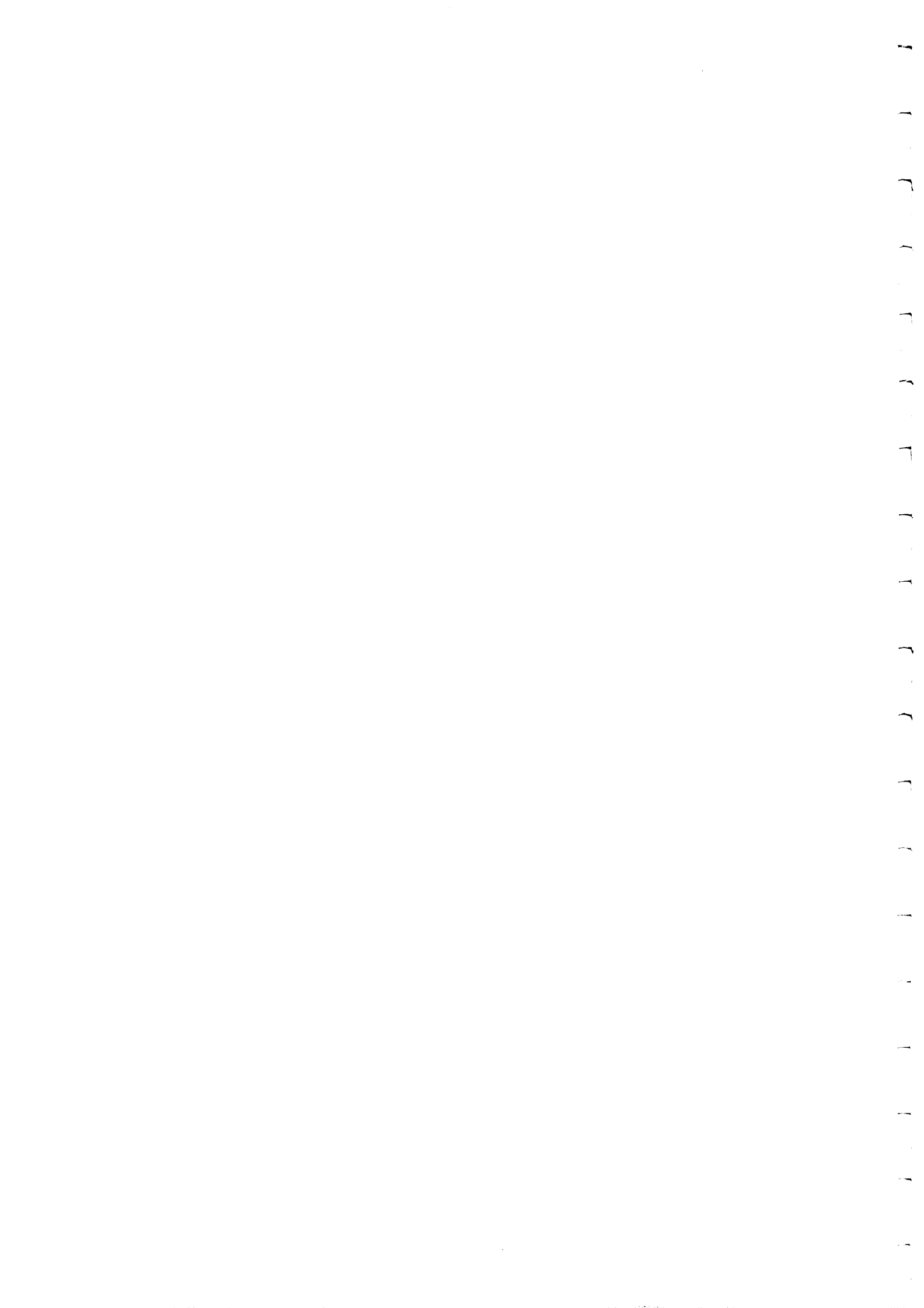


1992

PRODUCTION COMMITTEE
ENVIRONMENTAL EFFECTS
PRODUCTION AIDS
FOR SHIPBUILDERS
STANDARDS THE NATIONAL
PRODUCTION INTEGRATION SHIPBUILDING
SPACE INNOVATIONS RESEARCH
PAINTS AND COATINGS PROGRAM
AUTOMATION
AND TRAINING
CONSTRUCTION

**National Shipbuilding Research Program
Bibliography of Publications
1973-1992**

U.S. DEPARTMENT OF THE NAVY
David Taylor Model Basin
Carderock Division Headquarters
Naval Surface Warfare Center
in cooperation with
The University of Michigan



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16. Abstract <p>The National Shipbuilding Research Program (NSRP) has been in existence since 1973. The program is a cooperative effort of the U.S. Navy, the U. S. Shipbuilding industry, and selected academic institutions. The program has sponsored research in the areas of shipbuilding that include but are not limited to: facilities and environmental effects, outfitting and production aids, design and production integration, human resource innovation, shipbuilding standards, welding, industrial engineering, education and training, flexible automation, and surface preparation and coatings.</p> <p>This report is a revision and update of the bibliography prepared under contract N00167-89-0065. It is a compilation of abstracts for every report known to have been published under the auspices of the NSRP in support of shipbuilding research.</p>					
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**BIBLIOGRAPHY OF PUBLICATIONS
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**Microfiche Library
Abstract Report**

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August 1992

**The U.S. Navy
David Taylor Model Basin
Carderock Division Headquarters
Naval Surface Warfare Center
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FOREWORD

The development of the NSRP Microfiche Library is one product of many products managed and cost-shared by The University of Michigan for the National Shipbuilding Research Program. The NSRP is dedicated to assisting the U.S. shipbuilding industry in improving its productivity. The Program is a cooperative effort of the Naval Surface Warfare Center's Department of the U.S. Navy, the U.S. shipbuilding industry, and selected academic research institutions. This project was conducted by The University of Michigan Transportation Research Institute (UMTRI), Marine Systems Division, for the Education and Training Panel (SP-9), Ship Production Committee, Society of Naval Architects and Marine Engineers (SNAME).

This collection represents all reports produced under the auspices of the National Shipbuilding Research Program from 1973 to the present. New reports are added each year. All material is arranged by NSRP Ship Production Committee Ship Panel. Within each Panel the material is in chronological order. Each entry lists the NSRP number, title, author, date, and keywords assigned to that publication. The number of pages in each report is given in parentheses at the end of the abstract. Page numbering is incremental for each section of the Abstract Report. The Abstract Report contains an index for NSRP number, report title, author, and keywords.

Microfiche and paper copies of the reports in this collection may be obtained at a nominal charge from the NSRP Publications Coordinator, UMTRI, 2901 Baxter Road, Ann Arbor, Michigan 48109 (313-763-2465).

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PANEL SP 1: Facilities/Environmental Effects

NSRP 0035

UMTRI 48800-01

TITLE: Material Handling Equipment Study - Vols. I and II.

AUTHOR: Ingalls Shipbuilding, Division of Litton Systems, Inc.

DATE: 1973

ABSTRACT: This is a compilation of material handling equipment which could be used in a shipyard and summarizes the type of equipment available so that a manager may make more informed decisions about what equipment will best suit the desired material handling system. Also included is a handbook of economic options which analyzes several methods of transporting various categories of shipbuilding materials; it is intended to be a ready reference document so that a manager may make decisions with the best payback potential for the most economic method of moving the desired materials. (Vol. I, 33 p.; Vol. II, 156 p.)

KEYWORDS: Material handling, shipbuilding materials, economic options

NSRP 0074

UMTRI 70690

TITLE: Feasibility Study of Semi-Automatic Pipe Handling System and Fabrication Facility.

AUTHOR: Avondale Shipyards, Inc. New Orleans, LA.

DATE: April 1978

ABSTRACT: The primary objective of this study is to design a cost effective and semi-automatic method of fabricating pipe which will reduce the labor, material handling, storage space, and required fabrication area. Such a facility for the shipbuilding industry must be designed to handle 1 1/2 inch through 24 inch diameter pipe and all ASTM Class and MIL-SPECS, and schedules and alloys of pipe used in shipboard systems. The facility must be versatile and equipped to handle repair jobs and speciality items, as well as new vessel piping systems. (96 p.)

KEYWORDS: Feasibility study, pipe handling, automation, pipe fabrication

NSRP 0077

UMTRI 70692

TITLE: Feasibility Study on Development of an Economical System for Cleaning Dry Docks Prior to Flooding.

AUTHOR: Avondale Shipyards, Inc., New Orleans. LA.

DATE: October 1978

ABSTRACT: The primary objective of this project was to determine effective and economical means of cleaning drydocks prior to flooding in order to comply with EPA

NSRP BIBLIOGRAPHY

criteria. The EPA has been considering enforcing regulations requiring broom cleaning of drydock floors and the eventual use of vacuum cleaning. Utilizing broomclean as EPA's criteria, two crucial factors of dry docking operations should be effected: time and man-hours. (45 p.)

KEYWORDS: Dry docks, EPA, feasibility studies

NSRP 0106

UMTRI 48802

TITLE: Requirements Report: Computer Software System for a Semi-Automatic Pipe Handling System and Fabrication Facility.

AUTHOR: IBM, for Avondale Shipyards, Inc., New Orleans, LA.

DATE: May 1980

ABSTRACT: Avondale has entered into a detailed study to design a cost effective and semi-automatic method of fabricating pipe which will reduce the labor, material handling, storage space, and required fabrication area. This report presents the requirements of the computer software that must be developed to create pipe detail drawings through the pipe shop. Those requirements are separated into two major categories: the Computer Aided Drawing System and the Pipe Handling and Fabrication System. Section II of this report describes the application in terms of work flow and functions performed. Section III deals with the information necessary. Section IV describes the significant design constraints that must be considered during the design of the system. (114 p.)

KEYWORDS: Material handling, automation, computer software, pipe handling, computer aided drawing

NSRP 0128

UMTRI 48919

TITLE: Long-Range Facilities Plan.

