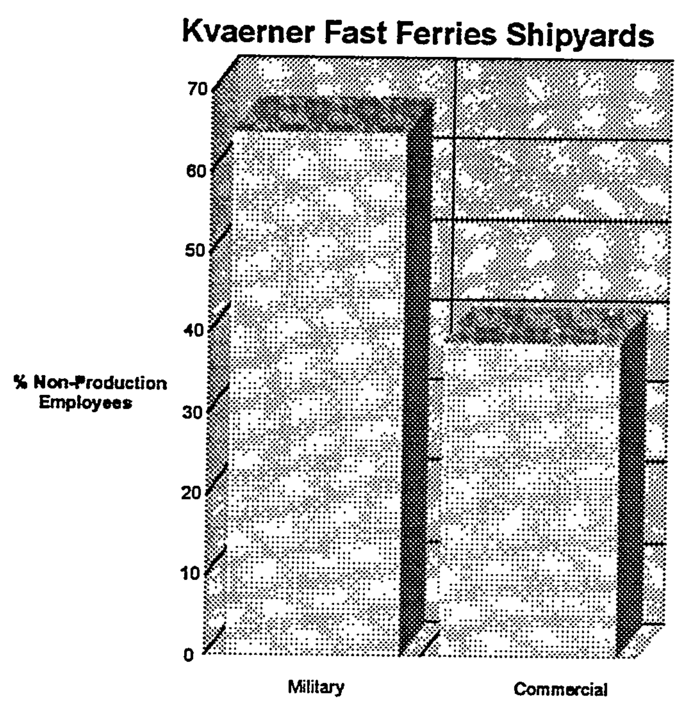


Figure 15

Table 12: Additional Indirect Staff For Military Contracts

General Description	Military Requirements Driven Staffing	
1) Contract Administration		
CM & General Administration & Estimating	3	
Change Order Pricing/ECP Preparation	5	In 7 & 8 on Table #11
2) Data Management - Done by Engineers	3	
3) QA	3	
4) QC	4	
Total	18	

Norwegian Navy - 1 On-Site + 3 QA Auditors

CONCLUSIONS

Based upon these studies, the following conclusions can be made:

Even without the legacy costs associated with government contracts, U.S. shipyards still have higher manpower requirements than do world class foreign shipyards (Figure 16). Reasons for the added requirement is due to external factors problematic with American industry in general (government regulations, inferior labor force level of education, etc.). Differences are also due to lack of modem facilities that reduces the potential for levels of productivity capable of foreign shipbuilders.

While there are definite disparities in the amount of capital investment between the typical U.S. shipyard and those abroad, a primary difference between the two shipbuilding segments lies in the business methods being applied and the human resources and support services available and being used. U.S. yards have tended to be less focused on satisfying customers with ship products that directly satisfies their needs. Instead, far more effort is placed upon selling a product that more directly satisfies the shipyard's immediate capabilities. Foreign yards place the primary emphasis upon successfully marketing their products so that these products are successful for the ship owner, then upon contract award, using aggressive and innovative project management methods and cultural attitudes to make the project successful for the shipyard.

One of the cultural differences is in the way quality assurance is carried out. While foreign yards establish QA responsibility down to the worker level. U.S. yards put QA responsibility essentially with a separate watchdog department that is outside production. Refer to Figure 17. This arrangement does not emphasize that the worker should do things right the first time. What more naturally occurs is that the work force tends to rely on the QA department to find defects and omissions, rather than they themselves. Most problems eventually do get caught, but caught later in the production cycle when corrections are much more expensive. Theses procedures can add significantly to the costs of production.

The Europeans, on the other hand, avoid these added costs because they are caught before the next production cycle gets under way.

Quality improvement programs have proved to benefit the operations with not only better products, but also products that are easier and less expensive to build. The U.S. approach with Total Quality Management ("TQM") is to set aside "quality time" to develop productivity enhancements. Unfortunately, these efforts more typically are outside the normal operations of on-going work. It is difficult to find such "quality time”"and relate their potential benefits to the work at hand. The European's, however, execute work with integrated product teams, and these multi-discipline teams work on developing quality improvements as a normal part of their efforts to satisfy specific contract objectives. Refer to Figure 18.

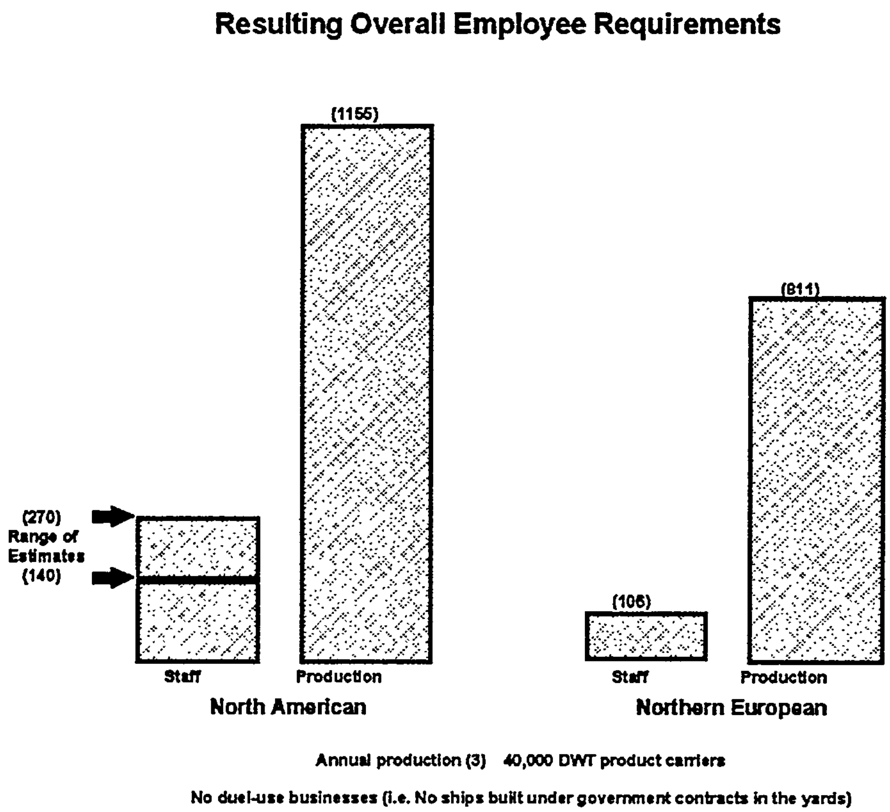

Resulting Overall Employee Requirements
(1155)
(811)
(270)
Range of
Estimates
(140)
(106)
Staff
Production
Staff
Production
North American
Northern European
Annual production (3) 40,000 DWT product carriers
No duel-use businesses (i.e. No ships built under government contracts in the yards)

