



# Benchmarking and Capabilities Study of Mid-tier U.S. Shipyards

## Overall Findings and Recommendations

May 2007

# Background



- 2004 - The Office of the Deputy Under Secretary of Defense (Industrial Policy) (ODUSD(IP)) completed Part 1 of a Global Shipbuilding Industrial Base Benchmarking Study (GSIBBS) that was focused on the first-tier U.S. shipyards and leading large international yard. (First Maritime International's benchmarking system was employed)
- 2005 -ODUSD(IP) extended GSIBBS to include the U.S. mid-tier yards (Part 2).
- 2005 - The Office of Naval Research (ONR) commissioned CNST to study mid-tier U.S. shipyards to assess their capability to build medium-sized combatants. (FMI as contracted to help develop a capabilities assessment process)
- The benchmarking study and capabilities assessment have common elements and a similar methodology. Therefore, the two studies were combined and carried out simultaneously.



## Capabilities Assessment

Sponsored by the Office of Naval Research through the Center for Naval Shipbuilding Technology

## Benchmarking

Sponsored by the Office of the Deputy Under Secretary of Defense (Industrial Policy)

## Capabilities Assessment and Benchmarking

Led by First Marine International

**Organization:** CNST is the Navy's Center of Excellence for shipbuilding and ship repair manufacturing technologies. ATI in Charleston, SC, manages CNST under a contract with the Office of Naval Research (ONR).

**Mission:** To identify, develop and deploy in US shipyards, advanced manufacturing technologies that will reduce the cost and time to build and repair Navy ships.



**Organization:** DUSD(IP) reports to Under Secretary of Defense (Acquisition, Technology & Logistics) who reports directly to the Secretary of Defense

**Responsibilities:** DUSD(IP) is responsible for monitoring and developing the industrial base (U.S. and International) supporting U.S. Department of Defense needs



First Marine International is an independent consultancy providing specialist services to the marine industries

## Operating in the following sectors:

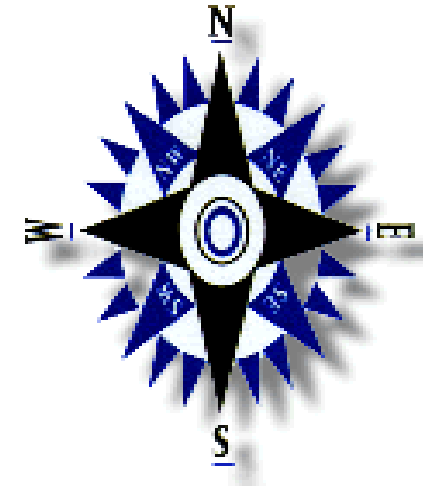
Commercial and naval shipbuilding

Ship repair, refit and conversion

Offshore structures construction

Marine equipment manufacturing

Shipping and transportation



## Clients include:

Public and private shipyards and marine companies

Government departments and agencies

Multinational authorities and funding agencies



## 1. Capabilities Assessment

1. Provide mid-tier shipyards with an independent assessment of their capabilities for building small Navy Combatants in accordance with the new ABS Navy Vessel Rules.

## 2. Benchmarking Study

1. Provide mid-tier shipyards with an independent assessment of their processes and practices and make recommendations to shipyards, industry and Navy on how to improve productivity.
2. Guide future investment (ManTech, NSRP, etc.)

- U.S Shipyard
  - Austal
  - Bender
  - Bollinger
  - Direcktor
  - NGSS Gulfport
  - Marinette
  - Todd
  - VT Halter
  - Aker Philadelphia (not a formal survey)
- Foreign Shipyards
  - INCAT
  - TENEX
  - Umoe Mandel
  - VT Shipbuilding



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CENTER for NAVAL SHIPBUILDING TECHNOLOGY

# Capabilities Assessment

# Capabilities Assessment Tool



- Developed by CNST and FMI, based on the FMI benchmarking system
  - Data collection method similar to benchmarking
  - Common elements
- Focused on capability of mid-tier yards to build medium size combatants
  - Considers ABS Naval Vessel Rules, FAR and Mil Standards
- Full capability means reasonable level of shipbuilding technology