AUTHOR: Todd Pacific Shipyards Corporation, Los Angeles Division.

DATE: July 31, 1981

ABSTRACT: The principal objective of the long-range plan is to provide a baseline against which all projected changes to the yard facilities may be measured in order to assure the orderly and efficient progress of yard improvement. This report includes a history of the yard, and long-range facilities plans addressing land requirements, material handling, communications, utilities, buildings, and major equipment. An appendix includes a report on the future business potential of Todd Shipyards Corporation prepared by International Maritime Associates. (200 p. approx.)

KEYWORDS: Facilities planning, long-range planning

NSRP 0135

UMTRI 48804

TITLE: Semi-Automatic Beam-Line Feasibility Study.

AUTHOR: Avondale Shipyards, Inc., New Orleans, LA.

DATE: November 1981

ABSTRACT: The goal of this project was the design of a semi-automatic system of beam fabrication to reduce labor costs, to revise the usual material handling methods, to upgrade flow efficiency, and to bring about streamlined space requirements for both operations and storage areas. The goal was a semi-automatic beam-line which would bring clear positive advances to current shipbuilding practice and enhance productivity. (62 p.)

KEYWORDS: Beam fabrication, material handling, flow efficiency, productivity, feasibility studies

NSRP 0142

UMTRI 70612

TITLE: Long Range Plan for Peterson Builders, Inc.

AUTHOR: Shipbuilding Consultants, for Peterson Builders, Inc.

DATE: February 22, 1982

ABSTRACT: PBI began preparation of a long-range business and facilities plan in 1980. Investigations were directed toward an understanding of the PBI market and competition, physical, financial, and labor constraints on future development and the capability of in-house systems and organization to handle current and future complex shipbuilding programs. Short-term, intermediate, and long-range plans are discussed in detail. (110 p.)

KEYWORDS: Facilities planning, long-range planning

NSRP 0153

UMTRI 71766-71

TITLE: Long Range Facilities Planning. Executive Summary and Vols. I-V.

AUTHOR: National Steel and Shipbuilding Company.

DATE: April 1982

ABSTRACT: NASSCO's Facilities and Industrial Engineering Department developed a long-range facilities master plan covering all essential operations. Many alternatives were considered and evaluated in depth. The contents of this report have been divided into five volumes: Plan Guide Lines; Long Range Capabilities; Industrial Survey; IHI Survey; and Exhibits. (1,038 p. total)

KEYWORDS: Facilities planning, long-range planning

NSRP 0165

UMTRI 70693

TITLE: Avondale Shipyards, Inc., Long Range Facilities Plan.

AUTHOR: Avondale Shipyards, Inc.

NSRP BIBLIOGRAPHY

DATE: February 1983

ABSTRACT: Participating shipyards developed a Long-Range Facilities Plan covering all activities in owned and/or leased facilities and owned and/or leased land. Each plan was prepared to give a clear picture, in summary form, on how the yard has developed, what the business and facilities situation is now, what top management sees as being the long-range plan for the yard, and the short and intermediate range steps to meet that plan. Within the scope of the overall plan, facilities improvement projects were identified for future action. (70 p.)

KEYWORDS: Facilities planning, long-range planning

NSRP 0167

UMTRI 48803

TITLE: Semi-Automatic Pipe Handling System and Fabrication Facility Phase II Implementation.

AUTHOR: Avondale Shipyards, Inc., New Orleans, LA.

DATE: March 1983

ABSTRACT: Phase I determined feasibility through site interviews with knowledgeable individuals in other shipyards as well as visits to pipe fabrication plants in Japan, Europe, and the U.S. The second phase included design of the overall facility layout as well as selection or fabrication of individual machines, and installation of the new equipment according to a phasing plan which allowed production to continue in the existing building throughout the installation and remodeling process. The project report describes the facility and the sequence of tasks, and provides numerous photographs. (72 p.)

KEYWORDS: Pipe fabrication, facility layout, pipe handling

NSRP 0190

UMTRI 70800

TITLE: Process Lanes Feasibility Study.

AUTHOR: Avondale Shipyards, Inc.

DATE: February 1984

ABSTRACT: A process lane system is described. Process lanes, when implemented correctly, are known to reduce labor costs, increase flow efficiency, and decrease space requirements for operations and storage areas. The goal of this project was to design a process lane system that would realize these benefits and increase shipbuilding productivity. (108 p.)

KEYWORDS: Process lanes, cost reduction, productivity, feasibility studies

NSRP 0202

UMTRI 71847

TITLE: Metal Forming Systems Research.

AUTHOR: Roggendorff and Partners Co., Ltd., for Avondale Shipyards, Inc.

DATE: January 1985

ABSTRACT: This report describes and compares three- and four-roller systems for forming steel plates by rolling. The report provides necessary background material to be used in new rolling machine design and selection. (95 p.)

KEYWORDS: Forming, plate rolling, rolling machine design, roller systems

NSRP 0203

UMTRI 71848

TITLE: The Nesting and Marking of Ship Parts Cut From Steel Plate.

AUTHOR: Harry Hooper, Consultant, for Avondale Shipyards, Inc.

DATE: February 1985

ABSTRACT: In this report, the methods presently used by United States' shipbuilders for preparing, nesting and marking plate parts are discussed. The use of existing computer technology is explored as a means for improving these operations by conserving plate and reducing operational costs. (50 p.)

KEYWORDS: Nesting, marking, cutting, numerical control, computer-aided manufacturing

NSRP 0206

UMTRI 72023

TITLE: Slew Cranes in Shipyards.

AUTHOR: M.A.N.-Wolffkran, for Avondale Shipyards, Inc.

DATE: May 1985

ABSTRACT: A study was completed to determine slew cranes characteristics for cost effective operations in American shipyards. Slew crane theory and practice were discussed to provide background for developing the evaluation criteria. Five cranes were studied in detail: double-boom (gooseneck) crane, single boom crane with level luffing, balance boom with level luffing, single boom crane with normal luffing, and turntable crane with normal luffing. Each crane was evaluated for speed, accuracy, energy consumption, first cost, maintenance cost, safety, and operator training. A column mounted crane with a single, unbalanced boom with appropriate luffing characteristics was determined to be the best crane for use in American shipyards. (71 p.)

KEYWORDS: Cranes, cost effectiveness

NSRP 0208

UMTRI 72025

TITLE: Fitting and Welding Cylinders.

AUTHOR: Roggendorff and Partners Co., Ltd., for Avondale Shipyards, Inc.

NSRP BIBLIOGRAPHY

DATE: April 1985

ABSTRACT: A flexible system for the assembly of large steel reinforced cylinders was described. Production equipment and operation sequencing was described in detail for fitting, welding, and turning cylinders and associated stiffeners. (101 p.)

KEYWORDS: Jigs, fixtures, pipe handling, pressure vessels; offshore structures, submarine, welding

NSRP 0230

UMTRI 73523

TITLE: Pipe Storage and Movement Study.

AUTHOR: Denson Engineers, Inc., for Avondale Shipyards, Inc.

DATE: February 1986

ABSTRACT: The purpose of this study was to evaluate various pipe purchasing, handling and storage practices in the shipbuilding industry. From these evaluations, recommendations were made for reducing material costs and improving productivity in accordance with the objectives of the National Shipbuilding Research Program. (152 p.)

KEYWORDS: Pipe handling, purchasing

NSRP 0231

UMTRI 73524

TITLE: Report on Moving Personnel and Light Material Onto a Ship and about a Shipyard.

AUTHOR: The Leawood Group, Richard Muther and Associates, for Avondale Shipyards, Inc.

DATE: November 1985

ABSTRACT: This document gives the results of a 1985 study performed at Avondale. The basic purpose of this project was to determine the cost of the present methods of moving light materials and people between yard operations and on and off ships, and to develop new methods and/or equipment to reduce the high cost of these functions. Many of the recommendations developed for Avondale could be applicable at other U.S. shipyards. (173 p.)

KEYWORDS: Cost effectiveness, productivity, material handling

NSRP 0237

UMTRI 73747

TITLE: A Study of the Effects of Applying CAD/CAM Techniques to a Shipyard Sheet Metal Shop.

AUTHOR: Harry Hooper, consultant to Avondale Shipyards, Inc.

DATE: May 1986

ABSTRACT: In this report, conventional and CAD/CAM manufacturing methods used in a shipyard sheet metal shop for producing duct fittings and other labor intensive products manufactured from sheet and plate are discussed. Time studies comparing the two methods as they apply to these products are presented. (60 p.)

KEYWORDS: CAD/CAM, productivity

NSRP 0250

UMTRI 74892

TITLE: Study of the Mechanized Manufacture and Welding of Reinforced Shell Units From Rolled Shell Plate and Tee Bar Segments.

AUTHOR: Roggendorff and Partners Co., Ltd., for Avondale Shipyards.

DATE: July 1986

ABSTRACT: Simple stage-by-stage production with step-by-step mounting and time recording control establishes a system eminently suitable for the accurate handling and positioning of a workpiece relative to the operation to be performed. This study attempts to describe two mechanized methods of shell ring manufacture; both are according to a stage-by-stage production method. (72 p.)

KEYWORDS: Mechanized manufacture, shell rings

NSRP 0251

UMTRI 74893

TITLE: Tower Cranes in Shipyards.

AUTHOR: Emscor and Man-Wolffkran, for Avondale Shipyards.

DATE: October 1986

ABSTRACT: It is apparent that the cranes traditionally used in U.S. shipyards do not offer the performance, the flexibility, or the cost-effectiveness of cranes available in Europe and the Far East. This study examines the suitability of tower cranes for use in dockyards in the U.S. Their cost and cost-effectiveness are studied, and applications for which they are particularly suited are presented in detail. (101 p.)

KEYWORDS: Cranes

NSRP 0315

UMTRI 82211

TITLE: Group Technology/Flow Applications in Production Shops.

AUTHOR: William S. Oakes, H.B. Bongiorno, W. O. Appleton, and Vincent F. Bobrowicz.