Figure 16

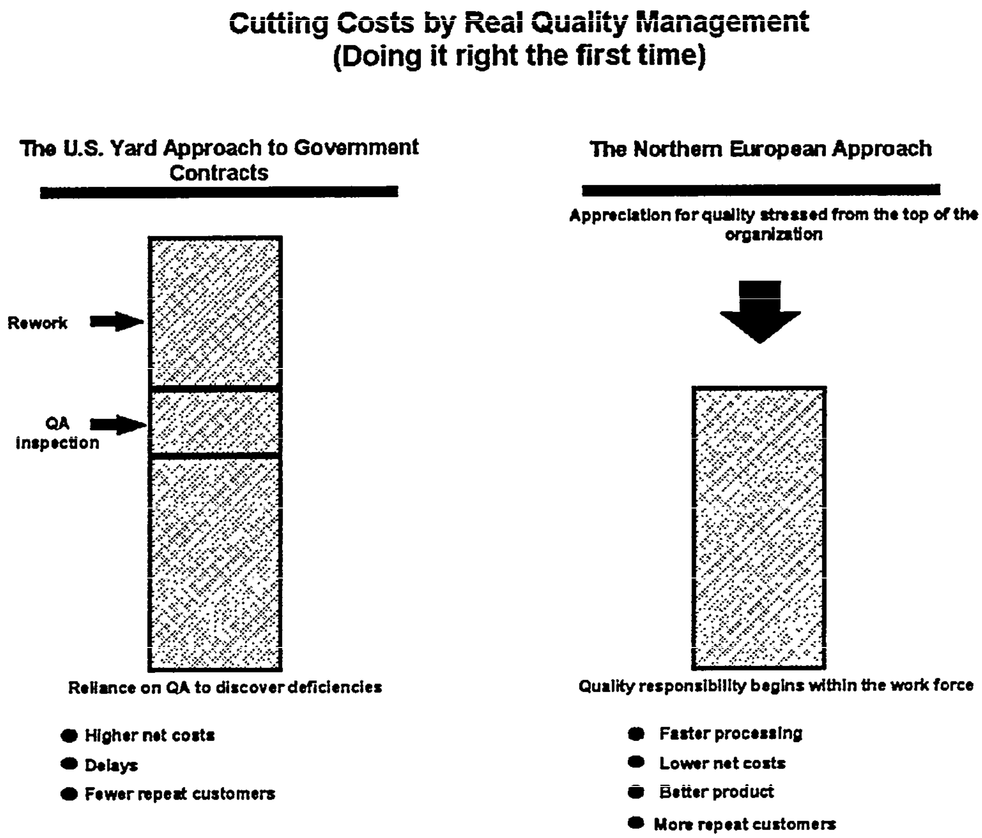

Cutting Costs by Real Quality Management
(Doing it right the first time)
The U.S. Yard Approach to Government Contracts
Rework
QA Inspection
Reliance on QA to discover deficiencies
Higher net costs
Delays
Fewer repeat customers
The Northern European Approach
Appreciation for quality stressed from the top of the organization
Quality responsibility begins within the work force
Faster processing
Lower net costs
Better product
More repeat customers

Figure 17

Product Teams: Implementing Active Quality Improvements

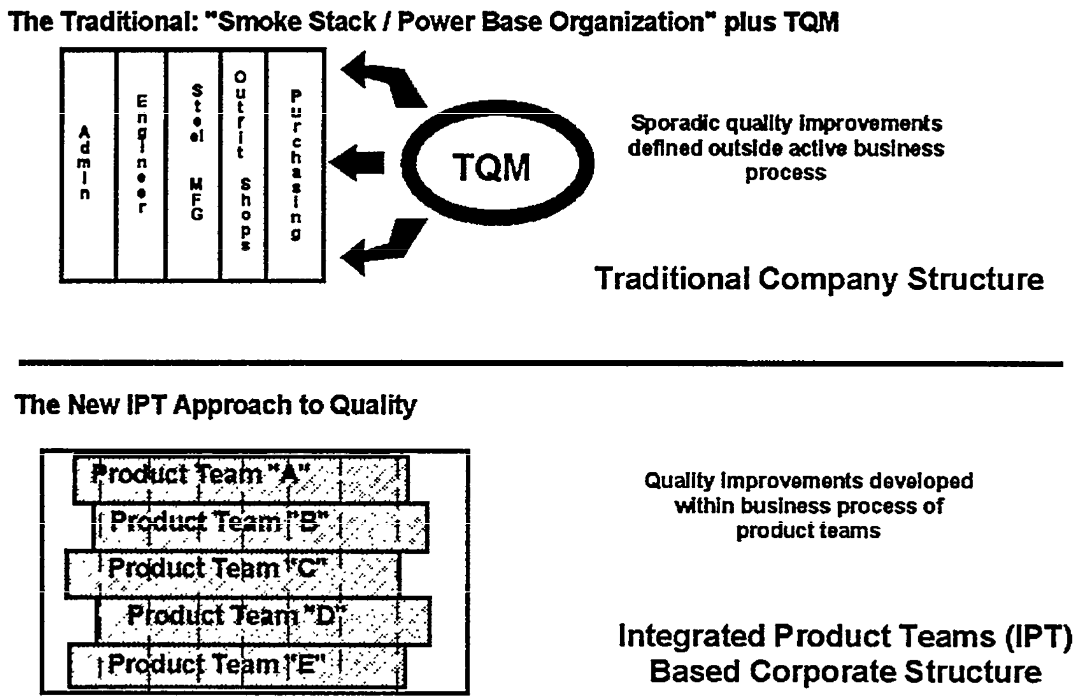


Figure 18

SUMMARY OBSERVATIONS AND STUDY CONCLUSIONS

The conclusions reached and expressed below emphasize human resources issues in keeping with the sponsorship of Panel SP-5, Innovations in Human Relations:

- Avondale is managed in a way which minimizes the "legacy cost" of bad business practices instilled in U.S. yards during the heavy ordering of ships for government agencies, (Department of Defense, Transportation, and Commerce) during the nineteen seventies and eighties.

  Cost shared, fixed price incentive contract provisions did not impact Avondale until the mid eighties.

  A nineteen seventies period of nearly all commercial ship construction lasted into the 1980's at Avondale.

  Senior management remembers how commercial ships are designed and built.

- The human resources of Northern European shipyards are generally homogeneous, well educated and trained. They are motivated by high investments in new, worker-comfortable facilities.

Ž The management human resources of Northern European yards, from senior executives to production supervision, nearly all graduate engineers. In Finland, most have master degrees in naval architecture.

Ž Everyone in the Kvaerner Masa-Yards receives an annual bonus when actual costs are below agreed on budgets. In 1994 this equalled three months pay for all employees. Bonuses continue to be paid at a reduced amount due to the tightening of the market and an unfavorable exchange rate.

Ž The management process in Northern Europe routinely incorporates multiple team efforts.

This is regularly done for all grand blocks and outfitting areas of the ships as they are built. Professionals from the design, material, and production departments guide the process and solve nearly all problems. Only major problems need the attention of senior management, who can concentrate on business strategy, marketing, public relations and human relations within the yard.

- The new, younger American shipyard employees are often lacking in a good public school education and have not been raised to be motivated and productive workers. This varies in degree from location to location, but is definitely a general trend in the U.S.

- The older, more experienced and skilled American employees were not so negatively affected by the poor performance of the U.S. public school educational system which has deteriorated over the last several decades. These workers are an asset to the U.S. shipbuilding industry, although many are reaching the age of retirement.

- Shipyard product quality suffers while costs increase under U.S. Government shipbuilding contract quality assurance program requirements, methods, and procedures. The old, pre-1970 approach to quality in the U.S. produced a higher quality product at less cost. This previous approach included a top management down emphasis on quality combined with a work ethic supportive of quality work. Northern Europe uses ISO 9000 as a format to document their good work processes, maintain uniform yard standards, and assure quality in the procured material. However, the shipyards do not believe being formally certified is an automatic benefit.