# Capabilities Assessment areas



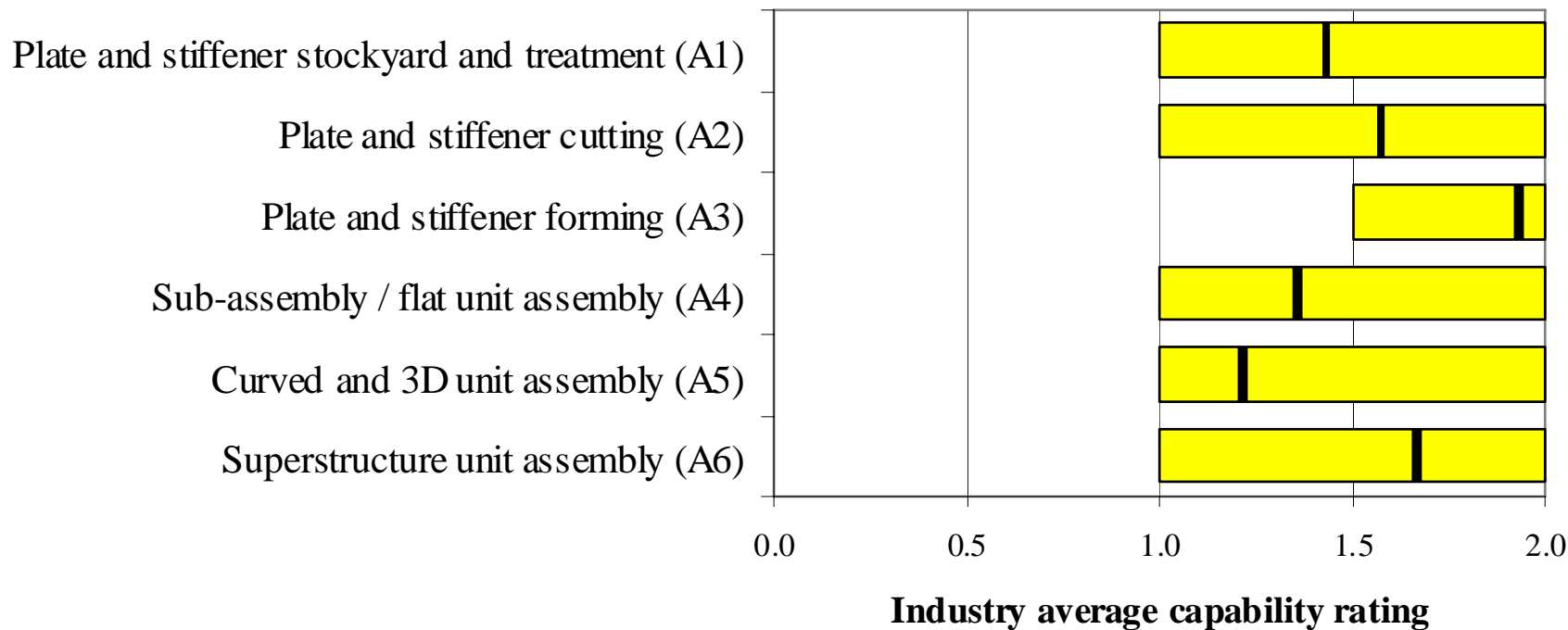
Assessment Areas	Number of elements
Structural production	6
Outfit manufacturing and storage	6
Pre-erection activities	3
Ship construction and outfitting	9
Facilities	3
Design, engineering and production engineering	10
Organization and management systems	11
Human resources	4
Purchasing and the supply chain	6
Logistics support	4

Scoring system:

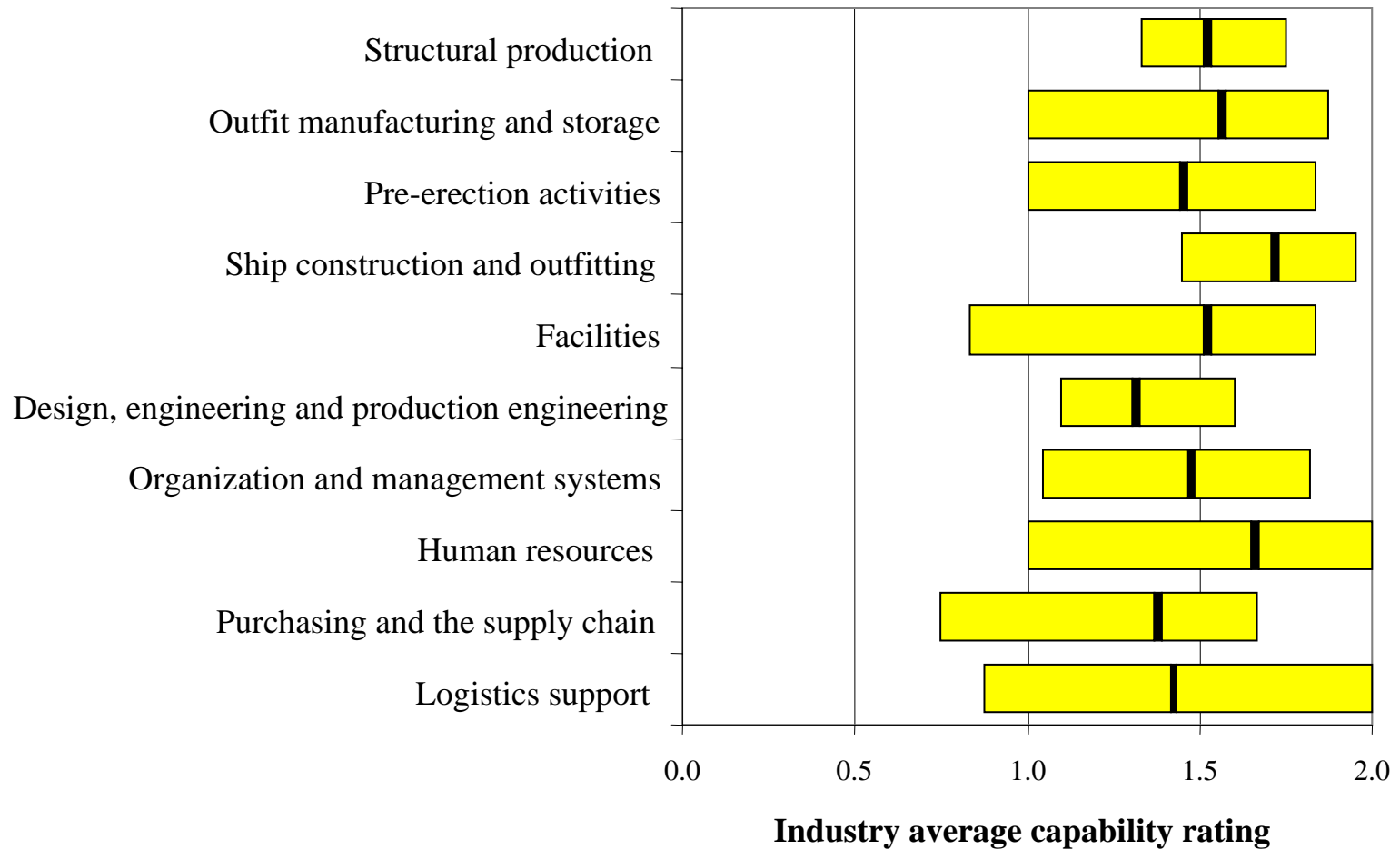
- 0 = no, or almost no capability
- 1 = some capability – requires developing
- 2 = full capability
- S = subcontracted