DATE: February 1988

ABSTRACT: This report discusses classification and coding as a method for developing functional groups of similar product types. This is a contrast to other methods such as

NSRP BIBLIOGRAPHY

process analysis or manual/visual search. Application of more than one method is required to avoid errors introduced when only one method is relied upon. A review of statistical concepts of classes is introduced. A general approach to the development of a classification and coding scheme is presented. Two case studies are presented the first dealing with shop applications, the second with installation of steel outfitting items. (69 p.)

KEYWORDS: Group Technology, shop applications, steel outfitting

NSRP 0317

UMTRI 82203

TITLE: Semi-Automatic Web-Line Feasibility Study.

AUTHOR: Richard Price and Harold Tabony.

DATE: December 1984

ABSTRACT: The objective of this project was to design a cost effective semiautomatic method of prefabrication, fabrication and assembly of web sections, known as a semi-automatic web line. The goal was to reduce material handling, fitting and welding labor, and at the same time bring about improved flow efficiency, space utilization and integration with other advanced manufacturing practices and scheduling. (175 p.)

KEYWORDS: Automation, web-line, material handling, fitting, welding

NSRP 0322

UMTRI 81349

TITLE: Movement and Storage of Pipe and Shapes.

AUTHOR: Albert W. Horsmon Jr. and Howard M. Bunch.

DATE: March 1991

ABSTRACT: A system is described for classifying pipe and shapes into unit loads and the attributes of various moving and storing devices are applied to unit loads and loose materials. An index to the various movement and storage equipment supplies is provided. Finally, a methodology is presented for analyzing various material handling systems and choosing the best alternatives. (107 p.)

KEYWORDS: Pipe, shapes, material handling, material storage

NSRP 0330

UMTRI 82760

TITLE: 1990 Clean Air Act Impact on Shipyard Painting Operation.

Author: Lynwood Haumschilt.

DATE: July 1991

ABSTRACT: This report gives the necessary background information on the Clean Air Act to cover the control technique guidelines for shipbuilding and ship repair which is required to be promulgated by the Environmental Protection Agency by November 15,

1993. Also, an explanation on how to interface with federal, state, and local regulators in regard to establishing air pollution rules and regulations as they relate to Volatile Organic Compounds (VOC). The past, current, and proposed efforts by the U.S. Navy concerning VOC's is also covered. (23 p.)

KEYWORDS: Clean Air Act, volatile organic compounds (VOC), control

KEYWORDS: Clean Air Act, volatile organic compounds (VOC), control technique guidelines, environmental protection agency (EPA)

NSRP 0342

UMTRI 82547

TITLE: Hazardous Material Tracking Systems: Scanning Module.

AUTHOR: Insight Industries

DATE: January 1992

ABSTRACT: This report involves the development, explanation, and application of the Hazardous Materials Tracking System's (HMTS) on-line electronic image of the Material Safety Data Sheet (MSDS) and the reasons for its necessity. This report is the result of a six-month study of the methods, design and programming for this scanning system. (26p.)

KEYWORDS: Hazardous Material, modules, tracking system

NSRP 0345

UMTRI 82548

TITLE: Environmental Compliance Inspection Checklist for Shipbuilding Facilities.

AUTHOR: John Martin and John Wittenborn.

DATE: April 1992

ABSTRACT: This checklist was developed to assist shipyards in determining their level of environmental compliance with federal regulatory requirements. The checklist addresses the full range of processes and operations found in the shipbuilding industry, and the environmental regulations that apply to them. The checklist was prepared using current available environmental checklists and published literature sources on environmental auditing. A draft checklist was reviewed by various representative shipyards to assure that all shipyard processes were covered. (126p.)

KEYWORDS: Environment, federal regulations

NSRP 0350

UMTRI 82785

TITLE: Staging Systems for Ships During New Construction and Repair.

AUTHOR: J. Frank Santoyo

DATE: June 1992

NSRP BIBLIOGRAPHY

ABSTRACT: Present scaffolding methods used by most shipyards are costly and, in general inefficient. The need to develop innovative scaffolding methods and to use state-of-the-art scaffolding systems and equipment is imperative. This report concentrates on scaffolding systems devoted primarily to exterior hulls and the use of other equipment utilized to make this operation more cost efficient. This area of shipbuilding could have significant impact in reducing costs, a necessary reduction in order for the American commercial market to expect to become competitive in the world-wide market place. (40p.)

KEYWORDS: Shipbuilding construction and repair, global marketing, scaffolding,

PANEL SP 2: Outfitting and Production Aids

NSRP 0031

UMTRI 71150

TITLE: Frame Spacing, Alternate Shapes for Longitudinal, and Wider Plates for Productivity.

AUTHOR: McDonnell Douglas Astronautics, for Todd Pacific Shipyards.

DATE: August 1973

ABSTRACT: In order to determine more economical hull configurations, cost equations were developed which permit rapid comparison of configurations with alternate transverse frame spacing, alternate stiffener shapes, and alternate plate widths. The cost equations are such that an individual shipyard can apply them using local cost figures. The form of the cost equations also permit their application at various levels of detail, commensurate with a shipyard's cost data. For maximum benefit, these equations should be applied early in the design and planning phases. (113 p.)

KEYWORDS: Cost equations, frame spacing, structural shapes, plates, productivity

NSRP 0036

UMTRI 48929

TITLE: Cost Effectiveness Study of Weather Protection for Shipbuilding Operations. (2 Vols.)

AUTHOR: Battelle Pacific Northwest Laboratories, for Todd Pacific Shipyards.

DATE: April 1974

ABSTRACT: This report contains data on how weather factors impact adversely on the shipbuilding process. It is comprehensive, and not intended for the casual reader. It is useful for the quantification of losses due to weather, and can serve management in the determination of the degree of investment required for weather protection devices. (Vol. I, 75 p.; Vol. II, 218 p.)

KEYWORDS: Cost-effectiveness, weather protection

NSRP 0037

UMTRI 48808

TITLE: Shipbuilding Alignment with Lasers.

AUTHOR: Boeing Airplane Company, for Todd Pacific Shipyards.

DATE: April 1974

ABSTRACT: The objective of this manual is to present actual experience in applying lasers to shipbuilding alignment and to identify areas where lasers would be advantageous over other systems for better alignment or measurement. This manual also provides guidance with which to select and specify lasers that serve suggested applications. It

NSRP BIBLIOGRAPHY

provides sufficient knowledge for someone already experienced in alignment techniques to adapt lasers to existing procedures as well as implementing new procedures. (117 p.)

KEYWORDS: Accuracy control, lasers

NSRP 0038

UMTRI 48918

TITLE: Use of Scale Models as a Management Tool.

AUTHOR: Bath Iron Works Corporation, for Todd Pacific Shipyards Corporation.

DATE: May 1974

ABSTRACT: The objective of this report was to investigate uses and develop cost data and techniques relative to the productive use of scale models in shipbuilding. The major topics covered by this illustrated manual are: model types, benefits of model use, costs, model building methods, and a reference list of further materials dealing with models. (77 p.)

KEYWORDS: Models, management techniques

NSRP 0043

UMTRI 48807

TITLE: NDT: Low Cost Alternatives to Film Radiography.

AUTHOR: McDonnell Douglas Astronautics Company, for Todd Pacific Shipyards Corp.

DATE: August 1974

ABSTRACT: This report describes explorations of nondestructive testing (NDT) techniques for welds in ship hulls and pipes, and test criteria. It is primarily intended for NDT and welding specialists. (156 p.)

KEYWORDS: Cost effectiveness, nondestructive testing, film radiography, welding

NSRP 0058

UMTRI 48806

TITLE: Photogrammetry in Shipbuilding.

AUTHOR: John F. Kenefick, Photogrammetric Consultants, Inc., for Todd Pacific Shipyards Corp.

DATE: July 1976

ABSTRACT: Photogrammetry is the art, science, and technology which includes obtaining reliable information about physical objects by measuring and interpreting photographic images. This project investigates the applicability of photogrammetry to dimensioning problems that frequently occur in shipbuilding. Particular emphasis has been placed upon applications that may have the greatest potential for improved productivity. (62 p.)

KEYWORDS: Photogrammetry, photographic methods, productivity

NSRP 0060

UMTRI 48814

TITLE: Fiberglass Reinforced Piping for Shipboard Systems.

AUTHOR: DeBell and Richardson, for Todd Pacific Shipyards Corp.

DATE: August 1976

ABSTRACT: This study examines the design and installation problems and the comparative economics in substituting fiberglass for steel in actual designs of shipyard piping systems. Part II is intended to sketch the fire and mechanical performance expected from glass reinforced plastic pipe of the filament-wound, epoxy type. (95 p.)

KEYWORDS: Fiberglass, fire performance, plastic piping, cost effectiveness

NSRP 0069

UMTRI 48805

TITLE: Rectangular Vent Duct Standards.

AUTHOR: John J. McMullen Associates, for Todd Pacific Shipyards Corp.

DATE: May 1977

ABSTRACT: The standards scheme contained herein established, in 2-inch increments, 106 different rectangular cross-sections which cover a useful range of applications. Further, a reasonable, but reduced, number of fitting types are incorporated. These features were exploited to minimize the number of material items required and to simplify construction details. (100 p.)

KEYWORDS: Standards, ventilation equipment, rectangular vent ducts

NSRP 0071

UMTRI 48921

TITLE: Plastics in Shipbuilding.

AUTHOR: Springborn Laboratories, for Todd Pacific Shipyards Corp.

DATE: August 1977

ABSTRACT: This book provides shipbuilders with a better understanding of plastics and composites which could cause a net decrease in requirements for manpower, materials and facilities. It discloses, for example, that fiberglass pipe can result in a decrease in all three resources. The book's purpose is to encourage shipbuilders to think of new applications that are based only upon matching performance specifications to the unique properties of plastics. (96 p.)

KEYWORDS: Plastics, composites, fiberglass

NSRP 0075

UMTRI 48925

TITLE: Phase I: Photogrammetric Dimensioning of Distributive Systems Models.