- The procurement function is strongly affected negatively by U.S. Government contract requirements. A good medium size commercial yard building commercial ships can perform well with an (8) to (12) man purchasing department. This compares to shipyard procurement organizations of a minimum of (40) to well over a (100) personnel for military ships.

- First half study results indicate that a shipyard sized and organized to build three (3) 40,000 DWT product tankers per year would be staffed with (106) non-production and (811) production persomel in Northern Europe and (270) non-production and (1155) production personnel in North America, about 50% more people.

- Second half study analyses concentrated on one of Canada's largest shipyards which is undergoing a major economic conversion from exclusively managing the entire Canadian Patrol Frigate Program and building nine frigates to actually pursuing international commercial shipbuilding markets. The management of this yard has independently restructured the yard's operations. The resulting staffing and organizational functions are remarkably close to the Northern European Cost Model.

- The four shipyards involved in this study were very cooperative with the AMS/KMM/SPAR study team and provided extensive support in time and insight into their operations. In the case of Saint John Shipbuilding Limited, the shipyard provided an actual analysis of their own organizational structure using our study format.

RECOMMENDATIONS

The authors of this study believe that considerable insight has been gained from this project. The results should give the U.S. shipbuilders abetter understanding of the key factors that have limited them from competing on an equal basis with world class international shipbuilders.

Because of the scope and detail of information in this report, it also is believed that little use would be served by spending more funds to pursue the analysis further. The study’s results are sufficiently detailed so that they should be useful to North American yards as examples of "lessons learned and of shipyard operations of European and Canadian models.

APPENDIX I

"SEAKEY" Cost Model

BASELINE PRODUCT CARRIER

DEADWEIGHT — 42700 mt

SPEED 14.5 KNOTS (TRIAL)

	Meters
LOA	182.0
LBP	174.9
BEAM	32.2
DRAFT	11.6
HEIGHT	18.4

PROPULSION

SLOW SPEED DIESEL	8160 KW
RANGE	12000
SHIP SERVICE POWER	3080 KW USING SHAFT GENERATORS
CREW	20
CREW CABINS	19

DEEP WELL CARGO PUMPS

4 CARGO SEPARATIONS

BUILDING COST ESTIMATE FOR THE FIRST SHIP IN THE SERIES BUILT IN NORTHERN EUROPE

YEAR DELIVERED — 1997

COST GROUP	COST MATERIAL (Million USD)	LABOR (Hours)	
General	2.02	44400	
Task Related Systems	3.68	30912	
Hull & Superstructure	7.98	282150	
Accomodation	1.04	23600	
Comfort System	1.09	17700	
Machinery	5.51	23042	
Accessories for Machinery	1.75	20232	
Outfitting & Ship System	2.40	14400	
Electric System	3.08	45000	
Total	$28.55m	501436	Direct Hours
Fourth Ship in Series	$28.00m	462123	Direct Hours

NORTHERN EUROPEA SHIPYARD COST (4th Ship in Series)

Labor	462123 x $47/Hour =	21.72
Material		28.00
Total		49.72 USD Million

APPENDIX II

SJSL Staff Levels To Build Two 5,000 Ton Frigates Per Year

SAINT JOHN SHIPBUILDING LIMITED
STAFF LEVEL SUMMARY
AS AT SEPTEMBER 21, 1990

		STAFF LEVELS				CURRENT STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		CURRENT STAFF LEVELS SEPT '90		APPROVED REQUISITIONS SEPT '90	
		1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR
80001	CORPORATE OFFICE (INCL. VP ENG)	244	301	350	329	81	216	0	1	76	209	0	1
	83001 VP ENGINEERING	197	231	232	183	39	121	0	0	37	116	0	0
80002	SR. V.P. & GEN MGR (INCL. VP PROD.)	221.5	236	372	423	161	307	2	1	159	305	2	2
	84301 VP PRODUCTION	196.5	213	349	389	123	293	1	1	122	291	1	2
80004	V.P. S.J.S.L.	9	7	5	7	0	0	0	0	0	0	0	0
80005	V.P. & C.P.F. PROGRAM MANAGER	190	206	262	270	91	166	3	4	84	166	5	7
80006	V.P. MATERIALS	104.5	107.1	127	132	83	86	0	3	82	88	1	5
85001	V.P. FINANCE & SYSTEMS	121.5	111	125	128	122	5	0	1	115	5	3	1
85502	V.P. CORPORATE ANG LEGAL	30	25	40	45	18	27	0	0	18	27	0	0
TOTAL STAFF LEVELS		920.5	993.1	1281	1334	556	807	5	10	534	800	11	16

		REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH BY PERIOD O/H			GROWTH BY PERIOD DIR		
		per1	per6	per12	per1	per6	per12	per1	per6	per12	per1	per6	per12
80001	CORPORATE OFFICE (INCL. VP ENG)	79	76	71	220	206	170	3	0	-5	10	-4	-40
	83001 VP ENGINEERING	39	38	33	123	109	73	2	1	-4	7	-7	-43
80002	SR. V.P. & GEN MGR (INCL. VP PROD.)	165.5	164.5	163.5	308	308	308	4.5	3.5	2.5	1	1	1
	84301 VP PRODUCTION	126	125	124	294	294	294	3	2	1	1	1	1
80004	V.P. S.J.S.L.	0	3	0	0	0	0	0	3	0	0	0	0
80005	V.P. & C.P.F. PROGRAM MANAGER	97.5	96.5	96.5	184.5	197.5	195.5	8.5	7.5	7.5	11.5	24.5	22.5
80006	V.P. MATERIALS	89	92	92	90	95	95	6	9	9	-3	2	2
85001	V.P. FINANCE & SYSTEMS	122.5	120.5	115.5	6	7	7	5.5	3.5	-1.5	-1	0	0
85502	V.P. CORPORATE ANG LEGAL	21	21	21	29	30	29	3	3	3	2	3	2
TOTAL STAFF LEVELS		574.5	573.5	559.5	837.5	843.5	804.5	30.5	29.5	15.5	20.5	26.5	-12.5

