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

August 1990
NSRP 0320

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

1990 Ship Production Symposium

Paper No. 1A-2: Manufacturing Lead Time -- A Factor to Consider During Planning and Acquisition of Navy Ships

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

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
AUG 1990	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuilding Research Program, 1990 Ship Production Symposium, Paper No. 1A-2: Manufacturing Lead Time -- A Factor to Consider During Planning and Acquisition of Navy Ships	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**	**15**	

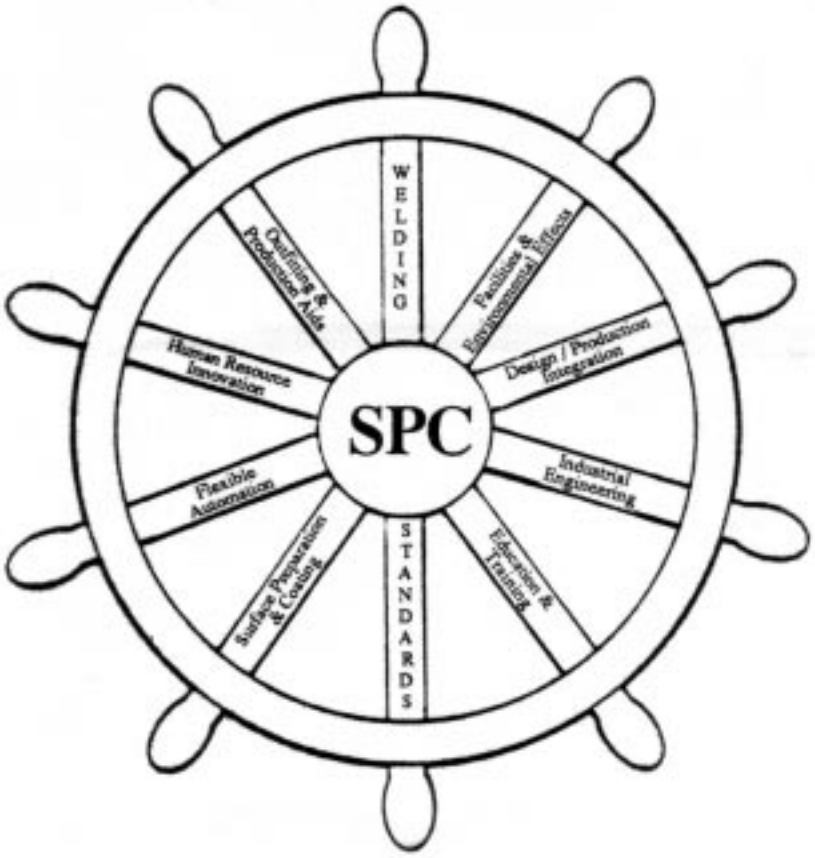
DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/ manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, “Persons acting on behalf of the United States Navy” includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM'S

1990 SHIP PRODUCTION SYMPOSIUM

Preparing for the 21st Century: Focusing on Productivity and Quality Management



August 22-24, 1990
Pfister Hotel
Milwaukee, Wisconsin

SPONSORED BY THE SHIP PRODUCTION COMMITTEE
AND HOSTED BY THE GREAT LAKES AND RIVERS SECTION OF
THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
601 Pavonia Avenue, Jersey City, NJ 07306

Paper presented at the NSRP 1990 Shlp Production Symposium,
Ptister Hotel. MuWaukee. Wisconsin, August 21-24.1990

Manufacturing Lead Time-A Factor To Consider During Planning and Acquisition of Navy Ships

1A-2

William V. Ennis, Visitor, Harry F. Speth, Visitor, and Albert Mieskolainen, Visitor, Philadelphia Naval Shipyard, Philadelphia, PA

ABSTRACT

NAVSEA Shipbuildig Support Office, Philadelphia, PA provides current Manufacturing Lead Time information to Navy planners, designers and acquisition mnagers responsible for the timely procurement of the latest design Navy ships. Lead time information is critical to effective budqeting and on-time delivery of basic mterial, hull mechanical and Electrical Compcnents and Combat Systems. ThiS paper will address the methodology for solicitation, statistical consolidation and final assessment of information provided by over 1300 domestic primary and secondary manufacturs. Early detection of lead time change provides a basis for remedial action whereby critical paths may be selected, schedules altered, or substitutions provided. The paper will further address the status of the United States Industrial Base capacity to provide these materials, components and systems and compares the current industrial base with its status five and ten years ago. Loss of domestic capacity has resulted in sole or single source procurement and in some cases sole dependence upon a foreign source for critical subcomponents. The ability of United States manufacturers respond to peacetime programs and potential surge or mobilization requirements will also be examined.