NSRP BIBLIOGRAPHY

AUTHOR: J. F. Kenefick Photogrammetric Consultants, Inc., for Todd Pacific Shipyards Corp.

DATE: August 1978

ABSTRACT: This is a report of only Phase I of the research project "Photogrammetric Dimensioning of Distributive Systems Models." It contains the acquired understanding and recommendations for Phase II. Its purpose was to solicit shipbuilders' comments. The final report was published as "Photogrammetric Dimensioning of Ships Engine-Room Models", March 1981. (165 p.)

KEYWORDS: Photogrammetry, photogrammetric dimensioning, distributive systems

NSRP 0079

UMTRI 48809

TITLE: Stern Frame and Hawsepipe Construction Technology.

AUTHOR: M. Rosenblatt and Son, for Todd Pacific Shipyards Corp.

DATE: 1978

ABSTRACT: A cross section of the United States shipbuilding industry, including shipyards, ship design agents, classification societies, and foundries, was interviewed with the objective of establishing the state-of-the-art in stern frame and hawsepipe design and construction techniques. The findings from the interviews were evaluated to determine different, more productive stern frame and hawsepipe configurations for single crew vessels in three recommended sizes most representative of the ships being constructed now in U.S. shipyards or contemplated for construction in the future. For each of the three vessel sizes, alternative designs and producibility analyses, including cost estimates, are prepared which incorporate the most feasible stern frame and hawsepipe configurations. (200 p. approx.)

KEYWORDS: Stern frames, hawsepipes

NSRP 0084

UMTRI 48923

TITLE: Photogrammetry in Shipbuilding: Measuring a Complex Casting.

AUTHOR: John F. Kenefick, Photogrammetric Consultants, Inc., for Todd Pacific Shipyards.

DATE: February 1979

ABSTRACT: Within the last three years photogrammetry has been employed in real production situations by six shipbuilders in the United States. This report describes a procedure for obtaining accurate dimensions of complex casting. It should be of particular interest to quality assurance people and those responsible for fitting a casting to an adjoining structure. (14 p.)

KEYWORDS: Photogrammetry, quality assurance

NSRP 0090**UMTRI 48812****TITLE:** Special Structural Shapes: Factors Affecting Usage in U.S. Shipbuilding.**AUTHOR:** Stanford Research Institute, for Todd Pacific Shipyards Corp.**DATE:** July 1979

ABSTRACT: Shipbuilders consider that the substitution of special structural steel shapes has potential for increasing productivity. The use of special shapes, e.g., long-leg angles and bulb flats, in ships is common throughout the rest of the world. In the United States (except where shipbuilders have resorted to fabricating shapes) standard angles, tees, and channels that frequently need further processing are the norm. In response to shipbuilders' interest in the potential for increasing productivity, this report presents the results of an investigation of the major issues and problems affecting the adoption of special shapes by U.S. shipbuilders. (57 p.)

KEYWORDS: Structural shapes, bulb flats, channels**NSRP 0096****UMTRI 48813****TITLE:** Outfit Planning.**AUTHOR:** IHI Marine Technology, Inc., for Todd Pacific Shipyards.**DATE:** December 1979

ABSTRACT: Outfit planning is a term used to describe the allocation of resources for the installation of components other than hull structures in a ship. Methods applied in shipyards in other countries are recognized to have greatly increased productivity. Thus, the purpose of this text, which is based upon a study of such methods and knowledge of domestic practices, is to identify the logic and principles which could lead to improving outfit procedures in the U.S. shipbuilding industry. (89 p.)

KEYWORDS: Outfit planning, product work breakdown structure, zone outfitting**NSRP 0098****UMTRI 48927****TITLE:** Improved Tank Testing Methods.**AUTHOR:** Southwest Research Institute, for Todd Pacific Shipyards Corp.**DATE:** January 1980

ABSTRACT: The purpose of this project was to seek new methods for testing integral tanks in ships which would improve shipbuilders' productivity while not detracting from assurances for safety of shipbuilders' test personnel, regulators' inspectors, and operators' crews and ships. (148 p.)

KEYWORDS: Tank testing methods, tanks

NSRP BIBLIOGRAPHY

NSRP 0117

UMTRI 48811

TITLE: Product Work Breakdown Structure.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards.

DATE: November 1980

ABSTRACT: PWBS employs the logic of Group Technology which is a method for applying mass production techniques to a variety of products in widely varying quantities. As applied to ship construction, PWBS classified components to be purchased, parts to be fabricated, and planned sub-assemblies in order to achieve uniform and coordinated work flows. In shipbuilding, as in other industries, GT has yielded substantial benefits even when resources remain essentially unchanged. (See also NSRP 0164 below) (88 p.)

KEYWORDS: Group technology, product work breakdown structure

NSRP 0124

UMTRI 48924

TITLE: Photogrammetric Dimensioning of Ships' Engine-Room Models.

AUTHOR: John F. Kenefick, Photogrammetric Consultants, Inc., for Todd Pacific Shipyards Corp. Seattle Division.

DATE: March 1981

ABSTRACT: This book describes how photogrammetry can be used to effectively link design modeling and computer-aided piping design systems. The linkage is important because traditional design procedures impede the implementation of proven, cost-effective shipbuilding methods. (50 p.)

KEYWORDS: Photogrammetry, models, design modeling

NSRP 0143

UMTRI 48920

TITLE: Process Analysis via Accuracy Control.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corp.

DATE: February 1982

ABSTRACT: This book addresses modern industrial methods as successfully applied by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) of Japan. Some traditional managers will become convinced that high productivity in Japan is not due to superhuman workers and miraculous subsidies. Instead, as this book demonstrates, high productivity comes from highly organized work. Together with *Product Work Breakdown Structure* (NSRP 0117 above; see also NSRP 0164) this publication presents the analytic methods needed to control and constantly improve work processes. (115 p.)

KEYWORDS: Process analysis, accuracy control, work organization

NSRP 0147

UMTRI 48922

TITLE: Pipe-Piece Family Manufacturing.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corp.

DATE: March 1982

ABSTRACT: This book was obtained from the study of preparations for and operation of the very efficient pipe shop in IHI's Kure shipyards which is manually operated and out-produces automated shops elsewhere. This book shows that a pipe shop's contribution to overall shipbuilding productivity is the only meaningful way to regard its performance. The industrial principles involved are Group Technology in support of Zone Outfitting. (56 p.)

KEYWORDS: Pipe handling, zone outfitting, group technology, pipe fabrication

NSRP 0163

UMTRI 48810

TITLE: Line Heating.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corp.

DATE: November 1982

ABSTRACT: This report describes line heating, the process of forming shapes by controlled heating and cooling. Line heating both achieves greater accuracy in shaping curved parts and removes distortion from subassemblies immediately after manufacture. It can minimize much rework and deferred welding at the building site, and distribute transformed work over all preceding hull construction processes, including designing and lofting. Moreover, Avondale Shipyards reported a 40 percent decrease in direct labor costs for man-hours per plate using line heating; this decrease excludes savings associated with elimination of plate-forming jigs and speeded-up assembly work. The line heating aids and work instructions described were developed by Ishikawajima-Harima Heavy Industries (IHI) of Japan and have now been applied in various U.S. shipyards. (86 p.)

KEYWORDS: Line heating, forming, cost reduction

NSRP 0164

UMTRI 71156

TITLE: Product Work Breakdown Structure - Revised.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corp.

DATE: Revised - December 1982

ABSTRACT: (See also NSRP 0117 abstract). The revisions made in this edition emphasize the interdependency of a product work breakdown, statistical control of accuracy for productivity purposes, and line heating. The revisions also include the substitution of pertinent photographs which depict the successful application of a product work breakdown in Avondale Shipyards, Inc. (89 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: Product work breakdown structure, statistical control

NSRP 0169

UMTRI 48926

TITLE: Integrated Hull Construction, Outfitting, and Painting.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corp.

DATE: May 1983

ABSTRACT: This report describes integrated hull construction, outfitting and painting (IHOP) techniques developed by Ishikawajima-Harima Heavy Industries of Japan. These methods are characterized by involvement of production personnel throughout the construction process, including the design phase, beginning with the development of contract plans, development of a premeditated building strategy, and collaboration between all shipyard departments. (67 p.)

KEYWORDS: Hull construction, outfitting, painting

NSRP 0178

UMTRI 70694

TITLE: Tank Sealing with Coating Materials.

AUTHOR: Southwest Research Institute, for Todd Pacific Shipyards Corp.

DATE: September 1983

ABSTRACT: This report complements another, *Improved Tank Testing Methods* (NSRP 0098 above). The common objective is to create assurances that would substitute for hydrostatic tests of tanks. Such tests adversely impact shipbuilding productivity and schedules because of the work and time durations required for filling and draining large volumes, because of the extraordinary loads imposed on building berths, and because of environmental concerns for drainage. (89 p.)

KEYWORDS: Tank sealing, coating materials, hydrostatic tests

NSRP 0179

UMTRI 48928

TITLE: Design for Zone Outfitting.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corp.

DATE: September 1983

ABSTRACT: This report describes the transition from system to zone orientation. This includes the reorganization of design information and people, based on the very effective methods developed by Ishikawajima-Harima Heavy Industries Co., Ltd., (IHI). Most significantly, each production department and shop must have a production engineering capability that can organize work in accordance with modern principles and that can describe the work so organized. (69 p.)

KEYWORDS: Zone outfitting, design information, work organization

NSRP 0193

UMTRI 71461

TITLE: Design Modeling.

AUTHOR: Hitachi Zosen Corporation, for Todd Pacific Shipyards.

DATE: July 1984

ABSTRACT: Since the demand for physical models continues, this publication addresses their most effective use, i.e., for creative purposes during a crucial design phase. The first three chapters describe managerial aspects including the formation of design-modeling teams and estimated man-hours required. Thereafter, practical information is included for modeling and for presenting information so created in work instructions. Among the ideas described is a unique scheme for dividing a model into sections to permit more people to work simultaneously and so minimize overall time required for design. (118 p.)