SAINT JOHN SHIPBUILDING LIMITED
CORPORATE OFFICE

		STAFF LEVELS				PREVIOUS STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		CURRENT STAFF LEVELS SEPT '90		APPROVED REQUISITIONS SEPT '90		REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH BY PERIOD O/H			GROWTH BY PERIOD DIR		
		1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	per1	per6	per12	per1	per6	per12	per1	per6	per12	per1	per6	per12
80001	CORPORATE OFFICE (SINGLE)	1	1	4	6	2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
80010	MANAGER PUBLIC RELATIONS	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
83001	VP ENGINEERING	197	231	232	183	40	120	0	0	37	116	0	0	39	38	33	123	109	73	2	1	-4	7	-7	-43
85455	DIRECTOR HUMAN RESOURCES	10	9	2	2	3	0	0	0	3	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0
85460	MANAGER COMP/ORG DEVELOP	0	0	6	7	7	0	0	0	6	0	0	0	7	6	6	0	0	0	1	0	0	0	0	0
85465	MANAGER PERSONEL SERV STF	0	0	5	20	10	0	0	0	9	0	0	0	10	10	10	0	0	0	1	1	1	0	0	0
85470	MANAGER MANPWR PLN & EMPL	0	0	6	4	4	0	0	0	4	0	0	0	4	3	3	0	0	0	0	-1	-1	0	0	0
	TOTAL DIRECTOR HUMAN RESOURCES	10	9	19	33	24	0	0	0	22	0	0	0	24	22	22	0	0	0	2	0	0	0	0	0
86101	DIRECTOR QA	2	4	1	2	2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
86110	MANAGER ENG QA & DOCUMENT	1	3	3	3	2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
86111	SPVR, QA AUDITING	2	2	2	2	0	2	0	1	0	2	0	1	0	0	0	2	2	2	0	0	0	-1	-1	-1
86120	MANAGER QA REPRESENT'VE	4	6	7	9	1	9	0	0	1	9	0	0	1	1	1	9	9	9	0	0	0	0	0	0
86112	MANAGER QA DOCUMENT	6	6	7	7	2	4	0	0	2	3	0	0	1	1	1	5	5	5	-1	-1	-1	2	2	2
86130	MANAGER QA SHIPYARD	3	4	4	74	7	71	0	0	7	69	0	0	7	7	7	71	71	71	0	0	0	2	2	2
86140	MANAGER QA ENGINEERING	5	2	2	3	1	1	0	0	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0
86150	MANAGER QA INSPECT - SPYD	6	17	40	0			0	0					0	0	0	0	0	0	0	0	0	0	0	0
86160	MANAGER NON-DESTRUCT EXAM	4	10	23	0			0	0					0	0	0	0	0	0	0	0	0	0	0	0
86180	MANAGER TEST & TRIALS QA	0	4	5	5	0	7	0	0	0	7	0	0	0	0	0	7	7	7	0	0	0	0	0	0
86170	DEPUTY DIR - QA	3	2	1	2	0	2	0	0	0	2	0	0	0	0	0	2	2	2	0	0	0	0	0	0
	TOTAL DIRECTOR Q.A.	36	60	95	107	15	96	0	1	15	93	0	1	14	14	14	97	97	97	-1	-1	-1	3	3	3
	TOTAL CORPORATE OFFICE	244	301	350	329	81	216	0	1	76	209	0	1	79	76	71	220	206	170	3	0	-5	10	-4	-40

SAINT JOHN SHIPBUILDING LIMITED
V.P. ENGINEERING

	STAFF LEVELS				PREVIOUS STAFF LEVELS		APPROVED REQUISITIONS		CURRENT STAFF LEVELS		APPROVED REQUISITIONS		REQUESTED BUDGET						GROWTH BY PERIOD					
					MAY '90				SEPT '90				O/H			DIR			O/H			DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	per1	per6	per12	per1	per6	per12	per1	per6	per12	per1	per6	per12
83001 V.P. ENGINEERING	2	2	2	2	4	0	0	0	4	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
83010 MANAGER ENG ADMIN/SECUR	0	0	8	6	6	0	0	0	6	0	0	0	6	6	4	0	0	0	0	0	-2	0	0	0
83101 MANAGER ENG SUPPORT	8	11	12	10	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
83150 MANAGER SCHEDUL & MANNING	9	11	1	3									0	0	0	0	0	0	0	0	0	0	0	0
83160 MANAGER ENG VFI	0	0	4	5	2	3	0	0	0	3	0	0	2	0	0	3	3	3	2	0	0	0	0	0
83230 DIRECTOR PROJECT ENG	22	24	14	7	2	6	0	0	2	5	0	0	2	2	2	7	6	4	0	0	0	2	1	-1
83401 MANAGER PROD DESIGN	2	1	2	3			0	0					0	0	0	0	0	0	0	0	0	0	0	0
83402 DIRECTOR ENG SERVICES	2	15	17	27	3	21	0	0	3	20	0	0	3	3	2	20	19	16	0	0	-1	0	-1	-4
83403 DRAWING MANAGEMENT					3	5	0	0	3	4	0	0	2	2	2	4	4	4	-1	-1	-1	0	0	0
83404 ENGINEERING PERFORMANCE ANALYSIS					1	1	0	0	1	2	0	0	1	2	0	2	2	2	0	1	-1	0	0	0
83405 ENGINEERING CHANGE CONTROL					1	2	0	0	1	2	0	0	1	1	1	2	2	1	0	0	0	0	0	-1
83515 ENG SUBCONTRACTOR - MSEI	0	0	59	14	0	4	0	0	0	3	0	0	0	0	0	4	1	0	0	0	0	1	-2	-3
TOTAL MANAGER ENG SUPPORT	43	62	109	69	13	42	0	0	11	39	0	0	12	11	8	42	37	30	1	0	-3	3	-2	-9
83205 DIRECTOR ELECTRICAL & SYSTEMS					2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
83201 DIRECTOR SYSTEMS ENG	0	2	1	5	0	3	0	0	0	3	0	0	0	0	0	3	3	2	0	0	0	0	0	-1
83430 CHIEF DRAFTSMAN -ELECTRL	14	13	14	14	2	11	0	0	2	11	0	0	2	2	2	12	12	12	0	0	0	1	1	1
83530 MANAGER ELECTRL SYSTEMS	9	9	8	7	0	5	0	0	0	5	0	0	0	0	0	5	5	5	0	0	0	0	0	0
83540 MANAGER SPEC DISCIPLINES	10	17	12	0			0	0					0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DIRECTOR ELECTRICAL & SYSTEMS	33	41	35	26	4	19	0	0	4	19	0	0	4	4	4	20	20	19	0	0	0	1	1	0
83450 DIRECTOR CAD/CAM					2	13	0	0	2	13	0	0	2	2	2	13	13	2	0	0	0	0	0	-11
83505 DIRECTOR N.A. & HULL SYSTEMS					2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
83260 MANAGER HULL PRODUCT ENG	0	0	13	14	1	9	0	0	1	9	0	0	1	1	1	10	6	2	0	0	0	1	-3	-7
83420 CHIEF DRAFTSMAN -HL OUTFT	13	10	10	8	1	8	0	0	1	7	0	0	2	2	2	8	8	4	1	1	1	1	1	-3
83440 CHIEF DRAFTSMAN -HL STEEL	35	38	19	21	0	5	0	0	0	5	0	0	0	0	0	5	4	1	0	0	0	0	-1	-4
83510 MANAGER HULL SYSTEMS	17	18	8	13	1	9	0	0	1	8	0	0	1	1	1	9	5	3	0	0	0	1	-3	-5
TOTAL DIRECTOR N.A. & HULL SYSTEMS	65	66	50	56	5	31	0	0	5	29	0	0	6	6	6	32	23	10	1	1	1	3	-6	-19
83550 MANAGER MARINE ENG - AUX	11	14	11	8	2	5	0	0	2	5	0	0	2	2	2	5	5	5	0	0	0	0	0	0
83410 CHIEF DRAFTSMAN -MAR. DES	21	13	8	11	2	5	0	0	2	5	0	0	2	2	2	5	5	1	0	0	0	0	0	-4
83520 MANAGER MARINE PROD - ENG	16	24	9	5	1	6	0	0	1	6	0	0	1	1	1	6	6	6	0	0	0	0	0	0
85432 MANAGER ENGINEERING ADMIN/SECURITY	6	9	0	0			0	0					0	0	0	0	0	0	0	0	0	0	0	0
TOTAL MANAGER MARINE SYSTEMS	54	60	28	24	5	16	0	0	5	16	0	0	5	5	5	16	16	12	0	0	0	0	0	-4
TOTAL V.P. ENGINEERING	197	231	232	183	39	121	0	0	37	116	0	0	39	38	33	123	109	73	2	1	-4	7	-7	-43