# Structural Production Average Scores



# Mid-tier capabilities scores



- High-level capacity model
- 0.3 – 1.3 ships per yard per annum at steady state
- All yards - 5 ships per annum at steady state
- The number and mix of people are principal constraints
- All yards - 7 ships per annum based on facilities alone

# Naval capabilities overview



- Most yards are low overhead and relatively lean
- Some experience with government work
- Physically capable with some facilities upgrades
- Weakest aspects of capabilities are in soft areas
- Changes needed in most areas to achieve good productivity, reduce risk or meet requirements
- Require increased manning/subcontracting and change in skills mix
- Change in configuration and culture

- Appropriate for some projects but limited capacity
- Increases competition in the naval shipbuilding industrial base
- Increases capacity in the naval shipbuilding industrial base
- May reduce opportunity to spread overhead cost in first-tier yards
- Likely to adversely affect commercial competitiveness
- To avoid loss of benefit, Navy needs to rationalize its acquisition practices



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# Benchmarking

# Benchmarking Process



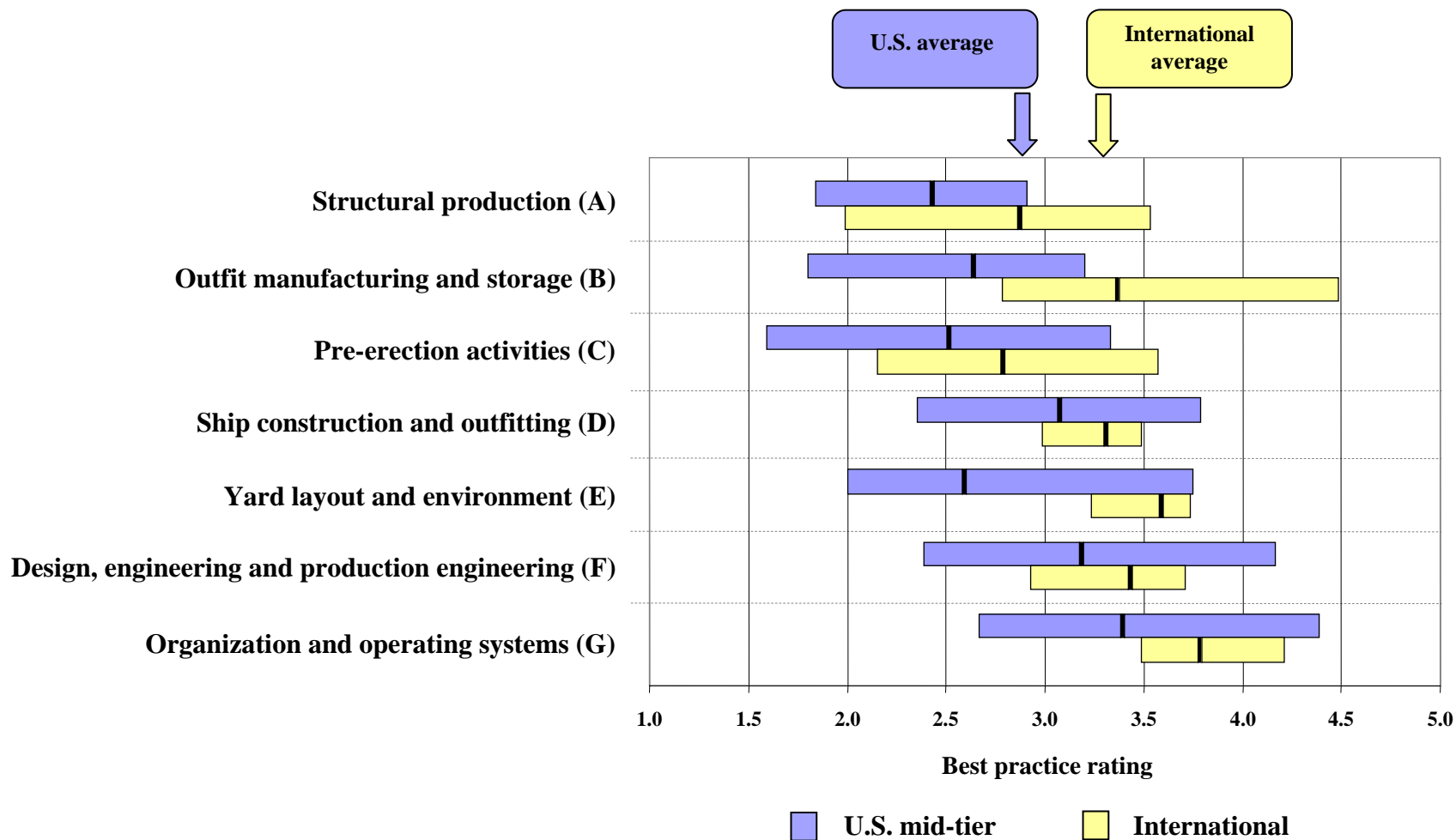
- FMI used its proprietary benchmarking system to assess shipbuilding technology in nine mid-tier U.S. shipbuilders and five international shipyards.
- The benchmarking system describes five levels of best practice in each of fifty elements of shipbuilding technology assessed in the survey. At the low end of the scale, Level 1 represents basic technology and, at the high end, Level 5 represents advanced technology which is normally associated with high levels of productivity.