KEYWORDS: Design modeling, physical models

NSRP 0196

UMTRI 71618

TITLE: Pre-Contract Negotiation of Technical Matters.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards.

DATE: December 1984

ABSTRACT: Many U.S. shipbuilders and owners experience problems with each other particularly during design and production phases. In order to avoid conflicts, the purpose of this publication is to provide guidance concerning technical items that should be clarified and/or incorporated in contract specifications. Obviously, when conflicts are avoided, a ship's cost is reduced and both owner and shipbuilder benefit. (151 p.)

KEYWORDS: Contract negotiations, contract specifications

NSRP 0210

UMTRI 72067

TITLE: Product Oriented Material Management.

AUTHOR: IHI International, for Todd Pacific Shipyards Corporation.

DATE: June 1985

ABSTRACT: The Ishikawajima-Harima Heavy Industries Company, Ltd., material management system for zone-oriented, integrated hull construction, outfitting, and painting is described. Also discussed are problem areas as identified in U.S. shipbuilding through a survey of shipyards and vendors. Included in the report are discussions of design, planning, purchasing, and subcontracting procedures used to support just-in-time procurement. (101 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: Purchasing, subcontracting, inventory, material control, zone outfitting

NSRP 0213

UMTRI 72710

TITLE: Shipyard Organization and Management Development.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards Corporation.

DATE: October 1985

ABSTRACT: Research into various other aspects of Ishikawajima-Harima Industries' (IHI) shipbuilding system led to suspicion that Japanese and American shipbuilders differed greatly in their development and employment of college-educated middle management. The research indicated that Japanese shipbuilders cultivate and exploit middle management to a far greater degree. A discovery was made that IHI's management development approach conformed with basic principles of organization and management as taught in U.S. universities. Thus, the project was redirected to include the influence of traditional functional organization such as IHI's. This report concludes that an effective management development program is impossible with a traditional functional organization. (32 p.)

KEYWORDS: Management, training, organizational approach

NSRP 0214

UMTRI 72709

TITLE: Process Analysis via Accuracy Control, Revised.

AUTHOR: IHI International Division, for Todd Pacific Shipyards.

DATE: August 1985

ABSTRACT: Since the original edition of this publication was issued in 1982, most U.S. shipbuilders accepted the idea that appreciable productivity gains can be obtained by more in-process accuracy and are responding accordingly. More importantly, some also accepted statistical control of accuracy variations as the most effective technique for control of work and for constantly improving productivity. They have responded with significant investments, e.g. assigning college-educated people as Accuracy Control (A/C) engineers and creating prerequisite data bases. This created the need for more in-depth understanding of A/C which this revision attempts to fulfill. The description of pertinent statistical theory has been made more comprehensive by the use of the same principals which are the basis for Statistical Quality Control. A section has been added on start-up which is based on actual experiences in U.S. shipyards. Also, this edition describes how a constantly improving manufacturing system operates by providing an analytical basis without which Quality Circles are ineffective. (123 p.)

KEYWORDS: Process analysis, accuracy control, work organization

NSRP 0238

UMTRI 73748

TITLE: Flexible Production Scheduling System.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards.

DATE: April 1986

ABSTRACT: A schedule which is developed in phases is far more effective than a schedule which attempts a level of detail beyond the progress of design. A product approach permits the principles of Group Technology to be exploited. This publication describes the methods of estimating work volumes for different end products as applied by Ishikawajima-Harima Heavy Industries, Co., Ltd. (IHI). By adaptation, they are applicable to other shipyards which employ product-oriented manufacturing systems. (168 p.)

KEYWORDS: Product work breakdown structure, group technology

NSRP 0239

UMTRI 73749

TITLE: U.S. Shipbuilding Accuracy - Phase I.

AUTHOR: ABS Worldwide Technical Services, Inc., (ABSTECH), for Todd Pacific Shipyards Corporation.

DATE: May 1986

ABSTRACT: This publication is the first statistical representation of pertinent data collected from those U.S. shipyards which are sufficiently advanced in their employment of statistics and of accuracy variations for structural work. The first phase of this project addresses accuracies normally achieved when manufacturing commonly used structural details for the midbody of the ship. Shipyards were contacted and asked to provide in-house data collected from their controlled manufacturing processes. The data received was statistically combined and Standard Ranges and Tolerance Limits of control dimensions developed. The data represents a mix of U.S. shipyards doing both commercial and naval construction. (13 p.)

KEYWORDS: Structural details, statistical control

NSRP 0240

UMTRI 73750

TITLE: Product Oriented Safety and Health Management.

AUTHOR: IHI Marine Technology, Inc., for Todd Pacific Shipyards.

DATE: May 1986

ABSTRACT: In shipyards which feature modern product organizations, workers, supervisors, and managers conduct safety and health matters as part of their everyday work just as they implement production routines. They have proven that quality is linked to productivity and that both are linked to safety and health in the work force. This publication describes the safety and health (S and H) program systematically implemented by Ishikawajima-Harima Heavy Industries, Co., Ltd. (IHI). (78 p.)

KEYWORDS: Health, safety, productivity, IHI

NSRP BIBLIOGRAPHY

NSRP 0249

UMTRI 74891

TITLE: Analytical Quality Circles.

AUTHOR: L.D. Chirillo Associates, for Todd Pacific Shipyards.

DATE: September 1986

ABSTRACT: TQC (Total Quality Control) is largely a Japanese outgrowth of the worldwide quality control movement. The two basic TQC goals are: Improvement of Company Structure and Growth in Employee Vitality. This report is a study of TQC as it evolved and progressed in Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI): the concept, application, examples and pervasive effects. (136 p.)

KEYWORDS: Quality Circles, IHI

NSRP 0260

UMTRI 74885

TITLE: Flexible Production Indices.

AUTHOR: L.D. Chirillo Associates for Todd Pacific Shipyards, Los Angeles.

DATE: April 1987

ABSTRACT: This publication describes various aspects of the very effective "flexible production system" developed by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) for operating shipyards. Their use is described to show how man-hour budgeting for most work is based on certainty. The indices are used to relate man-hours required to physical characteristics of materials that are to be fabricated, assembled or painted. With extraordinary attention to material definition, starting in basic design, the indices permit constant refinement of manpower requirements as design progress refines material requirements. The consequence is unprecedented control of production through control of material. (78 p.)

KEYWORDS: IHI, indices, production planning, production scheduling, manpower planning

PANEL SP 3: Surface Preparation and Coatings

NSRP 0032

UMTRI 70310

TITLE: Improved Fabrication Primer for Protection of Steel.

AUTHOR: General Dynamics/Quincy.

DATE: 1973

ABSTRACT: The objective of this report was to make available to the shipbuilding industry an acceptable pre-fabrication primer to protect steel plate after automatic abrasive blasting and before further use. Questionnaires distributed to U.S. shipbuilders determined industry needs, and a testing specification based on this information was developed. Included were: primer evaluation, 6 and 12 months weathering of primed steel in semi-tropical climates, top coat compatibility testing in a hydrodynamic tank at a water flow of 18 knots, impact resistance and flexibility of primers, drying time, welding tests, and welding fume analysis. (271 p.)

KEYWORDS: Primers, testing

NSRP 0033

UMTRI 70360

TITLE: Prefailure Evaluation Techniques for Coating Systems.

AUTHOR: Battelle-Columbus Laboratories, for General Dynamics/Quincy.

DATE: 1974

ABSTRACT: The number of tests available to control quality of product, surface preparation, application and cure are too numerous to use in their entirety in shipyard painting. Further, there are today very few tests which can determine the probability of failure of a coating system with any degree of reliability after application. The success of a coating system is dependent on many things, from surface condition to weather at time of application. The only assurance of the quality of a coating system comes from monitoring and controlling the surface preparation, paint quality and application. A few post application tests can be made to obtain limited assurance that the coating system will perform satisfactorily. The probable minimum practical tests and controls are: establish requirements based on standards such as the Steel Structures Painting Council, the Swedish Surface Preparation Standards, or the Society of Naval Architects and Marine Engineers Bulletin 4-9, Abrasive Blasting Guide for cleanliness and profile; establish specifications (or obtain them from vendor); and make sufficient tests to insure that the product is within specifications. (243 p.)

KEYWORDS: Surface preparation, coatings, primers, paint quality, paint application, standards

NSRP 0034

UMTRI 70356

TITLE: Automatic Painting of Structural Steel Shapes.

NSRP BIBLIOGRAPHY

AUTHOR: General Dynamics/Quincy.

DATE: 1974

ABSTRACT: Because of the large variety of sizes and configurations of structural shapes used in U.S. shipbuilding, painting equipment manufacturers have been limited in the development of an automatic paint facility for the painting of structural steel shapes. Other parameters which had to be considered in developing an automated paint facility were all the various coatings which are used in the U.S. and the necessity of controlling the coating thickness within fine tolerances, particularly for weld-through primers, in order to be compatible with subsequent welding processes. With the help of paint equipment manufacturers, prototype equipment was developed to provide a reliable automatic paint facility capable of coating all shapes in U.S. shipbuilding. The prototype has the capability to handle special or otherwise unusual shapes with minor modifications. (36 p.)

KEYWORDS: Coatings, surface preparation, paint application, paint quality, automatic paint facility

NSRP 0045

UMTRI 70357

TITLE: Development of Non-Polluting Solvent-Free Liquid Resin Coating Systems for Ships.

AUTHOR: Battelle-Columbus Laboratories, for General Dynamics/Quincy.

DATE: 1975

ABSTRACT: The objective of this research was to develop liquid, solvent-free coating systems and practical methods for their application in the shipyards. Successful attainment of this objective would result in lower cost due to elimination of solvents, faster application and fewer coats, ecological advantages resulting from elimination of solvents, and improved safety since elimination of solvents will decrease fire and toxicity hazards, particularly in confined areas such as ship holds and tanks. (39 p.)