SAINT JOHN SHIPBUILDING LIMITED
SR. V.P. & GENERAL MANAGER

	STAFF LEVELS				PREVIOUS STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		CURRENT STAFF LEVELS SEPT '90		APPROVED REQUISITIONS SEPT '90		REQUESTED STAFF LEVELS PER PERIOD O/H			REQUESTED STAFF LEVELS PER PERIOD DIR			GROWTH PER PERIOD O/H			GROWTH PER PERIOD DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	per1	per6	per12	per1	per6	per12	per1	per6	per12	per1	per6	per12
80002 SR. VP & GEN MGR (SINGLE)	4	1	0	1	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
82101 DIR.,SHIPBUILDING EMP. RELATIONS					4	0	0	0	4	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
82210 TRADE ADMINISTRATION	7	6	6	4	4	0	0	0	4	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
82215 PERSONNEL	0	0	0	2	3	0	0	0	2	0	0	0	3	3	3	0	0	0	1	1	1	0	0	0
82290 MANAGER INDUSTL RELATIONS	1	1	2	4	4	0	0	0	4	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
82291 MANAGER LABOUR RELATIONS	3	4	2	0			0	0					0	0	0	0	0	0	0	0	0	0	0	0
82292 MANAGER TRAINING	1	1	2	4	4	0	0	0	4	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
82293 MANAGER SAFETY & SECURITY	9	10	11	14	10	4	1	0	10	4	1	0	11.5	11.5	11.5	4	4	4	0.5	0.5	0.5	0	0	0
TOTAL DIR.,SHIPBUILDING EMPLOYEE RELATIONS	21	22	23	28	29	4	1	0	28	4	1	0	30.5	30.5	30.5	4	4	4	1.5	1.5	1.5	0	0	0
82207 DIRECTOR SPECIAL PROJECTS	0	0	0	4	3	1	0	0	3	1	0	0	3	3	3	1	1	1	0	0	0	0	0	0
82209 DIR.,PERFORMANCE ANALYSIS CHANGE	0	0	0	0	4	9	0	0	4	9	0	0	4	4	4	9	9	9	0	0	0	0	0	0
82208 NEW BUS. DEV. -COMMERCIAL	0	0	0	1	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
84301 VICE PRESIDENT PRODUCTION	196.5	213	349	389	123	293	1	1	122	291	1	2	126	125	124	294	294	294	3	2	1	1	1	1
TOTAL SR. VP GEN MGR	221.5	236	372	423	161	307	2	1	159	305	2	2	165.5	164.5	163.5	308	308	308	4.5	3.5	2.5	1	1	1

SAINT JOHN SHIPBUILDING LIMITED
V.P. PRODUCTION

	STAFF LEVELS				CURRENT STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		CURRENT STAFF LEVELS SEPT '90		APPROVED REQUISITIONS SEPT '90		REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH BY PERIOD O/H			GROWTH BY PERIOD DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	per1	per6	per12	per1	per6	per12	per1	per6	per12	per1	per6	per12
84301 V.P. PRODUCTION (SINGLE)	3	3	3	4	8	0	0	0	8	0	0	0	8	8	8	0	0	0	0	0	0	0	0	0
82201 DIRECTOR OF SHIP SUPPORT	4	4	0	3	3	0	0	0	2	0	0	0	3	3	2	0	0	0	1	1	0	0	0	0
82010 MANAGER ESTIMATING	21	8	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82650 MANAGER SERVICES	3	3	8	8									0	0	0	0	0	0	0	0	0	0	0	0
82690 SR. MGR SHIP REPAIR	23	2	3	2	2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
82270 MANAGER FACILITIES	10	11	8	5	6	0	0	0	7	0	0	0	6	6	6	0	0	0	-1	-1	-1	0	0	0
82271 PLANT ENGINEERING	9	9	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82273 INDUSTRIAL ENGIN.	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82274 FACILITIES MAINTENANCE	0	0	11	13	14	0	0	0	13	0	0	0	14	14	14	0	0	0	1	1	1	0	0	0
82280 INACTIVE	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82695 SUPT, ESTIMATING	0	0	10	10	9	1	0	0	8	1	0	0	9	9	9	1	1	1	1	1	1	0	0	0
TOTAL DIRECTOR SHIPBUILDING SUPPORT	70	37	40	41	34	1	0	0	32	1	0	0	34	34	33	1	1	1	2	2	1	0	0	0
82220 DIRECTOR CONST -GRAV DOCK	0	1	6	1	2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
82240 MANAGER NEW CONSTRUCTION	0	3	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82670 MANAGER CPF - 02 SHIP	0	0	25	49	13	48	0	0	13	52	0	1	13	13	13	48	48	48	0	0	0	-5	-5	-5
82680 MANAGER CPF - 04 SHIP	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DIRECTOR CONSTRUCTION GRAVING DOCK	0	4	31	50	15	48	0	0	15	52	0	1	15	15	15	48	48	48	0	0	0	-5	-5	-5
82710 DIRECTOR SHOP FABRICATION	0	4	1	2	3	0	0	0	3	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0
82221 MANAGER ASSEMBLY SHOP	31	8	64	35	6		0	0	7	30	0	1	6	6	6	30	30	30	-1	-1	-1	-1	-1	-1
82222 SUPT, - FABR & SUB-ASSEM	1	18	0	0		30	0	0					0	0	0	0	0	0	0	0	0	0	0	0
82223 SUPT, - ASSEM & PANEL L.	1	20	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82229 SOUTH STEEL SHOP COMPLEX	0	0	0	11	2	9	0	0	2	9	0	0	2	2	2	9	9	9	0	0	0	0	0	0
82230 MANAGER OUTFIT COMPLEX	11.8	0	27	13	4	11	0	0	4	11	0	0	4	4	4	11	11	11	0	0	0	0	0	0
82232 MACHINE SHOP	2	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82235 MANAGER MODULE SHOP	0	0	0	32	8	26	1	0	8	26	0	0	9	9	9	26	26	26	1	1	1	0	0	0
82239 MANAGER ELECTRICAL/ELECT	2	17	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82224 SUPT, - PRE-OUTFIT #1	0.5	4	0	0									0	0	0	0	0	0	0	0	0	0	0	0
82225 SUPT, - BLAST & PAINT	4.3	1	0	0	0	5	0	0	0	4	0	0	0	0	0	5	5	5	0	0	0	1	1	1
82227 SUPT, - PRE-OUTFIT #2	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SHOP FABRICATION	53.5	72	92	93	23	81	1	0	24	80	0	1	24	24	24	81	81	81	0	0	0	0	0	0
82715 DIRECTOR CONSTRUCT AFLOAT	0	0	1	4	4	0	0	0	4	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0
82640 MANAGER ELECTRICAL	0	0	22	24	3	9	0	0	3	8	0	0	3	3	3	9	9	9	0	0	0	1	1	1
82641 SUPT, CONNECTORIZATION	0	0	4	4									0	0	0	0	0	0	0	0	0	0	0	0
82660 MANAGER CPF - 01 SHIP	0	0	49	50	14	45	0	0	13	42	1	0	14	14	14	45	45	45	0	0	0	3	3	3
82720 MANAGER TEST & TRIALS OPS	0	0	9	19	3	28	0	1	2	30	0	0	3	2	2	31	31	31	1	0	0	1	1	1
TOTAL DIRECTOR CONSTRUCTION AFLOAT	0	0	85	101	24	82	0	1	22	80	1	0	24	23	23	85	85	85	1	0	0	5	5	5