ORGANIZATION

The NAVSEA Shipbuilding Support Office (NAVSHIPSO) is functionally responsible to Deputy Commandeer for Acquisition, Planning and Appraisal,NAVSEA 90. NAVSHIPSO is located in the Philadelphia Naval. Shipyard and is under the administrative control of its commander. NAVSHIPSO supports NAVSEA in the execution of its shipbuilding and major weapons acquisition programs throug manufacturing engineering and industrial.planning. It also provides Industrial Preparedness Planning functions for these program. In addition, NAVSHIPSO provides Support to NAVSEA by performing mobilization planning functions assigned to NAVSFA by the Office of the chief of Naval Operations and other Navy and Defense Department authority. Navy programs are analyzed to determine manufacturing facility and resource requirements. The industrial base is evaluated to determine its ability to support current and projected Navy programs and to identify problem areas and action required to resolve these issues. NAVSHIPSO supports acquisition and industrial preparedness planning with the development of ship and eguipment prcduction plans and analysis of individual contractor capabilities, performances,andmanufacturingleadtimes. NAVSHIPSO maintains statistical and historical records On Navy ships time of construction through final disposition.

MMANUFACTURING LEAD TIMES

A major element of industrial base planning and evaluation responsibility is the determination of manufacturing lead time (MLT) forecasts. MLT in formation is essential for effective financial planning/budgeting and to support schedule adherence for on-time delivery of shipboard Basic Material, Hull Mechanical and Electrical Components and Combat Systems. Early detection of future MIT change provides a basis for remedial action whereby critical paths my be selected schedules altered or substitutions provided. Specifically, within NAVSHIPSO, MLTs form the core of various industrial assessment and shipbuilding program related reports, including the following

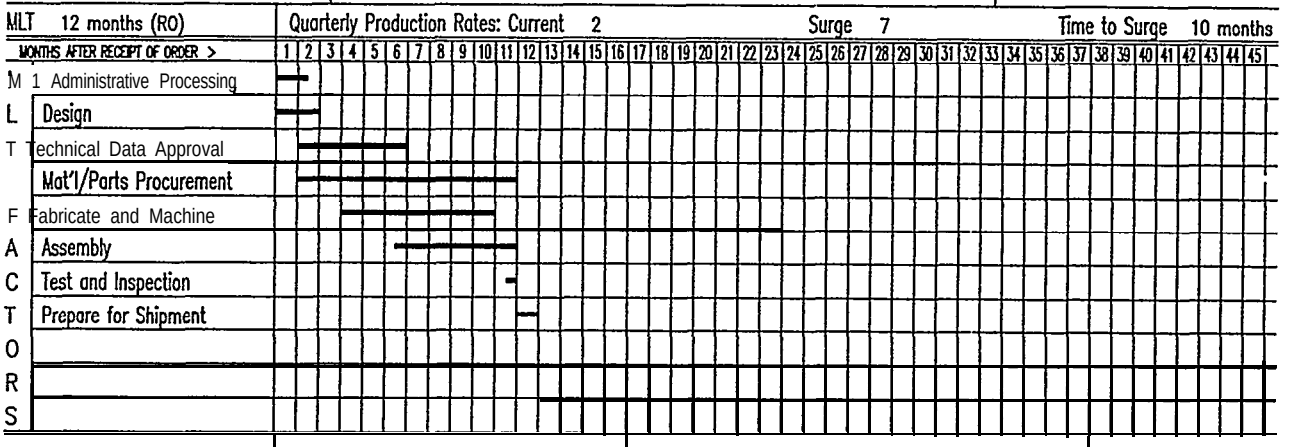
o SYSTEM/EQUIPMENTS MANUFACTURING LEAD TIME STUDUIES -An annual document which provides a breakdown of factors considered in a manufacturing process and result in quoted MLT for a specific component or system. DATA IS presented in a time phased Gantt chart format and includes an overview of subcompopnents/manufacturers production rates, and ship end use. Figure 1 depicts a typical study.

0 SPECIAL STUDIES- Reports are prepared on subjectS of particular importance to the Navy's shipbuilding program. Typical topics have included anchor chain,ball bearings, forgings, diesel engines, composite materials, periscopes, torpedo tubes and electric propulsion. Table 1 lists recently completed and planned studies. Some of these studies, such as ball bearings (quiet), *anchor chain and* forgings,havedirectlyresultedin purchase restrictions to US and canadian sourceS. Others, diesel enqines, strategic

materials, periscopes, propellers and electric motors have highlighted sole sourcing conditions or dwindling domestic industrial base capabilities concerns and have provided recommended plans of action to alleviate possible mobilization production constraints.

o ADVANCE PIANNING STUDIES(APS)-APS are prepared for various Ship Acquisition Program Managers providing estimates of required contract and construction periods, manning levels requirements and production need *requirements* of principal longleadtimecomponentsandcontrolling items. A typical APS consists of:

System/Component	Description	Source
SWITCHBOARD	Power Distribution 440 Volts, 60 Hz, 500 Kw	XYZ CORP



Controlling Items	Mojor Subcontractors	Remarks	End Use
Air Circuit Breakers AQB Circuit Breakers Meters and Switches Zener Diodes	AA CORP BB CORP CC CORP DD CORP	XYZ is working ot 70% copacity with 80% of output in support of Navy SCN programs.	A6X 1