KEYWORDS: Coatings, solvent-free coatings, solvents, non-polluting coatings, resin coatings

NSRP 0064

UMTRI 70306

TITLE: Catalog of Existing Small Tools for Surface Preparation and Support Equipment for Blasters and Painters.

AUTHOR: Avondale Shipyards, Inc.

DATE: May 1977

ABSTRACT: This report defines the principles required for efficient blasting and painting. Specialized cleaning methods from power tool cleaning to closed cycle blasting was discussed, equipment and facilities are described, and cost reduction procedures are defined. (89 p.)

KEYWORDS: Blasting and painting, surface preparation, cleaning, hand tools

NSRP 0091

UMTRI 70307

TITLE: Practical Shipbuilding Standards for Surface Preparation and Coatings.

AUTHOR: Offshore Power Systems, for Avondale Shipyards, Inc.

DATE: July 1979

ABSTRACT: This effort developed proposed "Shipbuilding Standard for Surface Preparation and Coating," and a "Standard Paint and Coating Product Data Sheet." Also, it identified the need for a preconstruction conference between the shipyard production and technical sections, the owner representatives, and the coating supplier. (52 p.)

KEYWORDS: Surface preparation, coatings, standards, painting

NSRP 0092

UMTRI 70711-12

TITLE: Marine Coating Performance for Different Ship Areas. Volumes I and II.

AUTHOR: Offshore Power Systems, for Avondale Shipyards, Inc.

DATE: July 1979

ABSTRACT: A computer program was developed to compare the effectiveness of the different generic coatings in different ship areas. The trends indicated by the program were supported by prefailure analysis test results. (Vol. I, 70 p. approx.; Vol II, 180 p. approx.)

KEYWORDS: Coatings, coatings tests

NSRP 0097

UMTRI 70358-59

TITLE: Training Courses for Blasters and Painters and Student Handbook. 2 Vols.

AUTHOR: Institute of Applied Technology, for Avondale Shipyards, Inc.

DATE: Revised 1984

ABSTRACT: Thirty-six shipyards participated in the instructor training program. (Vol. I, 108 p.; Vol II, 250 p. approx.)

KEYWORDS: Training programs, instructor training, blasting and painting

NSRP 0105

UMTRI 70308

TITLE: Cleaning of Steel Assemblies and Shipboard Touch-Up Using Citric Acid.

AUTHOR: Offshore Power Systems, for Avondale Shipyards, Inc.

DATE: May 1980

NSRP BIBLIOGRAPHY

ABSTRACT: This program confirmed the compatibility of citric acid cleaned surfaces with the present state of the art marine coatings, optimized the cleaning solution and procedure, and confirmed the feasibility of a Phase II implementation study. (50 p. approx.)

KEYWORDS: Surface preparation, cleaning

NSRP 0114

UMTRI 70309

TITLE: Shipyard Marking Methods.

AUTHOR: Bethlehem Steel Corp., Sparrows Point, for Avondale Shipyards, Inc.

DATE: September 1980

ABSTRACT: This report identified a marking material which would meet the necessary marine top coat requirements of durability and overcoat ability. (63 p.)

KEYWORDS: Marking, top coat requirements, overcoat ability

NSRP 0119

UMTRI 70254

TITLE: Copper-Nickel Hull Sheathing Study.

AUTHOR: Dr. Leslie W. Sandor, for Sun Ship, Inc.

DATE: December 1980

ABSTRACT: Fuel consumption of ships is related to hull roughness. The increasing high cost of fuel is the driving force behind the efforts that are expended in looking for methods which would reduce hull roughness and would maintain a smooth hull surface profile during the design life of a ship. One such method involves the use of copper-nickel. This study examined a number of methodologies for applying Cu/Ni in sheet form. The welding of Cu/Ni clad steel was also evaluated in a shipyard environment. The cost differential between Cu/Ni sheathed and conventional painted hulls was determined for a large container ship. (95 p.)

KEYWORDS: Roughness, hull sheathing, copper-nickel sheathing, cost differentials

NSRP 0127

UMTRI 70687

TITLE: Determination of Volume Solids of Paints and Coatings by Accurate Dry Film Thickness Measurements.

AUTHOR: Georgia Institute of Technology, for Avondale Shipyards, Inc.

DATE: March 1981

ABSTRACT: A new method to determine the volume solids of paints and coatings based on the measurement of dried film thickness over a known area was studied. It was compared to the American Society for Testing and Materials Method D, Volume 2697-73, *Nonvolatile Matter in Clear and Pigmented Coatings*. This method determines the volume of

the dry film by application of the Archimedes buoyancy effect. In addition, the project was structured to extend the ASTM method to coatings systems used in the marine industry. (38 p.)

KEYWORDS: Paint systems, dried film thickness, coatings systems

NSRP 0129

UMTRI 70686

TITLE: The Feasibility of Calcite Deposition in Ballast Tanks as a Method of Corrosion Control.

AUTHOR: Ocean City Research Corporation, for Avondale Shipyards, Inc.

DATE: August 1981

ABSTRACT: This program evaluated the parameters required for the deposition of thick calcite coatings on a steel substrate from low concentrations of colloidal calcium carbonate. This coating, in conjunction with anodes, would provide an economical means of corrosion protection in ballast tanks. Heavy coating deposition was obtained but solution agitation or flow was required. Phase II of the program will attempt to provide a practical method of initiation compatible with the complex configuration of ballast tanks. (30 p.)

KEYWORDS: Corrosion control, calcite coatings, calcium carbonate, corrosion protection, feasibility studies

NSRP 0130

UMTRI 70713

TITLE: Procedural Handbook. Surface Preparation and Coating for Tanks and Closed Areas.

AUTHOR: Complete Abrasive Blasting Systems, Inc., for Avondale Shipyards, Inc.

DATE: September 1981

ABSTRACT: The handbook provides the necessary information for planners to effectively, efficiently, and safely plan painting operations in confined areas. The information contained within this handbook includes: identification of the requirements and related problems associated with surface preparation and painting of tanks and enclosed areas; identification of personnel exposure limits; identification of monitoring equipment for measurement of fume and dust concentration and ventilation rates; identification of maximum allowable concentrations and ventilation requirements for abrasive blasting and coatings application; and identification of suitable ventilation and abrasive blast equipment for shipyard operations. (113 p.)

KEYWORDS: Surface preparation, blasting and painting, fume and dust concentration, ventilation equipment, blast equipment

NSRP 0132

UMTRI 70688

TITLE: Evaluation of Near Solventless Coatings for Marine Use.

NSRP BIBLIOGRAPHY

AUTHOR: Springborn Laboratories, Inc., for Avondale Shipyards, Inc.

DATE: October 1981

ABSTRACT: This program compared available near solvent free coatings with available "State of the Art" Marine Coatings. The coatings were exposed to testing conditions representative of the different ship areas. Many of the coatings performed as well as conventional systems but usage in certain ship areas would be limited because of application requirements and build characteristics. (41 p.)

KEYWORDS: Coatings, solvent-free coatings, coatings tests

NSRP 0134

UMTRI 70689

TITLE: Evaluation of Water Borne Coatings for Marine Use.

AUTHOR: Georgia Institute of Technology, for Avondale Shipyards, Inc.

DATE: November 1981

ABSTRACT: This report compares available water borne coatings to conventional marine coating systems. A limited number of these coatings compared sufficiently well to warrant application testing. (68 p.)

KEYWORDS: Water borne coatings, coatings, marine coating systems

NSRP 0155

UMTRI 70305

TITLE: Survey of Existing and Promising New Methods of Surface Preparation.

AUTHOR: Steel Structures Painting Council, for Avondale Shipyards, Inc.

DATE: April 1982

ABSTRACT: This report surveys and evaluates surface preparation and coating methods with special emphasis on new and conceptual ideas which might be developed for effective use in shipbuilding. (99 p.)

KEYWORDS: Surface preparation, coatings, coating methods

NSRP 0156

UMTRI 70303

TITLE: Surface Texture (Profile) Measurement.

AUTHOR: Offshore Power Systems/Westinghouse, for Avondale Shipyards, Inc.

DATE: May 1982

ABSTRACT: Many techniques exist for measuring surface texture (profile). Each gives a different average measurement with some overlap within the range of measurements. The most important observation concerning these measurements was that none is precise,

due to the random nature of the surfaces prepared for painting. To preclude these problems, future paint specifications, if referencing required profile heights, should specify the measurement techniques with a wide range of acceptable values. (73 p.)

KEYWORDS: Surface preparation, surface texture (profile)

NSRP 0158

UMTRI 70256

TITLE: Cathodic Protection/Partial Coatings Versus Complete Coatings in Tanks.

AUTHOR: Offshore Power Systems, for Avondale Shipyards, Inc.

DATE: May 1982

ABSTRACT: The 0-23-1 Panel of SNAME selected a research and development project to investigate alternative, cost effective corrosion control solutions. Four approaches were selected for mock-up ballast tank testing and 20 year life cycle cost analysis: completely coated tanks with high performance coatings; partially coated tanks with cathodic protection; soft coatings with cathodic protection; and preconstruction primer with cathodic protection. (71 p.)

KEYWORDS: Corrosion protection, cathodic protection, coatings, ballast tanks

NSRP 0162

UMTRI 70302

TITLE: A Descriptive Overview of Japanese Shipbuilding Surface Preparation and Coating Methods.

AUTHOR: Avondale Shipyards, Inc.

DATE: September 1982

ABSTRACT: This report gives a discussion of the methods used in Japanese shipyards regarding surface preparation and coatings, planning, application, and materials. This comparative analysis is based on a tour of four Japanese shipyards and two major surface preparation and coating subcontractors. (76 p.)

KEYWORDS: Surface preparation, coatings, Japanese shipyards

NSRP 0171

UMTRI 70304

TITLE: The Effects of Edge Preparation Standard Phase I.

AUTHOR: Dr. Leslie W. Sandor, for Avondale Shipyards, Inc.