# Benchmarking Elements

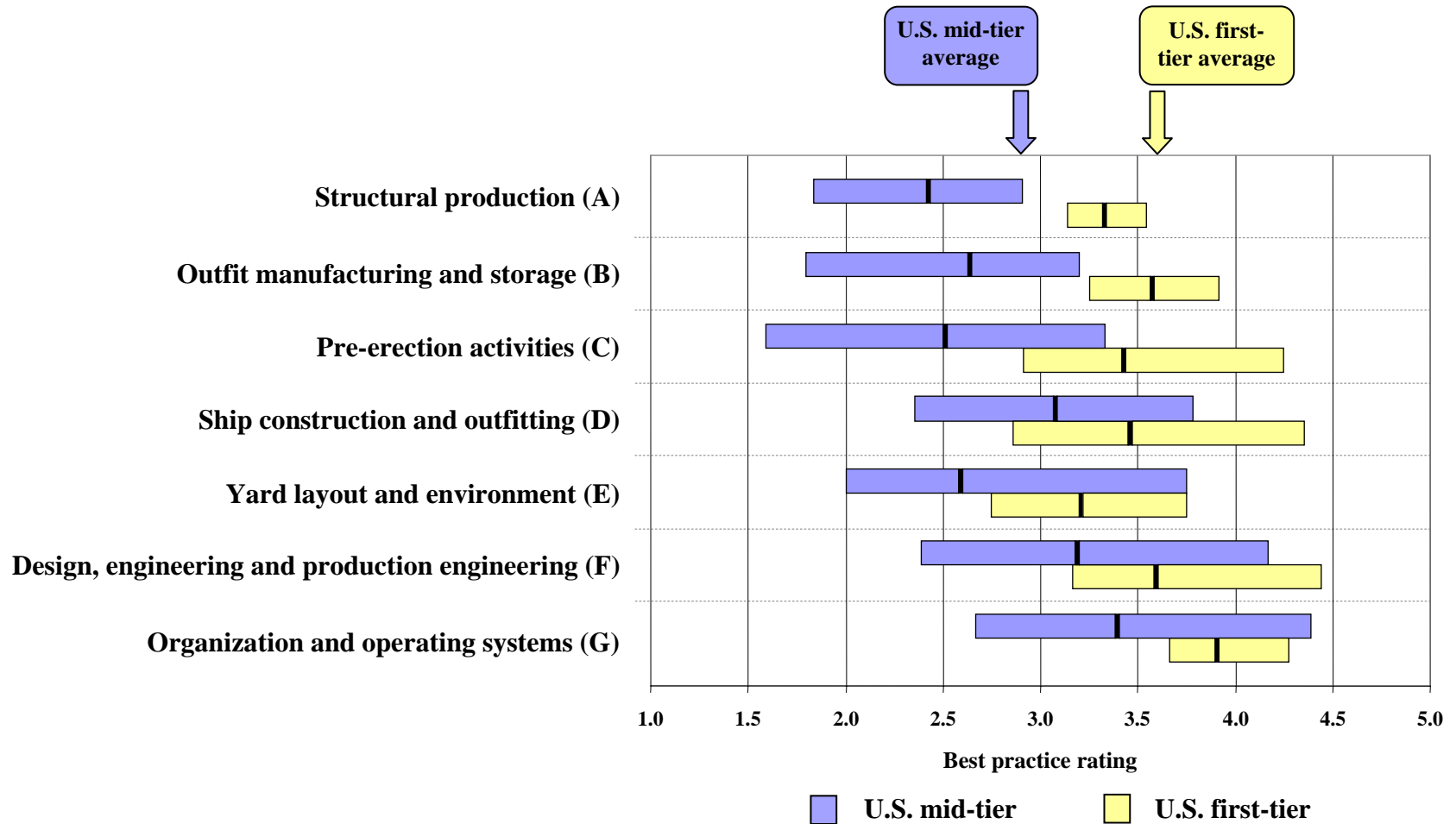


<b>Benchmarking Areas</b>	<b>Number of elements</b>
– Steelwork production	11
– Outfit manufacture and storage	6
– Pre-erection activities	6
– Ship construction and outfitting	7
– Yard layout and environment	2
– Design, engineering and production engineering	9
– Organization and operating systems	9