BUSINESS SENSITIVE

Fig. 1 - MANUFACTURING LEAD TIME STUDY

TABLE 1. SPECIAL STUDIES

Conpleted	In-Process
Electric Motors	Electric Propulsion
Electronic Equipment MFG	Propulsion Motors
Foreign Dependency	Prime Movers
Productivity Trends	Composite Material
Large crankshafts	Shafting
Tuebochargers	Strategic Materials
Arresting Gear	Machine Tools
Deigaussing system	Noise Quiet Bearings
Propellers	IAMPS/RAST
Anchor chain	Torpedo Tubes
Forgings	Satellite Comunications
periscopes	AN/UYQ-21 Display System
Global Positioning System	Over-The-Horizon Radar
Dehydrators	MK86 Gunfire Control
MIl-SPEC Air circuit Breakers	Commnd/Control/Dxision
Large Diesel Engines	AN/WSN-5 Navigation System
Retooling study	Navy Use of Composites
Capacity Utilization Trends	
Manpower and Labour Issues	
Main Propulsion Machinery	
Critical Forging Restrictions	
Anchor Chain Restrictions	

Shins Data Sheet - Provides proposed ships principal physical characteristics: length, beam, draft, displacement, type of propulsion plant, shaft horsepower, mission and any special systems or requirements peculiar to the ship design.

Assumptions and *Notes* - Such as availability of drawings and specifications prior to contract award; long lead time and controlling items which may require advance procurement, and source(s) of MLTS and land-on-ship times.

Program summary -Chronological sequence of milestones prior to ship delivery, including contract award, procurement of controlling and long lead time items by both the shipbuilder and government and start construction dates.

Construction Rationale - Provides justification for construction period which includes analysis of actual construction schedules of similar type ships and construction methods and facilities of possible shipbuilders.

Erection Schedule - Narrative description of major events listed chronologically by month.

Manday Estimates - Daveloped by NAVSHIPSO and are calculated by construction, method of construction and ship characteristics.

Advance Planning Lead Time study (APLTS)- Provides MLT, land-on-ship time, quantity, procuring agent, type of specification of long lead time and controlling items.

PUBLICATION OF MANUFACTURING LEAD TIMES- (MLTPUB)

This dOCUMENTS is issued annually and provides a twelve month projection of MLTS for Hull, Mechanical and Electrical Ship Components, Basi material and Combat Systems utilized by shipbuilders performing Navy related work. The publication is divided into six parts. Each is described below as to function and use. An excerpt from part l is *shown as* Figure 2.

Included in parts 1 and2 is the range column which is the composite of all MLTS provided to NAVSHIPSO by manufacturers for each item. Two numbers separated by a hyphen represent the lowest and highest MLTS provided for U.S. Government Specification repeat orders. For example, if the numbers, 16-18 appear, it indicates NAVSHIPSO validated manufacturer responses ranging from 16-18 months. Both the current lead time and the change from the previous issue are provided. For example, 14(-3) indicates a current lead time of fourteen months and a decrease of three months from the previous seventeen months figure. Items added since the previous issue are identified by a single asterisk (*) to the left of MLT column(s).

when a lead time is "not applicable" to a specific item, "NA" has been inserted in the respective column. in general, "NA" in the repeat order column indicates the item has not been produced to date or is not related to a *known* production line. "NA" in the initial order column indicates.theitemis a Qualified Products List (QPL) component, a single source item or standardized to the point that a new design is not anticipated.

Commnercial marine specification lead time is designated "NA"[1] when components are purchased solely under government specifications.

Part 1- Hull, Mechanical and Electrical

All lead times in the Hull, Mechanical and Electrical (HM&E) Ship Components section have been derived by NAVSHIPSO from Navy procurement experience and data obtained directly from manufacturers. The lead times under "U.S. Government SPECS" apply to ship components purchased under Federal or Military Specifications; where possible, specification numbers are listed. The lead times under "COMMERICAL MARINE SPECS apply to ship components which generally meet commercial standards specified by various technical associations including;

American Bureau of Shippig Rules For Building and Classing Steel Vessels
U.S. Coast Guard Electrical Engineering Regulations (OG-259)
U.S. Public Health Service Handbook on Sanitation of Vessel Construction (Standards of Sanitation and Rat Proofing For the Construction of Vessels), except that sheathing requirementS are not applicable
Institute of Electrical and Electronics Engineers, Incorporated (IEEE) Standard No. 45 (Recommended Practice for Electric Installations on Shipboard)
The National Electrical Code (NEC)
The National Electrical Manufacturers Association (NEMA) Standards
The American Gear Manufacturers Association (AGMA)
The American Society for Testing and Materials (ASTM)
The American Society of Mehanical Engineers (ASME)
United States of America Standards Institute (USASI)
American Standards Association (ASA)
National Institute of Standards and Technology (NET)

Manuafacturing Lead Times are a general guide for timely placement of purchase orders. The lead time is defined as the interval between the date a manufacturer accepts a firm order and the shipment date of the first complete production unit.