DATE: May 1983

ABSTRACT: The result of a literature search on available standards on edge preparation and surface defect repair is reported. Studies on the effects of edge preparation on coating life are documented, highlighting the results of a Russian study. (92 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: Edge preparation, surface preparation, surface defect repair

NSRP 0176

UMTRI 70361

TITLE: Surface Preparation: A Comparative Analysis of Existing Standards and a Proposed Marine Standard.

AUTHOR: Institute of Applied Technology, for Avondale Shipyards, Inc.

DATE: August 1983

ABSTRACT: The report documents a comparative analysis of existing surface preparation standards and proposes a standard for the marine industry. (86 p.)

KEYWORDS: Surface preparation, standards

NSRP 0177

UMTRI 70255

TITLE: Zone Painting Method.

AUTHOR: IHI, for Avondale Shipyards, Inc.

DATE: August 1983

ABSTRACT: This Japanese technology is described and implementation procedures are discussed. The integration of the zone painting method with hull block construction and zone outfitting processes is the basis for Japanese Shipbuilding productivity. The planning and organization required to achieve this are discussed. (61 p.)

KEYWORDS: Zone painting, zone outfitting, hull construction

NSRP 0187

UMTRI 70621

TITLE: An Investigation of Possible Ways to Enhance Title Deposition of Calcite-Type Coatings.

AUTHOR: Ocean City Research Corporation, for Avondale Shipyards, Inc.

DATE: January 1984

ABSTRACT: The shipbuilding industry has directed much effort toward ways of limiting escalating coating costs. Of special concern, with respect to increasing coating coats, are segregated seawater ballast tanks. The use of calcite-type coating represents a possible alternative approach for controlling corrosion in the segregated tanks with a substantial savings in cost. As a result, Ocean City Research Corporation undertook a follow-up laboratory study which continued investigating the feasibility of applying calcite-type coatings to segregated ballast tanks. (57 p.)

KEYWORDS: Coatings, ballast tanks, calcite-type coatings, corrosion protection

NSRP 0188

UMTRI 70622

TITLE: Mineral Slag Abrasive Survey and Specification.

AUTHOR: Ocean City Research Corporation, for Avondale Shipyards, Inc.

DATE: April 1984

ABSTRACT: Because of potential silicosis problems, the U.S. shipbuilding industry has largely abandoned the use of open-air sand blasting. The predominate abrasives now being used for open-air blasting are mineral slags having a low free silica content. Concerns about their continued availability as well as batch-to-batch variations in quality prompted the subject program. Hence, a study was performed to catalog sources of mineral slag abrasives for U.S. shipyards, and to develop a tentative material specification for mineral slag abrasives consistent with the requirements of U.S. shipyards. (52 p.)

KEYWORDS: Surface preparation, open-air sand blasting, silica, mineral slags, abrasives, blasting and painting

NSRP 0191

UMTRI 70801

TITLE: Evaluation of Rust Compatible Primers for Marine Applications.

AUTHOR: Rensselaer Polytechnic Institute, for Avondale Shipyards, Inc.

DATE: May 1984

ABSTRACT: The principle objective of the program was to determine the state-of-the-art of primers and/or coating systems which were designed to be applied directly to a rusted surface, and to determine through laboratory evaluations if any of the materials performed sufficiently well enough to be used in marine application. (56 p.)

KEYWORDS: Primers, corrosion, surface preparation, coating systems, rust

NSRP 0194

UMTRI 71459

TITLE: Shipyard Design and Planning for a Zone Orientated Painting System.

AUTHOR: IHI Marine Technology, for Avondale Shipyards, Inc.

DATE: July 1984

ABSTRACT: This paper describes the Zone Painting Method, a new concept in ship construction which is based on the Product Work Breakdown Structure. The essence of the Zone Painting Method is proper planning and scheduling, in coordination with hull construction and outfitting. Design and planning structures, as related to zone painting, are presented. Departmental responsibilities for those segments of the shipyard organization which impact painting are detailed. The paper then proceeds to delineate the planning process according to the three phases of contract planning, system planning and zone planning. These phases examine the painting process in detail. (64 p.)

KEYWORDS: Zone painting, contract planning, system planning, zone planning

NSRP BIBLIOGRAPHY

NSRP 0204

UMTRI 71846

TITLE: The Effect of Edge Preparation on Coating Life - Phase Two.

AUTHOR: Franklin Research Center, for Avondale Shipyards, Inc.

DATE: February 1985

ABSTRACT: This program evaluated the effect of edge preparation and application method of the life of three commonly used marine paint systems. The results are discussed and optimum radii are identified which result in edge protection approaching that of the flat surface. (39 p.)

KEYWORDS: Edge preparation, paint systems, surface preparation, corrosion protection

NSRP 0205

UMTRI 71845

TITLE: Cathodic Protection/Partial Coatings Versus Complete Coating in Ballast Tanks - A Project Update.

AUTHOR: Associated Coating Consultants, for Avondale Shipyards, Inc.

DATE: February 1985

ABSTRACT: This report documents the results of three years ballast cycling of test tanks with the following protection systems: completely coated tanks with high performance coatings, partial coated tanks with cathodic protection, preconstruction primer with cathodic protection, and soft coatings with cathodic protection. The preconstruction primer with zinc anodes shows promise of being effective economical method of protection based on the testing to date. (30 p.)

KEYWORDS: Cathodic protection, coatings, paint methods, paint tests, primers, ballast tanks

NSRP 0207

UMTRI 72026

TITLE: Dynamic Corrosion Testing "Copperlok" Coating System.

AUTHOR: Ocean City Research Corporation, for Avondale Shipyards, Inc.

DATE: April 1985

ABSTRACT: New coatings, such as "Copperlok" are being developed to prevent marine fouling. A study was completed to determine the rate at which Copperlok coating would corrode in seawater flowing at 30 fps and to determine the effect of Copperlok coating on the steel substrate exposed at faults in the coating both with and without Copperlok short circuited to the steel substrate. Test configuration and corrosion measurement techniques, were discussed. Following a 63 day test period, it was concluded that Copperlok coating, as applied and tested, will not accelerate corrosion of the steel substrate provided there is no short circuit. At test conditions the coating corrosion/erosion rate is approximately two mils per year. No significant change in surface roughness appeared. (20 p.)

KEYWORDS: Corrosion, anti-fouling, corrosion measurement, coatings, "Copperlok"

NSRP 0217

UMTRI 72707

TITLE: Abrasive Testing Cabinets – A State of the Art Study.

AUTHOR: W.H. Radut, Associates, for Avondale Shipyards, Inc.

DATE: June 1985

ABSTRACT: There is considerable work being done on developing specifications or guidelines for abrasives. SSPC, ASTM, NAVSEA, NACE and others are involved in this work. Most of the physical testing and chemical testing is standardized either by ASTM methods or by using proprietary equipment. There are some performance characteristics, however, which are important to the evaluation of abrasive materials for which there are no standard tests. Examples are cutting rate, friability, and dust generation. Various investigators have constructed test chambers or test cabinets to conduct such tests. It was decided that an investigation was required into what existing equipment is available. As a result, a study was made to investigate the current state of the art. This document reports the results of that study. (60 p.)

KEYWORDS: Abrasives, testing

NSRP 0218

UMTRI 72708

TITLE: Evaluation of the Effectiveness of Wet Blast Cleaning Methods of Surface Preparation.

AUTHOR: Steel Structures Painting Council for Avondale Shipyards, Inc.

DATE: June 1985

ABSTRACT: Dry abrasive blasting, the most efficient and economical technique for preparing steel for painting, is frequently not feasible or permitted for the following reasons: contamination of machinery or equipment, damage of adjacent intact paints, or visual dust pollution. The use of sand may present a hazard from silical dust inhalation. Currently, the most practical and widely used alternatives to dry blasting are wet methods of blast cleaning. The use of water in combination with abrasives significantly reduces the amount of dust produced and the range over which it is distributed. Wet methods of blast cleaning also reduce the visible pollution from abrasive dust clouds. This report describes the results of field evaluations of several different types and manufacturers of equipment for wet blasting. The objective of this study are to (1) determine cleaning rates and effectiveness of wet blast units, (2) determine safety, reliability, and practicability of wet blast units, and (3) develop guidelines for use of wet blast equipment for cleaning various types of structural steel for repainting. (88 p.)

KEYWORDS: Blasting and painting, surface preparation, cleaning

NSRP 0227

UMTRI 73520

TITLE: The Economics of Shipyard Painting, Phase One: (Of Three Phases).

NSRP BIBLIOGRAPHY

AUTHOR: Peterson Builders, Inc., for Avondale Shipyards, Inc.

DATE: January 1986

ABSTRACT: This report describes the first phase of a three year project; the objective for the first year was to deal with the problem of identifying the constituent parts of painting and surface preparation costs within the shipyard. The painting operation is somewhat unique in that the end product of the Paint Department is extremely susceptible to damage by other trades and resulting rework costs are generally high. Separate identity and tracking of the cost drivers in the painting area are essential to resolve the problems that are responsible for high painting cost. Phase I of this project has established a detailed labor reporting system for painting costs. (53 p.)

KEYWORDS: Painting, surface preparation, economic options

NSRP 0228

UMTRI 73521

TITLE: Marine Coating Performance-A Six Year Report.

AUTHOR: Associated Coating Consultants, for Avondale Shipyards, Inc.

DATE: October 1985

ABSTRACT: The objective of this project was to continue a series of exterior test, performance studies which began in 1978 and 1980 as portions of other projects. For the first time, shipyards have access to data which can be used to evaluate the various generic coating systems presently on the market — to predict actual coating performance. In addition, accelerated test methods are presented which can be used to screen candidate coating systems. (38 p.)

KEYWORDS: Coating systems, paint systems

NSRP 0229

UMTRI 73522

TITLE: Painting On-Block; The Zone Painting Method Advantage.

AUTHOR: Avondale Shipyards, Inc.

DATE: March 1986

ABSTRACT: This report describes the planning and methodology of zone-oriented painting based on the research of Japanese shipyards that have successfully implemented the Zone Painting Method (ZPTM). A special focus in this report is given to the "on-block" painting stage in ZPTM. Application of shop primer and on-board painting are also treated with some detail, as they are connected with an on-block painting and part of the zone-oriented painting process. (125 p.)