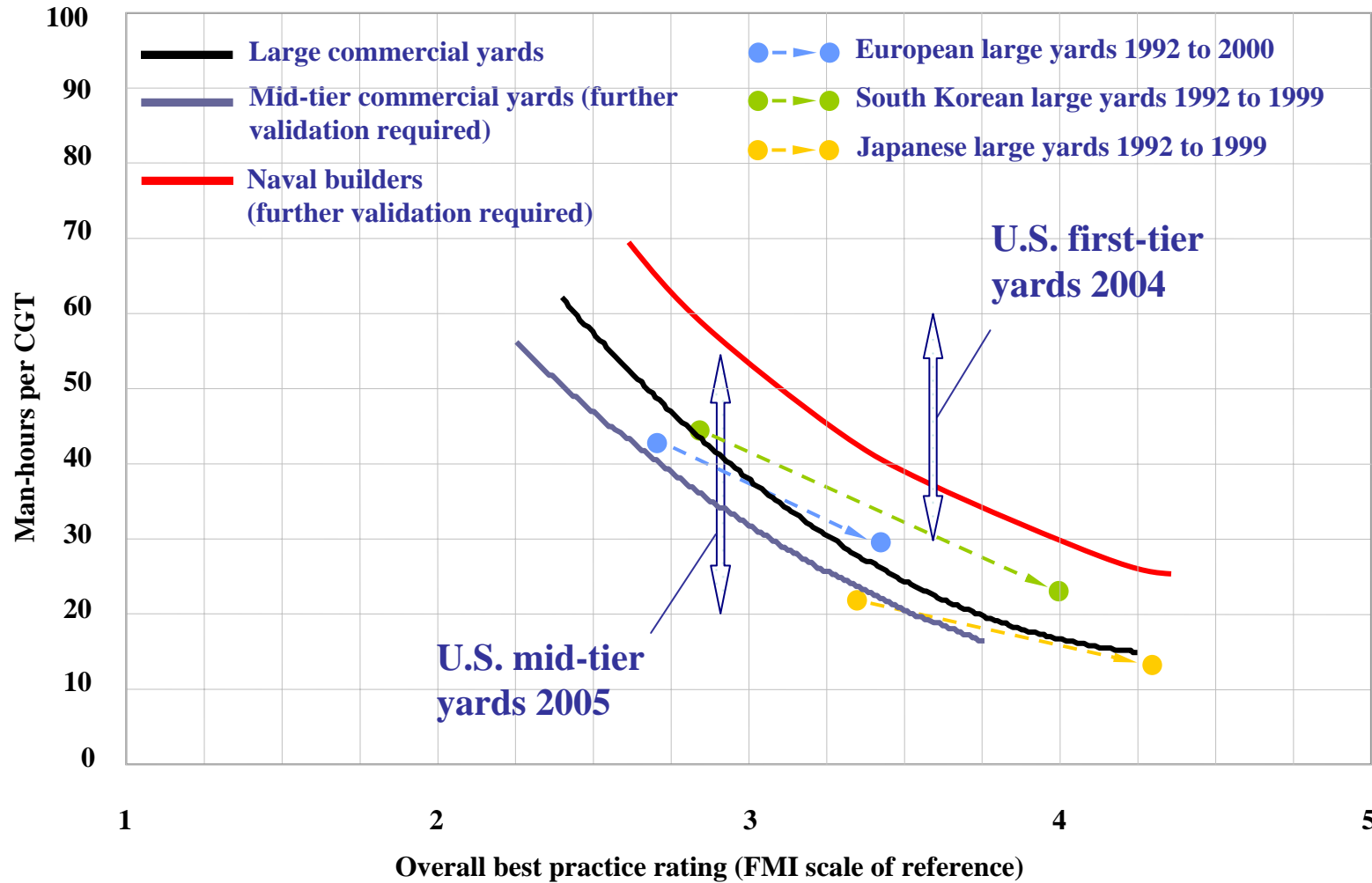
# Best practice rating mid-tier U.S./international