The lead time estimate does not include any allowance for the administrative time required to develop purchase specifications, to prepare prccurement requisitions, or to conduct negotiations prior to award of production

contracts. Additionally, because of various factors such as material and physical specifications, end use, temperature and pressure conditions, qualifications apply to the following components;

propallers - Design is not included in initial order of solid propellers, add two months for prairie masher
Shafting - Iead times include finish machining
Valves -Add two to four months for 100% radiography

time necessary for the manufacturer to design, obtain plan approval, tool, procure material and subcomponents manufacture, assemble, condut tests, and prepare the first production unit for shipment. When a Military Specification requires testing of the prototype or preproduction model at government facilities or a private laboratory, an allowance is included in the lead time. If floating shock platform testing is required, two to four months should be added to the listed lead time.

PART 1

HULL. MECHANICAL, AND ELECTRICAL SHIP COMPONENTS

COMPONENT	MIL SPEC	U S GOVERNMENT SPECS			COMERCIAL MARINE SPECS	
		REPEAT ORDER	RANGE	INITIAL ORDER	REPEAT ORDER	INITIAL ORDER
		(IN MONTHS)			(IN MONTHS)	
ANCHOR						
LIGHTWEIGHT ALL SIZES / RATINGS ETC	MIL-A-15707 ML-A-15708	4	4	6	4	6
STOCKLESS ALL SIZES / RATINGS ETC	ML-A-22575	4	4	4	4	4
ANNOUNCING SYSTEM						
AUDIO COMMUNICATION INTERCOM	MIL-I-22560 MIL-I-24078	11	10-12	12	9	10
LOUD HAILER		9	9-10	1 0	9	10
PUBLIC ADDRESS	MIL-A-21577	11	10-12	12	10	10
VOICE ENHANCEMENT 1MC - 59MC	MIL-A-21577	11	10-12	12	NA	NA
ARRESTING GEAR SYSTEM						
MOD 3 ALL SIZES / RATINGS ETC		54	54	NA	NA	NA

Fig. 2 - MANUFACTURING LEAD TIME PUBLICATION

The lead times stated herein assume that purchasers indicate, on their procurement documents, the order is certified for national defense use under Defense Priorities and Allocations System regulations and pass on the authorized rating assigned (i.e., DO-A3, DX-A3) . The use of ratings on contracts and orders is mandatory through all tiers of procurement.

Thelead times listed for ship components are shown for both Initial Order and Repeat order. NAVSHIPSO definitions for each type order follows;

Initial Order - The time to design and produce a component within the state of the art (without extensive research and development)by a menufacturer who has not previously Produced. the It includes the

Repeat Order- The lead time required, after a complete break in production, to produce an item identical, except for minor changes, to one made on a previous order. Generally, the manufacturing lead time of a repeat order is less than that required on an initial order since design and approval of plans will be considerably less and the aptterns,tools and dies [redacted] required for production are available. It is assumed the components previously shock tested and accepted will not require retesting.

part 2- Basic Material

Lead times as for basic material have been derived by NAVSHIPS0 from exeprience and data obtained from producers, foundries, and distributors. They are based on the-minimum

amount of the basic material (i.e., mill lot) the producer will accept as a firm order to justify production. The lead times listed are for basic material purchased in accordance with Federal or Military Specifications or comparable commercial specification.

The lead time estimate for basic material is defined as the interval between the date that the producer accepts firm order and the shipment date. lead times include the time necessary for certification of chemical content and tests as stipulated in the specification. However it is emphasized lead times do not apply for less than mill lot orders of basic material are generally available from inventories maintained by distributors and suppliers.

It must be recognized that forgings and costings are not standard production and lead times are subject to negotiation with the individual foundres and forge shops. the lead times shown are for general guidance only. specific lead times for individual ordes are dependent upon the complexity of the customer's drawing specification sizes quantities amount of machinig required, and other factors. Approximately eight weeks should be added to the listed lead times for Number products that require fire-retardant salting, drying or preservation oiling treatment.

part3 -combat/syatem/Equipments

The selected combat systems/Equipments herein can be purchased commercially as contractor furnnished Mareria1 (CFM)for Navy Shipbuilding programs; however, for the most part ,they are procured as Government furnished Material (GFM). Teh applicationj Navy model designation has been included in the item description for specific identification. The conditioms for procurment parallel the criteria listed for part 1, HM&E Ship components-

Part 4 - Combat Systems/Equipments Turnaround Programs

The combat system/Equipmentsherein are available for the most part as a "turnaround " or "one for one" exchange as GEM. The applicable Navy model designator has been included in the item description for specific identification. The indicated period is the nominal"turnaround" time required by the manufacturre or refurbishment agency.

Part 5 -selected manufacturing lead Time Trends

Manufacturing lead Time Trends are provided for three general categories: Hm&E ship component , Basic Material and Combot system. For each category, typical historical representative samples of repeat order lead times were chosen. Ten year history of selected items is presented both numerically and graphically .