SAINT JOHN SHIPBUILDING LIMITED
V.P. PRODUCTION

	STAFF LEVELS				CURRENT STAFF LEVELS		APPROVED REQUISITIONS		CURRENT STAFF LEVELS		APPROVED REQUISITIONS		REQUESTED BUDGET						GROWTH BY PERIOD					
					MAY '90				SEPT '90				O/H			DIR			O/H			DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	per1	per6	per12	per1	per6	per12	per1	per6	per12	per1	per6	per12
82750 DIRECTOR NIGHT-SHIFT PROD	0	0	0	6	7	0	0	0	7	0	0	0	7	7	7	0	0	0	0	0	0	0	0	0
84302 DIRECTOR PRE-CONSTR ACTIV'S	17	6	3	4	2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
84320 MANAGER PRODUCTION PLANN	37	54	55	41	2	40	0	0	2	39	0	0	2	2	2	40	40	40	0	0	0	1	1	1
84330 MANAGER WELDING ENG	1	8	8	9	2	6	0	0	4	4	0	0	4	4	4	4	4	4	0	0	0	0	0	0
84335 WELDING - TRAINING	0	0	1	1									0	0	0	0	0	0	0	0	0	0	0	0
84340 MANAGER LABOUR CONTROL	15	16	16	24	6	19	0	0	6	19	0	0	6	6	6	19	19	19	0	0	0	0	0	0
84350 SUPT, ACCURACY CTRL	0	13	15	15	0	16	0	0	0	16	0	0	0	0	0	16	16	16	0	0	0	0	0	0
84360 MANAGER MATERIAL COORDINATION													0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DIRECTOR PRE-CONSTRUCTION ACTIVITIES	70	97	98	94	12	81	0	0	14	78	0	0	14	14	14	79	79	79	0	0	0	1	1	1
TOTAL V.P. PRODUCTION (SHIPYARD)	196.5	213	349	389	123	293	1	1	122	291	1	2	126	125	124	294	294	294	3	2	1	1	1	1

SAINT JOHN SHIPBUILDING LIMITED
V.P. SJSL

	STAFF LEVELS				PREVIOUS STAFF LEVELS MAY '90		APPROVED REQUISITIONS		CURRENT STAFF LEVELS SEPT '90		APPROVED REQUISITIONS		REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH BY PERIOD O/H			GROWTH BY PERIOD DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	Per1	Per6	Per12	Per1	Per6	Per12	Per1	Per6	Per12	Per1	Per6	Per12
80004 V.P. S.J.S.L.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80003 DIRECTOR NEW BUSINESS DEVELOPMENT	9	7	5	7	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0
TOTAL V.P. S.J.S.L.	9	7	5	7	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0	0

SAINT JOHN SHIPBUILDING LIMITED
V.P. C.P.F. PROGRAM MANAGER

	STAFF LEVELS 1986	1987	1988	1989	CURRENT STAFF LEVELS MAY 90 O/H	DIR	APPROVED REQUISITIONS MAY 90 O/H	DIR	CURRENT STAFF LEVELS SEPT 90 O/H	DIR	APPROVED REQUISITIONS SEPT 90 O/H	DIR	REQUESTED BUDGET O/H per1	Per6	per12	DIR per1	Per6	per12	GROWTH BY PERIOD O/H per1	Per6	per12	DIR per1	Per6	per12
80005 V.P. & C.P.F. PROGRAM MGR	.0	0	0	1	1	0	0	0	1	0	0	0	2	2	2	0	0	0	1	1	1	0	0	0
82206 DIRECTOR FOLLOWYARD -SJSL	0	0	3	1	1	0	0	0	0	0	0	0	3	3	3	0	0	0	3	3	3	0	0	0
82205 FOLLOWYARD MGMNT @ YARD	0	0	1	3	1	2	0	0	1	2	2	0	1	1	1	3	3	3	-2	-2	-2	1	1	1
TOTAL FOLLOWYARD - SJSL	0	0	4	4	2	2	0	0	1	2	2	0	4	4	4	3	3	3	1	1	1	1	1	1
82730 DIRECTOR TEST & TRIALS	0	0	11	23	9	18	0	1	10	19	0	1	10	11	12	20	30	32	0	1	2	0	10	12
83701 DIRECTOR COMBAT SYS ENG	12	18	30	37	4	30	1	2	3	32	1	0	5	5	5	33	33	32	1	1	1	1	1	0
83270 I.M.C.S. (ENG)	0	0	0	6	0	7	0	0	1	7	0	0	0	0	0	10	10	10	-1	-1	-1	3	3	3
TOTAL DIRECTOR COMBAT SYS ENG	12	18	30	43	4	37	1	2	4	39	1	0	5	5	5	43	43	42	0	0	0	4	4	3
84002 DEPUTY PROG MGR - SYSTEMS	2	3	10	9	3	7	0	0	3	6	0	3	5	5	5	11	11	11	2	2	2	2	2	2
84910 TECH & SHIP SUPPORT	7	4	3	1									1	1	1	0	0	0	1	1	1	0	0	0
84940 COMBAT SYSTEMS	1	4	1	1									0	0	0	0	0	0	0	0	0	0	0	0
84950 CONFIGURATION MGMNT	0	0	7	10	2	7	0	0	2	7	0	0	2	2	2	7	7	7	0	0	0	0	0	0
TOTAL DEPUTY PROGRAM MGR - SYSTEMS	10	11	21	21	5	14	0	0	5	13	0	3	8	8	8	18	18	18	3	3	3	2	2	2
84801 DPM-ILS,MATERIALS,SPARES					1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
84101 DIRECTOR ILS	9	12	2	6	2	3	0	0	2	3	0	0	2	2	2	3	2	1	0	0	0	0	-1	-2
84110 MANAGER ILS	2	2	2	1			1	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0
84111 MTCE PLAN.	22	20	37	9	0	9	0	0	1	8	0	0	1	1	1	8	8	6	0	0	0	0	0	-2
84112 IN-SERV DOCUMENT.	5	4	3	8	0	7	0	0	0	7	0	0	0	0	0	8.5	8.5	8.5	0	0	0	2	2	2
84113 INITIAL PROVISION	25	12	3	1									0	0	0	0	0	0	0	0	0	0	0	0
84114 R.A.M. MGMNT	0	0	2	3	0	4	0	0	0	3	0	0	0	0	0	4	3	3	0	0	0	1	0	0
84115 2009\100x DRAWINGS					0	3	0	0	0	3	0	0	0	0	0	3	5	5	0	0	0	0	2	2
84130 MANAGER ILS PERS.	8	15	4	4	2	2	0	0	2	2	0	0	1.5	1.5	0.5	2	2	2	-1	-1	-2	0	0	0
84140 MANAGER SUPPLY S.	0	0	18	20									0	0	0	0	0	0	0	0	0	0	0	0
84150 MANAGER ILS ADMIN	0	0	9	7	0	3	0	0	0	3	0	0	0	0	0	3	5	5	0	0	0	0	2	2
84160 MANAGER ILS FACIL	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
TOTAL DPM ILS,MATERIALS,PROCUREMENT	70	65	80	59	5	31	1	0	6	29	0	0	5.5	5.5	4.5	31.5	33.5	30.5	-0.5	-0.5	-1.5	2.5	4.5	1.5
84901 DEPUTY PROG MGR - PERF.	29	23	8	10	4	10	0	0	4	7	0	0	6	6	6	8	8	8	2	2	2	1	1	1
84930 MGR - TEST & TRIALS	1	1	1	1			0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	-1	-1	-1
84960 DIRECTOR PERFRMNCE CTRLS	0	0	1	1	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
84511 RISK MANAGEMENT					2	3	0	0	2	3	0	0	2	2	2	3	3	3	0	0	0	0	0	0
84955 PROGRAM CONTROLS	0	3	9	9	2	8	0	0	2	9	0	0	2	2	2	8	9	9	0	0	0	-1	0	0
84310 PROG PLANN & SCHE	7	7	10	10	2	12	0	0	2	12	0	0	2	2	2	12	12	12	0	0	0	0	0	0
85320 PERFORMANCE ANAL.	3	5	12	11	1	10	0	0	1	9	0	0	1	1	1	14	14	14	0	0	0	5	5	5
TOTAL DEPUTY PROGRAM MGR - PERFRMNCE	40	39	41	42	12	43	0	0	12	40	0	1	14	14	14	45	46	46	2	2	2	4	5	5
85410 MANAGER SECURITY	3	3	3	4	6	0	0	0	6	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0