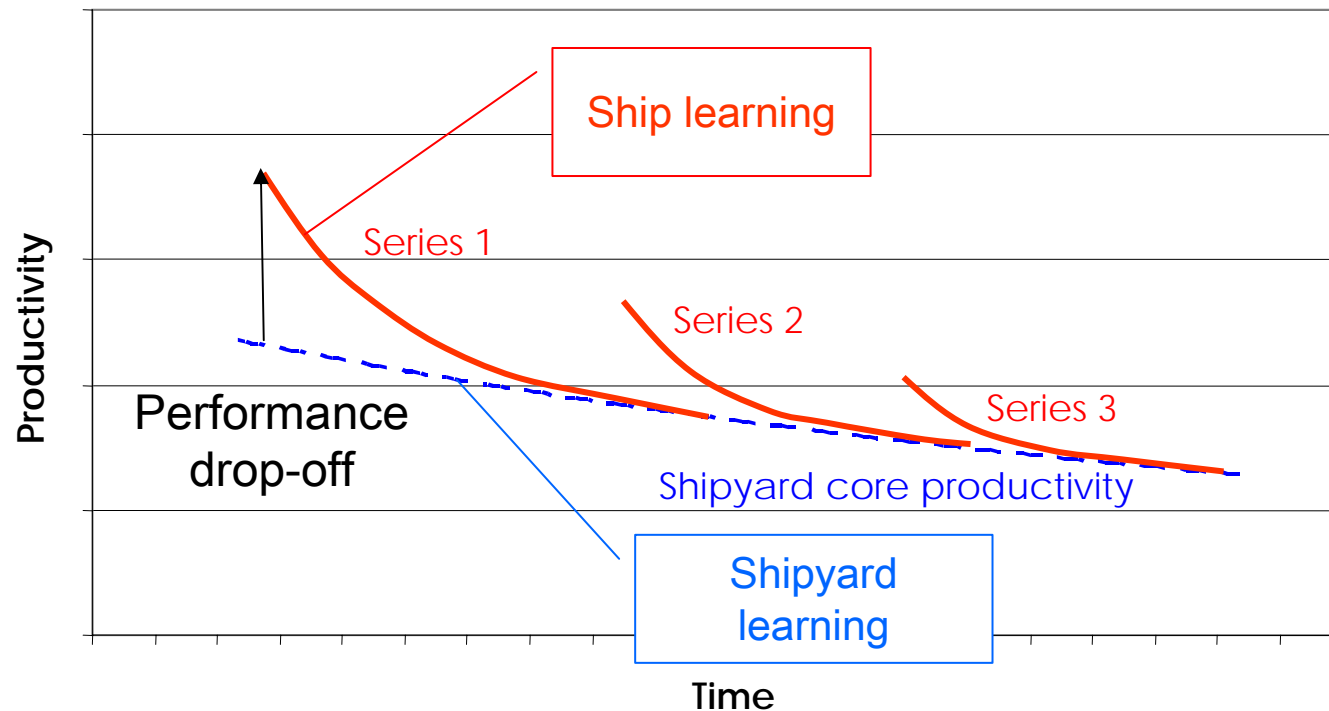
# First-tier/mid-tier scores



# First-tier/mid-tier comparison



# First of class performance drop-off



Ship learning – unique to series  
Shipyard learning – transferable

*Leading commercial: 3-10%  
Naval: up to 50%. At least four ships*

# Emphasis in leading yards



- Reduction of work content
- Carry out work at most cost effective stage (usually as early as practicable in the cycle)
- Organize work into optimized workstations and maximize use of the facilities
- High level of dimensional accuracy
- Efficient flow of materials and technical information - keep shop-floor workers at their workstations
- Visibility of performance of individual processes
- Continuous performance improvement
- Coordination and control over the operation
- Reduce work in progress and inventory
- Skills development

# Customer factor issues



- Some issues raised have significant impacts on calendar time, and labor and material costs
- List of examples does not cover the full scope of customer factor areas
- The points listed have not been discussed with the Navy
- The Navy should continue its review and make changes

# Examples of issues raised



- The time taken for Navy approvals and capacity to deal with day-to-day technical issues in a timely manner
- Local Navy oversight not empowered
- Incomplete specifications and low design maturity at start of construction
- Compromised build strategies to meet political milestones
- Duplication of inspection/supervision responsibilities
- Conflicts in the Naval Rules and confusion in interpretation
- A lack of flexibility towards modifications that would reduce work content
- A purchasing regime that results in much higher management and materials costs and progress payments that encourage shipyard inventory

## Priorities and Recommendations



## Simple approach that considers:

- **Technology gap** (large gap – high priority)
- **Overall effect on performance** (big effect – high priority)
- **Capital cost** (lower cost – high priority)
- **Timescale** (current contracts – high priority)

# Top 25 priorities



Element description	Rank: mid-tier
Production engineering	1
Design for production	2
Outfit scheduling	3
Manpower and organization of work	4
Outfit installation	5
Dimensional accuracy and QC	6
Outfit module building	7
Pre-erection outfitting	8
Production control	8
Outfit parts marshalling	10
Master planning	11
Steelwork scheduling	11
Coding systems	13

Element description	Rank: mid-tier
Onboard services	14
Block assembly	15
Electrical	16
Outfit steel	17
Quality Assurance	18
Outfit production information	19
Performance and efficiency calculations	20
Welding	21
Materials handling	22
Curved and 3D unit assembly	23
Parts listing procedure	23
Ship design	25



# Top 10 action areas



Rank	Mid-tier	First-tier
1	Production engineering	Ship design and design for production
2	Design for production	Production engineering
3	Master planning, steel and outfit scheduling and production control	Master planning and steel and outfit scheduling
4	Manpower and organization of work	Outfit module building, pre-erection outfitting and onboard outfitting
5	Dimensional accuracy and QC	Dimensional accuracy and QC
6	Outfit module building, pre-erection outfitting	Outfit parts marshalling and general storage and warehousing
7	Outfit installation and onboard services	Pipe shop and other outfit manufacturing activities
8	Outfit parts marshalling	Manpower and organization of work
9	Steel and outfit coding system	Steelwork and outfit production information
10	Block assembly	Steelwork and outfit coding system



# Suggestions for Government and Navy (GSIBBS Part 1)



- Gain a more in-depth understanding of the relationship between ship specification, complexity and work content
- Work with the design authorities to reduce the inherent work content
- Work with industry to develop the pre-production processes to reduce first-of-class performance drop-off
- Review the acquisition rules, regulations and practices
- Stabilize the ship acquisition program
- Improve shipyard incentives
- Continue to support performance improvement initiatives such as NSRP