Part6 -participating manufacturers

This part us and canadian manufacturers, by product,that assist NAVSHIPSO by providing lead time information. Without this invaluable assistance, the publication would not be possible. In the **state/province (ST/PROV)** column the following **Canadian provincial postal** abbreviations are **used as required.**

AB-Alberta	NT-Northwest Territories
Bc- British columbia	ON-ontaro
MB-Manitoba	PE-prince Edward **Island**
NB-New Brunswick	PQ-Quebec
NF-Newfoundland	sK-saskatchewan
NS-Nova scotia	YT-Yukon Territory

canadian manufactures MlT information was solicited during l989 and appears for the first time in the January l990 publication.

MANUFACTURING LEAD TIME DETERMINATION METHODOLOGY

MLTS are obtained by large data collection efforts from five sources.The most significant being an annual office of Managementand Budget approved mail solicitation to 1300 us and Canadian mnufacturers, figure3. as can be seen, other key data elements such as capacity, utilization rates, workload distribution, employment levels and value of shipmenrt are also collected. After initial solicitation is received, most of the data, with exception of "company Data" elements, preprinted on subsequent solicitations in order to reduce the burden on respondents. since 1980 the solicitation fomat and the data base have both grown **substantially** In l980 solicitations consisted **only of basic**MLT data elements. In I984 capacity utilization was added and in 1986 the scope was expanded to include most of the factors of 1990 solicitation. The prccess used to collect, validate and analyze MLTS is substatially automated. It is a process within the modelling system "ALIAS",a NAVSEA approved computer system. This automated process includes;

Manufacturing lead Time production Solicitations (MLT solicitations) - This form is preprinted with previously supplied "product Data" (MLTS and Production Rates) for selected components, material or system that manufacturers are, have or are capable producing for Navy shipbuilding programs. MLT solicitations are mailed to each manufacturirer for pen/ink change, additions or deletions and return to NAVSHIPSO. A cognizant Industrial specialist, after reviewing and validating the data will typically find changes in themanufacturers address, point -of -contact, or "company/prouct Data" elements which are incorporated into ALLAs. on occasion, manufacturewrs respond with a narrative containing exceptions or

qualifying remarks to the MLTs presented. Examples are MLT increases for testing (environmental, stress, shock), special processes (heat treating, plating, inspections, etc) or exclusion of certain subcomponents (government furnished, long lead time or foreign sourced).

The industrial specialist is responsible for interpreting the remarks and adjusting the MLT quote according to circumstances reported and Navy procurement methods and requirements. When all responses deemed required are received, generally averaging 90%, and data validation and entry is complete, NAVSHIPSO

SAMPLE

DATE: 20 AUG 90

CAGE	COMPANY	CONTACT	TTTLE	TELEPHONE
xx001	XYZ CORP	H. SPECH	PRESIDENT	(215)897 3161

PRODUCT DATA				PRODUCTION RATES			MONTHS TO REACH	
DESCRIPTION/GOVT SPEC	MLT GOVT COMML PERIOD	RO/I0		CURRENT	SURGE		MOB	UNIT OF ISSUE
CIRCUTT BREAKER,AIR, ACB/MIL-C-17587Iic-17587	MONTHS	6/8	6/7	234	360	500	8	12 FACH

DEFINITIONS:

MLT = MANUFACTURING LEAD TIME
GOVT = PRODUCED TO GOVERNMENT/MILITARY SPECIFICATIONS
COMML = PRODUCED TO COMMERCIAL MARINE SPECIFICATIONS
RO = REPEAT ORDER MLT
IO = INITIAL ORDER MLT
CURRENT = NUMBER OF UNITS BEING PRODUCED TO MEET CURRENT CONTRACTUAL COMMITMENTS.
SURGE = ACCELERATED PRODUCTION WITH EXISTING FACILITIES AND EQUIPMENT IN A PEACETIME ENVIRONMENT - NO DECLARED NATIONAL EMERGENCY. ONLY PEACETIME PROGRAM PRIORITIES WILL BE AVAILABLE.
MOB = FULL EXPANSION RESULTING FROM ACTION BY CONGRESS AND THE PRESIDENT TO MOBILIZE ALL UNITS AND THE MATERIAL RESOURCES NEEDED FOR THESE UNITS. PRODUCTION OF NON-ESSENTIAL CONSUMER GOODS MIGHT DECLINE SIGNIFICANTLY AND MODIFIED DESIGNS WOULD PROBABLY BE USED TO MAXIMIZE PRODUCTION RATES.
UNIT OF ISSUE = PHYSICAL MEASUREMENT OR COUNT OF A PRODUCT.
CAPACITY UTILIZATION = RATIO OF CURRENT PRODUCTION TO SURGE PRODUCTION.
VALUE OF SHIPMENTS = VALUE IN CURRENT DOLLARS OF ALL PRODUCTS SHIPPED DURING LAST ACCOUNTING YEAR.
REMARKS = ANY SIGNIFICANT AMPLIFYING INFORMATION ON PRODUCTION UNITS, PRODUCT MIX AND/OR CONCURRENT OR INDIVIDUAL PRODUCTION EFFORTS.