SAINT JOHN SHIPBUILDING LIMITED
V.P. C.P.F. PROGRAM MANAGER

	STAFF LEVELS				CURRENT STAFF LEVELS MAY 90		APPROVED REQUISITIONS MAY 90		CURRENT STAFF LEVELS SEPT 90		APPROVED REQUISITIONS SEPT 90	
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR
85420 DIRECTOR DATA MGMNT	1	1	2	2	2	0	0	0	1	0	0	0
85421 SUP. DATA - SHIPYARD	11	17	2	0								
85422 SUP, DATA - ENG	12	16	25	30	10	14	1	1	5	17	1	2
85423 SUP, DATA - LIBRARY	12	13	12	13	13	0	0	0	12	0	1	0
85425 SUP, DATA - PROG OFF	19	23	16	11	0	7	0	0	0	7	0	0
85426 DATA RETRIEVAL	0	0	15	17	22	0	0	0	21	0	0	0
TOTAL DIRECTOR DATA	55	70	72	73	47	21	1	1	39	24	2	2
TOTAL V.P. & C.P.F. PROGRAM MGR	190	206	262	270	91	166	3	4	84	166	5	7

	REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH BY PERIOD O/H			GROWTH BY PERIOD DIR		
	per1	Per6	per12	per1	Per6	per12	per1	Per6	per12	per1	Per6	per12
85420 DIRECTOR DATA MGMNT	1	1	1	0	0	0	0	0	0	0	0	0
85421 SUP. DATA - SHIPYARD	0	0	0	0	0	0	0	0	0	0	0	0
85422 SUP, DATA - ENG	7	6	6	18	18	18	1	0	0	-1	-1	-1
85423 SUP, DATA - LIBRARY	13	13	13	0	0	0	0	0	0	0	0	0
85425 SUP, DATA - PROG OFF	0	0	0	6	6	6	0	0	0	-1	-1	-1
85426 DATA RETRIEVAL	22	21	21	0	0	0	1	0	0	0	0	0
TOTAL DIRECTOR DATA	43	41	41	24	24	24	2	0	0	-2	-2	-2
TOTAL V.P. & C.P.F. PROGRAM MGR	97.5	96.5	96.5	184.5	197.5	195.5	8.5	7.5	7.5	11.5	24.5	22.5

SAINT JOHN SHIPBUILDING LIMITED
V.P. MATERIALS

	STAFF LEVELS				PREVIOUS STAFF LEVELS — MAY '90		APPROVED REQUISITIONS — MAY '90		CURRENT STAFF LEVELS — SEPT '90		APPROVED REQUISITIONS — SEPT '90		REQUESTED BUDGET — O/H			REQUESTED BUDGET — DIR			GROWTH BY PERIOD — O/H			GROWTH BY PERIOD — DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	Per1	Per6	Per12	Per1	Per6	Per12	Per1	Per6	Per12	Per1	Per6	Per12
80006 VICE PRESIDENT MATERIALS --	0	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
84201 DIRECTOR MATERIALS	1	1	1	1									2	2	2	0	0	0	2	2	2	0	0	0
84020 SPARES PROCUREMENT					2	10	0	0	2	10	0	0	2	2	2	10	10	10	0	0	0	0	0	0
84202 SR MANAGER MAT'L CPF	2	2	2	2									0	0	0	0	0	0	0	0	0	0	0	0
84230 MANAGER EXPEDITING	9	8	7	8			0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1
84260 REPL MATLS - ENG DESIGN	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
84265 REPL MATLS - PRODUCTION	0	0	0	0									0	0	0	0	0	0	0	0	0	0	0	0
84210 SENIOR BUYER - SHIPYARD	4	3	3	3	3	0	0	0	3	0	0	0	4	4	4	0	0	0	1	1	1	0	0	0
84220 MANAGER PURCHASING CPF	27	25	24	26	7	18	0	2	7	18	0	2	8	8	8	21	21	21	1	1	1	1	1	1
84225 MANAGER MATERIAL ADMINISTRATION					1	1	0	0	1	2	0	1	1	4	4	3	3	3	0	3	3	0	0	0
TOTAL DIRECTOR MATERIALS	43	39	37	40	13	29	0	3	13	31	0	3	17	20	20	34	34	34	4	7	7	0	0	0
84275 DIRECTOR MATERIAL SYSTEMS					2	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0
82255 ADMIN - MAT'L OPERATIONS	9	4	8	8	15	0	0	0	15	0	0	0	16	16	16	0	0	0	1	1	1	0	0	0
84270 MANAGER MAT'L SYS	0	0	3	3	1	1	0	0	1	1	1	2	2	2	2	0	5	5	0	0	0	-3	2	2
84280 MANAGER MATERIAL ANALYSIS					1	5	0	0	1	5	0	0	1	1	1	5	5	5	0	0	0	0	0	0
TOTAL DIRECTOR MATERIAL SYSTEMS	9	4	11	11	19	6	0	0	19	6	1	2	21	21	21	5	10	10	1	1	1	-3	2	2
84285 DIRECTOR SPECIAL PROJECTS					1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
84290 MATERIAL PROJECTS/PLANNING					3	0	0	0	3	0	0	0	2	2	2	0	0	0	-1	-1	-1	0	0	0
82250 SR MANAGER MAT'L OPERATIONS	3	3	2	2									0	0	0	0	0	0	0	0	0	0	0	0
82251 MANAGER WAREHOUSING	6	6	5	15	24	0	0	0	23	0	0	0	24	24	24	0	0	0	1	1	1	0	0	0
82254 SHIPYARD STORES & TOOL RM	0	0	7	0									0	0	0	0	0	0	0	0	0	0	0	0
82252 CPF CABLE HANDLING FACILY	5	6	1	0									0	0	0	0	0	0	0	0	0	0	0	0
82253 WAREHOUSING & RAW MAT'L	1	1	15	18									0	0	0	0	0	0	0	0	0	0	0	0
84141 MANAGER WAREHOUSING - ILS/CRW					0	9	0	0	0	9	0	0	0	0	0	9	9	9	0	0	0	0	0	0
84142 MANAGER WAREHOUSING - ILS/HFX					0	5	0	0	0	5	0	0	0	0	0	5	5	5	0	0	0	0	0	0
84250 MANAGER CUS/TRANS/LOG	5	3	3	3	3	0	0	0	3	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0
82256 MANAGER MAT'L CTRL - CPF	1	3	9	14	11	12	0	0	11	12	0	0	12	12	12	13	13	13	1	1	1	1	1	1
82257 SUPT, CPF CARE & PRESERV	0	0	1	4	0	2	0	0	0	2	0	0	0	0	0	3	3	3	0	0	0	1	1	1
82258 CPF CARE & PRESERVATION	0	0	2	0									0	0	0	0	0	0	0	0	0	0	0	0
82259 CPF01 WEIGHT RECORDING	0	0	5	0									0	0	0	0	0	0	0	0	0	0	0	0
83120 MANAGER MATL REQUIREMENT	24	32	29	25	6	17	0	0	6	17	0	0	6	6	6	15	15	15	0	0	0	-2	-2	-2
84140 MANAGER SUPPLY SUPPORT/W.HOUSE					2	6	0	0	2	6	0	0	2	2	2	6	6	6	0	0	0	0	0	0
84240 MANAGER MATERIAL CONTROL	8	10	0	0									0	0	0	0	0	0	0	0	0	0	0	0
TOTAL MATERIAL PROJECTS/PLANNING	52.5	64	79	81	49	51	0	0	48	51	0	0	49	49	49	51	51	51	1	1	1	0	0	0
TOTAL VICE PRESIDENT MATERIALS	104.5	107	127	132	83	86	0	3	82	88	1	5	89	92	92	90	95	95	6	9	9	-3	2	2