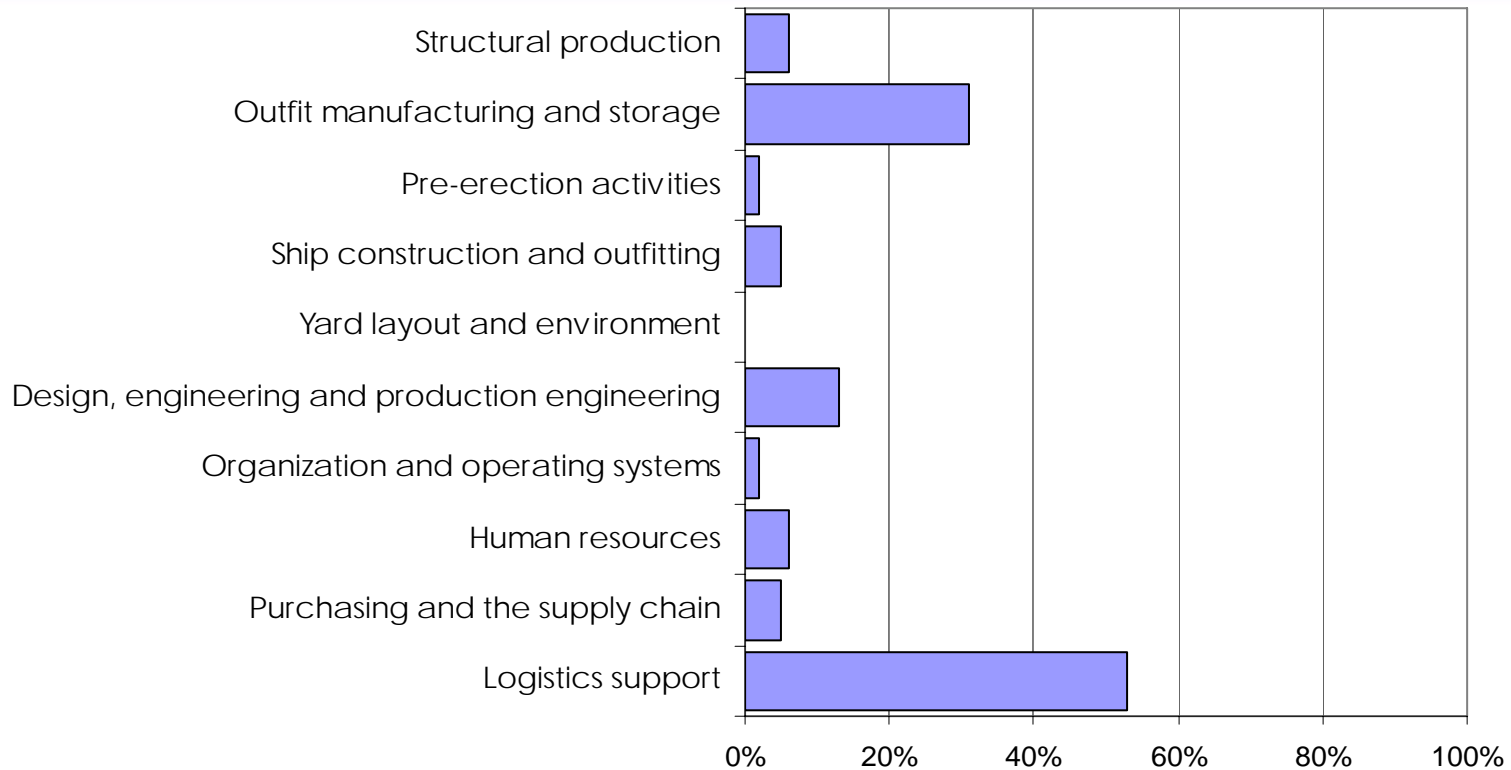
1. Address the customer factor issues
2. Encourage shipyards to develop long-term performance improvement plans
3. Encourage more yards to take part in performance improvement programs
4. Coordinate industry assistance
5. Clarify the responsibilities of ABS, SupShips and NAVSEA and streamline interactions
6. Continue to develop ABS Naval Vessel Rules
7. Improve the timeliness of the approval cycle



# Discussion & Questions



# Profile of subcontracting



## Reasons for subcontracting:

- 25% smoothing of peak labor loads
- 75% not part of the core business, no in-house skills or desire to mitigate risk
- 10% subcontracted to other organizations in the same group