COMPANY DATA:

REMARKS:
PRODUCTION RATES ARE BASED ON PRODUCING ALL ITEMS CONCURRENTLY

1. CAPACITY UTILIZATION = 72.00 %

2. CURRENT EMPLOYMENT LEVEL = 200

3. WORKLOAD DISTRIBUTION PERCENTAGES:

NAVY= 2 00 % ARMY= 20%AIR

OTHER GOVT= 5% COMMRCIAL-= 3 00 % FOREGEN= 5%

4. VALUE OF - = SHIPMENTS =$6.000,000.

Fig. 3 - MANUFACTURING LEAD TIME PRODUCTION SOLICITATION

personnel lWillbegintheprocesS to generate . the final information to be printed in the Publication of manufacturing Lead Time .

The first step is to perform a regression' analysis of MLTS, product by product, using a standard deviation to determine control limites limits.

The resultant figure is then subjected to a validation proccess in industrial specialist campares it to recent performances by Navy supportive manufacturers and MLT data from other 0sources. -. The primary sources for recent actual MLTS(performance) are:

• Material Monitoring guides (MMG) -An MMG is derived by NAVSHIPSO from shipbuilding Material odering schedules for ships under construction. Each summarizes the most important components/systems and provides as a minimum, the following information;

Item Nomenclature

manufacturer (or other source, such as a distributor)

Purchase Order Award Date

Required-in-Yard Date

Land-on-Ship Date

Scheduled Delivery Date

Actual Delivered Date

• Plant Load Report (PIR) - A PIR provides a manufacturer' Navy shipbuilding/repair orderbord. It is Preparead by by NAVSHIPO === and ccompleded by the manufacturing, often with the assistance of the cognizant Defense contract Administration Service representative. are essential validation tools. A typical PIR provides;

Item Nomenclature

contract-

Customer

Data of order

Order Required Date

Estimated Shipment Date

Actual Shipment Date

• On-site Industrial Plant Surveys (Plant surveys)grs) -Plant Surveys conducted to collect and validate MLTS, capacity, facility and manpower data relative to Navy shipbuilding, canversion and repair- demands for ship components, material and system. information previously provided by the manfacturers **obtained** from other sources s is verified and other data is obtained. figure (4) NAVSHIPSO Industrial profile,details data elements and obtained during the course of a plant Survey.

•various Government and commercial Documents and publications -NAVSEA prime contracts are reviewed and monitored for performance appraisal. pertinent MLT information ids also obtained frm other Navy,DOD and government sources and commerical publications including purchasing Magazine and metalworking News.

The last step in the MLTPUB producttion procces. is development of a twelve month MLT forecast. all data previously obtained, validated and analyzed is then weight mitigating factors in order to develop a forecast for publication. projected requirements versus capacity, lobor, subcomponent,mterial and labor availability, and capacity utilization utilization are considered and compared, t**uences on MLT growth or LT forecasts for ships' main** propulsion gas tubinē enginēs, , for example, are not only based on demand but also but by MLTs ofkeysubcamponents such as shaft bearings. . Therefore, even though demand for the turbine may not be sufficiently strong enough to extend MLTs, longer MLTS may develop because of demands on the bearing producers by other industries. although NAVSHIPSO has been successful in thus this type Of approach in collecting, validating and forecasting MLTS,, the office is developine and implementing macroecconomic forecasting model, Navy Econometric System for predicting Relevant Industrial Trends (NESPRIT). It will be used to enhance our ability to project MLTs Industrial capablity in support of NAvy shipbuilding programs ten years into the future.

Upon analysis completion, forecasts are enterad into ALIAS,with the exception of the memo, table of contents and intro introductison, camera ready reports of PARTS 1 throught 6 are Prepared directly from ALIAS report generators. These are forwarded to a coammercial publisher via Navy publication and printing service Branch office .

Since its inception in l955, the MLTPUB has been expanded from 20 pages to 280 pages and is currently distributed to 1522 uS manufacturing and government offices and 95 canadian manufacturers and government office. Among the government recipier recipients are:

Department of Defence- Army, Navy, Air Force,Defence Logistics ~agencY

Departments of Commerce and Transportation

Office of Management and Budget

Federal Emergency Management Agency

Canadian Defense Production Office

NAVSHIPSO INDUSTRIAL PROFILE

A. COMPANY NAME: _____ DATE: _____
DIVISION: _____
COMPANY ADDRESS: _____
(STREET PO BOX) (CITY, STATE, ZIP)

CAGE: _____ PIN: _____
CONTACT NAME: _____ TITLE: _____
PHONE: _____

B. GOVERNMENT REPRESENTATIVE: _____

C. TOTAL EMPLOYMENT LEVEL: _____

CATEGORY / PERSONNEL	PERSONNEL / SHIFT (1)	(2)	(3)	HRS/ DY	DyS/WK
OFFICE _____					
ENGINEERING _____					
PRODUCTION _____					

