U.S. Naval Shipbuilding Capacity: Is There Enough And What Can Be Done To Improve?

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Abstract

The primary research question that this thesis answers is: What does the Navy need to do to expand the nation's shipbuilding capabilities to fulfill the Navy's 30-year shipbuilding plan? In our research, we applied a mixed-method design approach to ascertain the production capacity for two of the nation's largest shipbuilders. By exploring the shipbuilding industry's consolidation trends and acquisition process, the authors were able to identify design specific production issues from the data and provide recommendations based on the application of supply chain principles.

Research Method

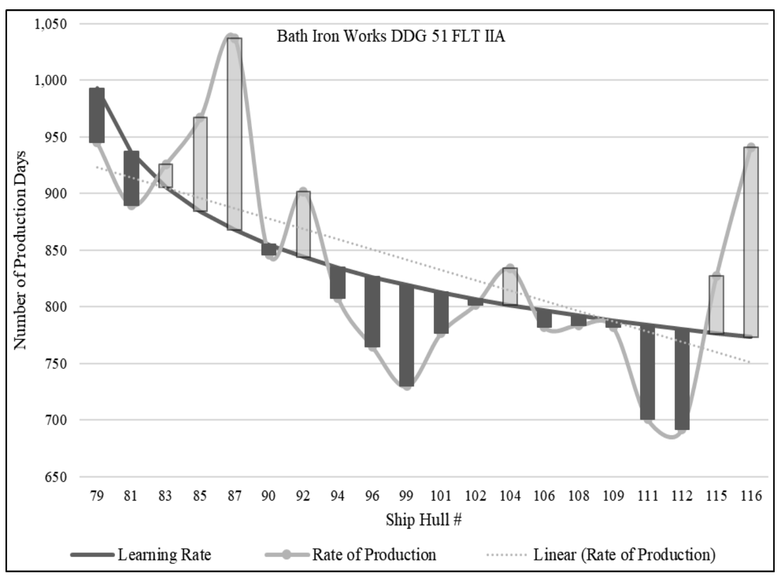
- Mixed-Method Design
  - Design Productivity Complexity Model
  - Production Efficiency Learning Curve Model
  - Queuing Theory and Capacity Model
  - Logistics Principles

Research Summary

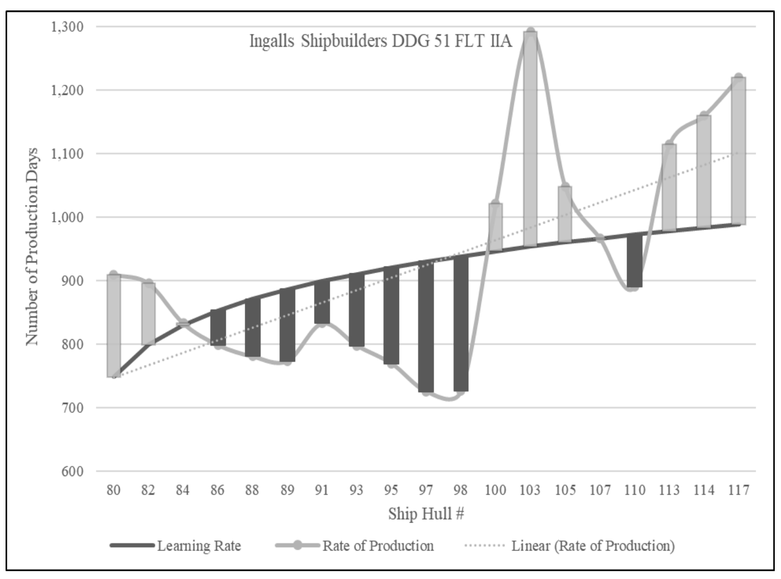
- Opportunities exist for major shipyards and the Navy to work together for design optimization and production efficiencies.
- The U.S. shipbuilding industry suffers from many inefficiencies and other problems that could be remedied by applying former Secretary of the Navy, Richard Danzig's logistics principles.
- Historical shipbuilding data provided the inputs for use in a multi-server model to determine a utilization rate.

Results

- Actual shipyard production capacity varies based on the complexity and the maturation of the ship design.
- Learning rates vary by shipbuilder and can be negatively influenced by the congestion effect of parallel production activities.
- Both BIW and Ingalls Shipbuilding have similar utilization rates of 81%
- Both shipbuilders are believed to be at full effective capacity given enormous supply chain complexities.



Bath Iron Works DDG 51 FLT IIA Learning Curve



Ingalls Shipbuilder DDG 51 FLT IIA Learning Curve

	Bath Iron Works	Ingalls Shipbuilding
Average Inter-arrival Time (days)	215	220
Average Inter-arrival Time (years)	0.825	0.847
Arrival Rate (λ)	1.21	1.18
Arrival Rate Standard Deviation	0.706	0.831
Average Inter-service Time (days)	867	895
Average Inter-service Time (years)	3.33	3.44
Service Rate (μ)	0.300	0.291
Service Rate Standard Deviation	0.467	0.602
CV Arrival Time	0.583	0.703
CV Service Time	1.56	2.07
Service Lines	5	5
Utilization Rate (ρ)	0.808	0.813
Surge Capacity	0.192	0.187
Number of Ships in Service	4.04	4.06
Lq	3.46	6.22
Wq	2.85	5.27
Number of Tons Under Work	28830	28560
Authorization to Build (days)	741	1370

BIW versus Ingalls Shipbuilding DDG Building Capacity

Recommendations

- A shift towards manufacturing "low-road" naval ships—ships that are less sophisticated, short-lived, and less expensive to make compared to current "high-road" naval ship designs.
- Building all classes of naval ships in at least two separate shipyards in order to increase capacity through buffering and to establish strategic redundancy.
- Consolidation of similar ship classes to reduce the variety and complexity of future naval ship designs.
- Minimize the demand variability experienced by the nation's shipbuilders by emphasizing the production of mature designs in favor of radically different designs.

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