SAINT JOHN SHIPBUILDING LIMITED
V.P. FINANCE & SYSTEMS

	STAFF LEVELS				PREVIOUS STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		CURRENT STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH BY PERIOD O/H			GROWTH BY PERIOD DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	Per1	Per6	per12	Per1	Per6	per12	Per1	Per6	per12	Per1	Per6	per12
85001 V.P. FINANCE	1	1	0	1	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
85201 DIRECTOR FIN PLAN & MIS	3	3	3	3	4	0	0	0	5	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0
85310 MANAGER SYS FACILITIES	20	13	6	5	5	0	0	0	5	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0
87340 MANAGER APPLIC DEVELOP	0	0	10	15	9	0	0	0	8	0	2	0	8	8	8	0	0	0	-2	-2	-2	0	0	0
87350 MANAGER USER SERVICES	0	0	8	7	11	0	0	0	11	0	0	0	11	11	11.	0	0	0	0	0	0	0	0	0
TOTAL DIRECTOR FIN PLAN & MIS	23	16	27	30	29	0	0	0	29	0	2	0	29	29	29	0	0	0	-2	-2	-2	0	0	0
85210 DIRECTOR BUDGETS & CPF	5	4	3	4	3	0	0	0	3	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0
85330 MANAGER CSCS	12	11	5	4	3	0	0	0	3	0	0	0	3	2	1	0	0	0	0	-1	-2	0	0	0
85610 MANAGER IND BENEFITS	6	7	6	6	1	3	0	0	0	3	0	0	1	1	1	3	4	4	1	1	1	0	1	1
87210 MANAGER BUDGET CONTROL	0	0	7	6	6	0	0	0	6	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0
87230 MANAGER CONTRACT FINANCE	0	0	4	5	1	2	0	1	1	2	0	1	1	1	1	3	3	3	0	0	0	0	0	0
TOTAL DIRECTOR BUDGETS & CPF	23	22	25	25	14	5	0	1	13	5	0	1	14	13	12	6	7	7	1	0	-1	0	1	1
85402 SR. MANAGER ADMIN SERV	4.0	3	2	15	14	0	0	0	11	0	0	0	14	14	14	0	0	0	3	3	3	0	0	0
85430 MANAGER ADMIN SERV	2.0	3	3	0									0	0	0	0	0	0	0	0	0	0	0	0
85431 PROG OFFICE ADMIN/ACCOM	12.5	13	13	0									0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SR. MANAGER ADMIN SERV	18.5	19	18	15	14	0	0	0	11	0	0	0	14	14	14	0	0	0	3	3	3	0	0	0
85601 DIRECTOR IND BENEFITS	1	1	2	1									0	0	0	0	0	0	0	0	0	0	0	0
87101 DIRECTOR ACCOUNT OPER	2	2	2	1	5	0	0	0	5	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0
87110 ASST CTRL - ACCT OPER	2	1	8	1									0	0	0	0	0	0	0	0	0	0	0	0
87120 ASST CTRL - GEN ACCT	39	39	32	41	47	0	0	0	44	0	0	0	47	46	42	0	0	0	3	2	-2	0	0	0
87130 ASST DIR FIN REPORT/TRES	6	5	5	4	5	0	0	0	5	0	0	0	4.5	4.5	4.5	0	0	0	-0.5	-0.5	-0.5	0	0	0
87140 AUDIT LIASION/RECORD RET	0	0	3	3	2	0	0	0	2	0	1	0	3	3	3	0	0	0	0	0	0	0	0	0
87220 MANAGER FINANCIAL ANALYS	6	5	3	6	5	0	0	0	5	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0
TOTAL DIRECTOR ACCOUNT OPER	55	52	53	56	64	0	0	0	61	0	1	0	64.5	63.5	59.5	0	0	0	2.5	1.5	-2.5	0	0	0
TOTAL V.P. FINANCE & SYSTEMS	121.5	111	125	128	122	5	0	1	115	5	3	1	122.5	120.5	115.5	6	7	7	4.5	2.5	-2.5	0	1	1

SAINT JOHN SHIPBUILDING LIMITED
V.P. CORPORATE AND LEGAL

	STAFF LEVELS				CURRENT STAFF LEVELS MAY '90		APPROVED REQUISITIONS MAY '90		CURRENT STAFF LEVELS SEPT 90		APPROVED REQUISITIONS SEPT 90		REQUESTED BUDGET O/H			REQUESTED BUDGET DIR			GROWTH PER PERIOD O/H			GROWTH PER PERIOD DIR		
	1986	1987	1988	1989	O/H	DIR	O/H	DIR	O/H	DIR	O/H	DIR	per1	per6	per 12	per1	per6	per12	per1	per6	per 12	per1	per6	per12
85502 V.P. CORPORATE & LEGAL	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80030 DIRECTOR CLAIMS MGMNT	0	0	12	17	6	12	0	0	6	12	0	0	6	6	6	13	15	16	0	0	0	1	3	4
85501 DIRECTOR CONTRACTS	2	2	2	2	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1
85510 MANAGER CONT - COMBAT	20	16	17	19	5	13	0	0	6	13	0	0	9	9	9	15	14	12	3	3	3	2	1	-1
85530 MANAGER INTELLECT PROP	1	1	2	1	0	1	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0
85560 DIRECTOR INSURANCE	2	2	3	2	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
TOTAL DIRECTOR CONTRACTS	25	21	24	24	7	15	0	0	7	15	0	0	10	10	10	16	15	13	3	3	3.	1	0	-2
85520 DIRECTOR LEGAL	5	4	4	3	5	0	0	0	5	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0
TOTAL V.P. CORPORATE & LEGAL	30	25	40	45	18	27	0	0	18	27	0	0	21	21	21	29	30	29	3	3	3	2	3	2

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