D. UNION A[redacted]: _____
CONTRACT EXPIRATION DATE: _____

E. CAPABILITIES FOR: FORGINGS _____ CASTINGS _____

F. FACILITIES:
(1) TOTAL PLANT ACREAGE: _____ OCCUPIED: _____
(2) PLANT FLOOR SPACE: ADMINISTRATIVE: _____ R&D: _____
(Square Feet)
PRODUCTION: _____ TEST: _____
(3) FUEL USED: INDUSTRIAL: _____ HEATING: _____
(4) UTILIZATION
PERCENTAGE OF EXISTING PLANT CAPABILITY CURRENTLY IN USE: _____%
PERCENTAGE OF CURRENT WORKLOAD FOR:
(a) NAVY _____% (d) OTHER GOVERNMENT _____%
(b) AIR FORCE _____% (e) COMMERCIAL _____%
(c) ARMY _____% (f) FOREIGN _____%

G. CURRENT NAVY CONTRACTS: (Direct or Indirect)

CONTRACT OR P.O. NUMBER	PURCHASER	AWARD DATE	ITEM PROVIDED	NAVY PROGRAM SUPPORTED

H. PAST NAVY CONTRACTS: (Direct or Indirect)

CONTRACT OR P.O. NUMBER	PURCHASER	AWARD DATE	ITEM PROVIDED	NAVY PROGRAM SUPPORTED

I. PRODUCTION CAPABILITY:

ITEM DESCRIPTION	MLT (W or M) GOVT RO/IO	COML RO/IO	QUARTERLY PRODUCTION RATES CURR	NORM	SURGE	MOB	MONTHS TIME TO REACH SURGE	MOB	UNIT OF ISSUE

J. SPECIAL LABOR REQUIREMENTS:

SKILL/TRADE/ PROFESSION	NUMBER OF PERSONNEL CURR	NORM	SURGE	MOB	TYPE TRAINING PROVIDED (OJT, TUITION AID, (APPRENTICESHIP ETC.)

K. SUBCONTRACTORS: (Major, Sole Source, Unique, Overseas, Etc.)

NAME/ADDRESS/ CITY/STATE/ZIP	ITEM/SERVICE PROVIDED	MLT (MONTHS)	ITEM SUPPORTED	MANUFACTURING SITE

L. PLANT EQUIPMENT: (Major/special; machine tools, inspection, test, etc.)

QTY	MANUFACTURER	TYPE	CAPACITY	YEAR BUILT	ORIGIN

FOREIGN DEPENDENCY FOR PARTS/SERVICE:

M. COMMENTS:

Fig. 4 - NAVSHIPSO INDUSTRIAL PROFILE

MLT TRENDS

Although the shipbuilding supporting industrial base has contracted over the past decade, MLTs for some Basic Material and HM&E components have generally decreased while Combat Systems/components increased. Tables II and III provide ten year overviews of selected items' MLTs. HM&E and Basic Material MLT improvements are attributed mainly to the aggressive Navy shipbuilding program which consisted of a large number of follow-on orders (large lot procurement) for DD 963, FFG 7, AO 177, CG 47, LSD 41, T-AO 187, SSN 688, SSBN 726, T-AGOS 1 and LCAC classes of ships and craft. This building program afforded many manufacturers opportunities to;

Improve workforce learning curve

Improve processes, workflow and testing methods

Develop capable subtier material suppliers and subcontracted work support

Improve plant equipment and facilities

Improve planning and scheduling

Stabilize design

All of these conditions affected HM&E and Basic Material MLTs during the 1980's.

MLTs increases in the same time period are attributable to:

- o Increased backlog at prime or subtier level for such components and material as castings, forging, bearings, motors, plate and sheet.
- o More stringent specifications requiring increased testing or requirements; such as reduced airborne and structureborne noise levels, improved efficiency, weight and volume reductions and increased mean-time-between failure.
- o Change orders which interrupted production schedules
- o Material/subcomponent costs

However, for Combat Systems MLT increased slightly in the last decade due mainly to longer MLTs for material and subcomponents, minor changes in regulations and long lead time material purchasing practices, alternate sourcing (initially) and complex systems reaching full production status.

TABLE II

MANUFACTURING LEAD TIME TRENDS FOR SHIP COMPONENTS
(IN MONTHS)

	JAN 1981	JAN I982	JAN 1983	JAN 3984	JAN 3985	JAN 3986	JAN 1987	JAN 1988	JAN 1989	JAN 1990
BLOWERS	14	15	l3	11	9	9	8	8	8	9
BOILERS	13	13	12	ll	10	10	8	8	8	9
CONDENSERS	16	15	3.3	12	ll	l1	8	10	10	10
CONSOLES	14	14	l3	13	12	13	10	11	11	10
DISTILLING PLANTS	14	13	11	ll	11	ll	10	11	ll	11
ENGINES	12	12	11	9	9	9	7	8	8	9
REDUCTION GEARS	20	19	18	19	19	20	17	15	20	19
GENERATOR SETS	15	15	14	13	13	13	13	13	13	14
POWER SUPPLIES	17	17	13	12	12	9	9	8	8	8
PROPELLERS	12	12	11	10	9	9	10	10	12	14
SHAFTING	10	8	7	8	7	6	6	6	7.	8
SWITCHBOARDS	12	12	12	12	11	10	9	10	9	9
TURBINES	23	24	20	20	22	23	20	20	20	20