# Example



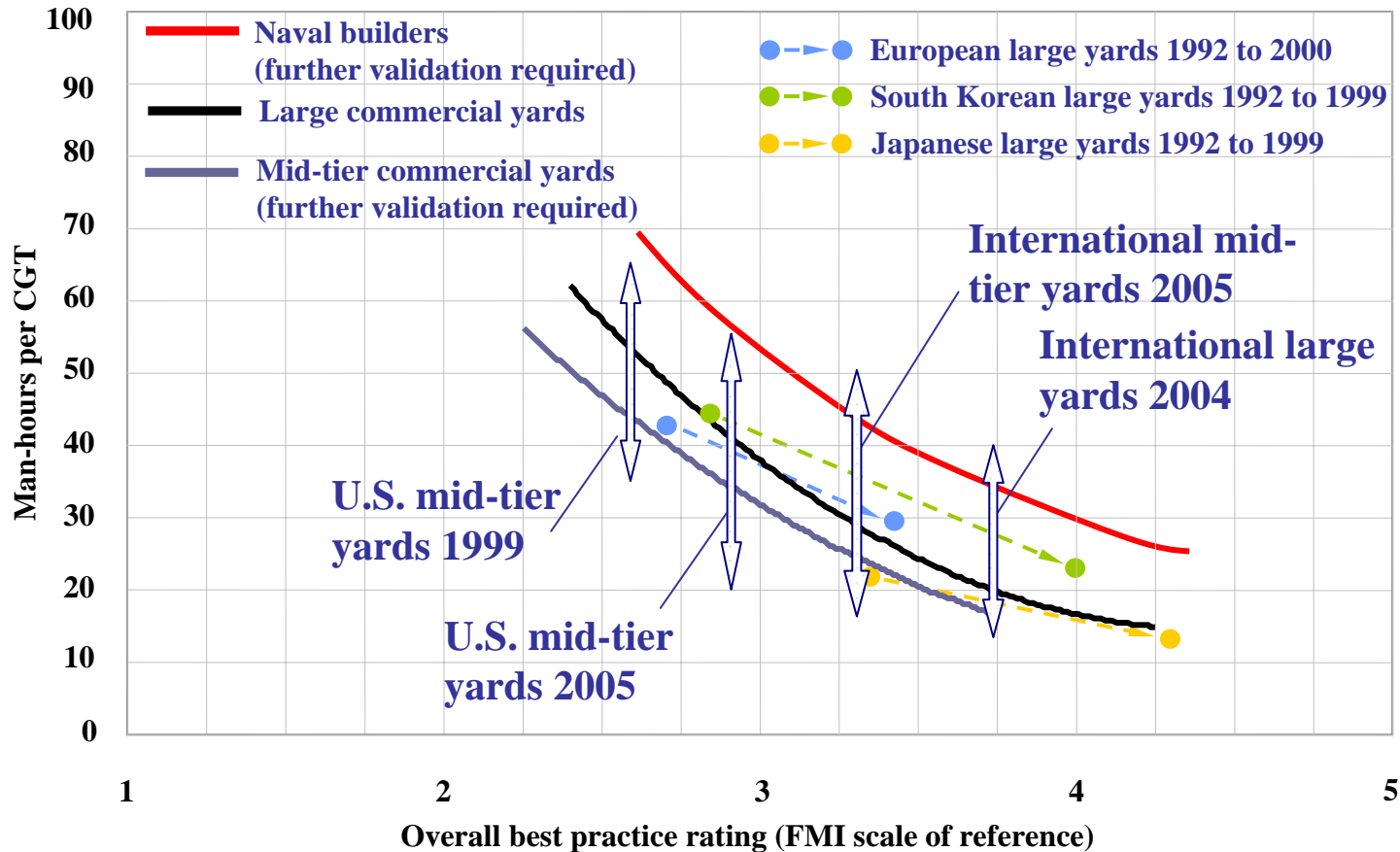
## 0.1 F1 Ship design

Experience/ability with communicating large quantities of shipbuilding information between the yard and the designer. Experience/ability in providing the higher level of expertise required with respect to production support, field engineering, design, document control, and integration of design and production functions.

Ability indicators	Proportion of shipyards			Notes
	Yes	Partial	No / Subcontract	
The design and engineering function has sufficient core experience to develop the functional and production detail design of naval vessels.	86 %	14 %	0 %	The core design and engineering teams in mid-tier yards are generally good as they frequently produce new designs. However, they have limited capacity and tend to use design agents or other resources within their own groups of companies to supplement capacity or to provide basic designs. They also have to contract in specialist assistance from time to time.
The design and engineering team is organized on an area management basis.	14 %	29 %	57 %	Most design offices are organized on a system basis, which is less efficient.
The yard has established procedures and experience in working with design bureaus.	100 %	0 %	0 %	All yards have this experience.
There are design software tools in use for naval architecture, structure and other design calculations.	100 %	0 %	0 %	Most yards have up-to-date and appropriate design software tools.
There is a 3D product modeling system in use.	86 %	14 %	0 %	Most yards model in 3D and use ShipConstructor.
The product modeling system is integrated with the planning and material control systems.	14 %	0 %	86 %	There are examples of world class systems integrations in the mid-tier yards but most have fairly limited or no electronic links between the CAD system and other systems.
The yard is experienced in formal design reviews.	86 %	14 %	0 %	This is a common activity in most yards, although it is sometimes limited to commercial vessels.
There is a defined document control process.	100 %	0 %	0 %	This exists in all yards.



# International comparison



# Areas of increased work content due to customer – GSIBBS Part 1



- Ship-specific design and drawing office support
- Planning and project control
- Material procurement and warehousing
- Quality assurance and quality control
- Testing and trials
- Production support services
- General management

# Shipyard configuration



- To be successful, shipyards must be configured for the chosen market sector, throughput and cost base
  - Facilities
  - Equipment
  - Overhead structure and cost
  - Skills
  - Systems
  - Culture
- Therefore the first and mid-tier yards should be configured differently