TABLE III

MANUFACTURING LEAD TIME TRENDS FOR MAJOR COMBAT SYSTEMS
(IN MONTHS)

	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986	JAN 1987	JAN 1988	JAN 1989	JAN 1990
COMBAT DlRECTION	14	14	17	17	18	18	18	17	16	17
COMMNICATIONS	ll	12	l3	l3	12	13	13	12	11	10
ELECTRONIC 14		13	17	18	18	17	15	16	17	17
NAVIGATIONAL	13	15	14	14	14	15	17	16	17	16
RADAR	14	14	14	14	15	15	16	16	15	16
SONAR	14	15	15	14	13	12	13	12	15	16
WEAPONS	23	23	22	21	20	21	22	21	23	23
WEAPONS DIRECTION	24	22	20	20	20	19	20	22	23	24

IMPACT OF MLT ANALYSIS

PERHAPS THE MOST Concise assessment of Of MLT analysis is that which appears in reference (1). "Defense system typically exhibit lead time volatility. in the discussions of scheduling it is noted that the start date for contractor activity is normally based on a set back from the required completion date The set back is dictated by the operation flow time and the material and component lead time when the lead time is in error, two possible problems exist. IF the lead time estimate is excessive, the funds requirement will be established unecessarily early. This may lead to an overstatement of the lead time and could result in funds being drawn unneccessarily from other areas of need If the lead time estimate is understated, specific contractaor activities could experience a start date that will not support the required delivery date wihtout the expenditure of of premium effort, resulting in higher than necessary program cost or even potential schedule slippage." These results, as stated, have in the past and unfortunaetly, Without accurate estimates and forececasts could plague future programs.

SHIPBUILDING SUPPORTING INDUSTRIAL BASE

The industrial base that manufactures key systems, components and material is comprised of approximately 1300 US and Canadian companies. This base consists of a cross-section of major corporations, small business concerns, sole proprietorships, partnerships, government-owned, government-operated and government-owned, contractor-operated facilities. Complementing this base is a network of support companies including distributors, design agents, service companies, assembly plants and subcomponent manufacturers. The major manufacturers under contract to government and shipbuilders are dispersed throughout the country. Large smokestack industries continue to be concentrated in the Northeast and Midwest, whereas the combat systems base is located predominately in California and the Northeast. Canadian manufacturers of major components and systems are located mostly in the Eastern part of the nation. Primary products manufactured by this North American Industrial Base includes; reduction gears, shafting, steam and diesel engines, gas turbines, combat systems/components, ordnance, communication and electrical equipment.

Although many HM&E industries can be considered "healthy", capacity reductions and MLT increases are occurring in some key Navy supportive segments. The segment of the base that manufactures propulsion diesel engines and gas and steam turbine engines has been reduced by approximately 40% since 1980. There are currently only two active producers of steam turbines, one of which, has recently conslidated and moved its manufacturing site. There is only one manufacturer of gas turbines and one of large diesel engines and they and do not manufacturre slow speed engines frequently used in new commercial ships.MLTS for diesel engines have increased slightly since l987. There were eight reduction gear manufacturers producing reduction gears for large naval applications in 1980. Today, five are suppoting Navy programs and only three have in grinding capability to produce state-of-the art hardened and ground reduction gears. since 1988, MLTs have increased from 15 to 19 moths. The depressed condition of the gear industry is of such significance to the Navy that procurement of some Navy reduction gears has been restricted to us manufacturer.

manufacturers of propulsion shafting for large applications has been reduced from f i v e firms to three since 1980, with one inactive in Navy programs at present. MLTs for this industry have increased from six to eight months. Since FEB 86, DOD has restricted procurement of all ship shafting, except that used on service and landing craft, to US or

Canadian sources.

Large marine propeller manufacturers in the US has declined from seven to five since 1980, while MLTs increased from nine months in 1985 to 14 months forecasted for 1990.

Many other Navy supportive industries have realized capacity reductions and MLT increases since 1980. They represent a cross section of nearly every industry including; bearings, motors, generators, switchboards, pipe and tubing, compressors, steel plate, castings, deck equipment and cable.

Considering past industry trends, the lack of US commercial ship construction the probabilty that future Navy ship work will decline, and difficulty domestic manufacturere have experienced in their attempts to become competitive on the international market, continued loss of capacity and MLT increases many key industries is expected throughout the foreseeable future. continued erosion of the U S ' - Base will result in increases of single and sole sourcing loss or transfer of production capacity to foreign sources, causing a significant reduction in domestic productive capacity.

REFERENCES

1. David D. Acker, "Dfense manufacturing Management, Guide for programe managerrs,"third"uries edition, Superintendent of Documents, U.S. Government printing office, washington, D.C., 1989.