KEYWORDS: Zone painting, on-block painting, painting, paint methods

NSRP 0246

UMTRI 74879

TITLE: A Survey of Japanese Shipyard Applied Marine Coatings Performance.

AUTHOR: Avondale Shipyards, Inc.

DATE: November 1985

ABSTRACT: In July of 1982, an on-site inspection of Japanese shipbuilding facilities was performed to study Japan's surface preparation and coatings planning and production methods. The study found that the Japanese have developed a standard coating system designed to facilitate construction, and that their approach to planning and construction, does reduce cost. To test the hypothesis of the adequacy of the Japanese shipyard techniques, a Research and Development project was formulated to survey the performance of Japanese coated ships. (42 p.)

KEYWORDS: Coating systems, Japanese shipyards

NSRP 0248

UMTRI 74890

TITLE: Overcoating of Inorganic Zinc Primers for Underwater Service - Final Report.

AUTHOR: Ocean City Research Corporation, for Avondale Shipyards and National Steel and Shipbuilding Company.

DATE: July 1986

ABSTRACT: A major portion of coating costs may be attributed to surface preparation. This study investigated the acceptability of overcoating inorganic zinc primers in underwater service. Of particular interest was the performance of inorganic zinc pre-construction primers. If it can be demonstrated that conventional topcoats are compatible with inorganic zinc pre-construction primers in underwater service, the requirement for removing the primer by abrasive blasting prior to coating of the underwater hull might be eliminated resulting in a substantial cost savings. (36 p.)

KEYWORDS: Zinc primers, overcoating

NSRP 0272

UMTRI 74889

TITLE: Prototype Mineral Abrasive Reclaimer: Shipyard Operation.

AUTHOR: John W. Peart, Consultant for National Steel and Shipbuilding Company.

DATE: March 1987

ABSTRACT: Reclamation of spent mineral abrasives is a new concept for shipyards. There is considerable value retained in spent abrasives, particularly with today's escalating procurement and disposal costs. The cost effectiveness of reclaiming abrasives in some operations is further enhanced in the jurisdictions where the spent material is classified as hazardous waste. The reclaim potential of abrasives is discussed in this report, along with a quality comparison for reclaimed vs. virgin abrasive. The prototype reclaimer in operation at Bethlehem Steel Corporation is described, and operational costs and payoff, as well as a review of design criteria, are discussed. (89 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: Abrasives, reclamation

NSRP 0270

UMTRI 77472

TITLE: Adaption of Japanese Prefabrication Priming Procedure to U.S. Shipbuilding Methodology.

AUTHOR: KTA-TATOR, Inc. for Avondale Shipyards.

DATE: August 1987

ABSTRACT: The U.S. and Japanese Maritime shipbuilding coating practices currently involve the application of a reconstruction primer to blast cleaned steel prior to fabrication. After fabrication, the Japanese incorporate this primer into the protective coating system after minimal cleaning. In contrast, the U.S. removes this primer by blast cleaning, followed by the application of a new inorganic zinc primer and the remainder of the coating system. The result is an escalation in the U.S. costs of coating application as compared with the Japanese methodology. If the Japanese approach provides adequate performance, a significant cost savings would result. This report describes the results of a laboratory study to investigate and compare the performance of selected Marine coatings applied according to the Japanese and U.S. methodologies. (68 p.)

KEYWORDS: Primer, coating methods

NSRP 0275

UMTRI 77474

TITLE: Work Planning for Shipyard Surface Preparation and Coating (SP and C) - A Training Manual.

AUTHOR: DDL OMNI Engineering Ltd.

DATE: January 1987

ABSTRACT: This report is the result of an industry survey and two workshops pertaining to work planning of surface preparation and coating activities within a shipyard environment. The purpose of the manual is to improve work planning by providing training material directed primarily at those personnel involved in the near-term planning, scheduling, and directing of SP and C operations. It provides: (1) the means to use the material for instructional purposes, and (2) work planning factors that will be of value to other levels of work planners within a shipyard. (498 p.)

KEYWORDS: Training, surface preparation

NSRP 0280

UMTRI 77479

TITLE: Cathodic Protection/Partial Coatings versus Complete Coating in Ballast Tanks - Five Year Report.

AUTHOR: Associated Coating Consultants.

DATE: November 1987

ABSTRACT: Ship ballast tanks are one of the most costly items of new ship construction. In addition, ballast tanks are one of the most severe corrosion areas during ship operations. This report is the result of a research and development project to investigate alternate, cost-effective corrosion control solutions. Four approaches were originally selected for mock-up ballast testing and 20-year life cycle cost analysis. A new coating was added after five years. The initial report published in 1982 and the project update report published in 1985 demonstrated that, of the systems evaluated, the inorganic zinc preconstruction primer with zinc anode cathodic protection was the best performer, least expensive initially, and least expensive over the 20 year economic life of the ship. This five year update concurs. (26 p.)

KEYWORDS: Cathodic protection, corrosion control

NSRP 0288

UMTRI 78698

TITLE: Marine Coatings Performance-Ten Year Report.

AUTHOR: Associated Coating Consultants.

DATE: July 1988

ABSTRACT: The objective of this project was to continue a series of exterior test performance studies which began in 1978 and 1980 as portions of other projects. The program has continued for over ten years and is now beginning to provide meaningful test results. For the first time, shipyards have access to field test data systematically developed from exposure specimens where the application was controlled and the characteristics of the applied film were carefully defined and documented. Failure assessments were made at planned intervals utilizing standard evaluation techniques. The marine exposure selected, while not as harsh as that experienced by ships at sea, possesses sufficiently similar exposure elements to provide significant data to evaluate and compare various generic coating systems utilized for these applications. Even though the state of the art has progressed since the program was initiated, many of the projects tested are still available as originally formulated or have been reformulated to improve service life. Shipyards now have data which can be used to predict the performance of marine coatings in service. (40 p.)

KEYWORDS: Marine coating systems

NSRP 0294

UMTRI 79327

TITLE: Automated Painting of Small Parts.

AUTHOR: National Steel and Shipbuilding Company.

DATE: August 1989

ABSTRACT: Shipyard painting is most often viewed as pure ship construction operations, where the painting of the hull, deck, superstructure, and cargo spaces make up the total effort and cost. This view may be justified when analyzing various trade production costs as parts of the total ship cost. However, parts preparation and painting costs are significant when looked at in summary as a new construction or repair contract sub-cost item. (46 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: Painting of small parts, automated painting

NSRP 0295

UMTRI 79328

TITLE: Development of Standard Procedures for Shipboard Paint Inspection.

AUTHOR: Thomas Radakovich.

DATE: September 1988

ABSTRACT: The use of protective coatings is a common method of corrosion control in the marine industry. To ensure that these coatings remain intact and effective, they must be inspected periodically so that damaged areas are discovered and repaired. Currently there are no widely accepted standard methods for shipboard inspection of anti-corrosive coating systems. The Navy, the Maritime Administration, and the shipbuilding industry co-sponsored a program directed at standardizing the methods used for shipboard inspection of coating systems and for reporting inspection data. The output of this program was the development of four inspection standards for different ship areas. These four standards have been adopted by the American Society for Testing and Materials (ASTM) as ASTM standards. This report discusses the development of these inspection standards. (146 p.)

KEYWORDS: Painting of small parts, shipboard paint inspection

NSRP 0302

UMTRI 80448

TITLE: The Economics of Shipyard Painting Phase II, Bid Stage Estimating.

AUTHOR: National Steel and Shipbuilding Company.

DATE: December 1988

ABSTRACT: This document is the result of Phase II of a three phase project and presents a generic bid estimating program which calculates bids for painting work in shipyards. The program also maintains historical data for past contract comparisons. This follows work performed in Phase I that identified the actual tasks and costs associated with paint department work. (83 p.)

KEYWORDS: Painting, estimating, surface preparation and coating

NSRP 0303

UMTRI 80449

TITLE: Benefit Analysis of SPC Panel SP-3 Projects and Evaluation of SPC Panel SP-3 Management and Administration.

AUTHOR: National Steel and Shipbuilding Company.

DATE: July 1989

ABSTRACT: This is a survey and analysis of the benefits that has accrued from the projects sponsored by SP-3 since 1974, and how the management and administration of

SP-3 is seen by the using community. The purpose of this survey was to determine the types of SP-3 projects that have been most beneficial, to determine the types of SP-3 projects that are most likely to be beneficial in the future, and to determine how the direction of SP-3 might be improved. (71 p.).

KEYWORDS: Surface preparation and coating, history, project benefits,

NSRP 0306

UMTRI 80451

TITLE: Corrosion Protection by Calcite-Type Coatings.

AUTHOR: National Steel and Shipbuilding Company.

DATE: October 1989

ABSTRACT: This document presents the results of a study of the feasibility of applying calcite-type coatings to segregated seawater ballast tanks. The purpose of studying these types of coatings is to substantially reduce corrosion in segregated seawater tanks. (39 p.)

KEYWORDS: Surface preparation and coating, corrosion, painting

NSRP 0307

UMTRI 80452

TITLE: Abrasive Contaminants and Their Effect on Coating Performance.

AUTHOR: National Steel and Shipbuilding Company.

DATE: January 1990

ABSTRACT: This study characterizes eight commercially available abrasive products for the water lechate conductivity, chloride and sulfate content and their effect on rust-back and coating performance in ambient and pressurized deionized water immersion. Four copper slag product were examined petrographically to identify the minerals in the slag particles and to determine if free copper was present. Scanning Electron Microscopy - Energy Dispersive X-Ray Fluorescence (EDXRF) analysis was used to identify slag constituents. (30 p.)

KEYWORDS: Abrasive contaminants, coating, copper slag products, scanning electron microscopy, energy dispersive x-ray fluorescence

NSRP 0308

UMTRI 80453

TITLE: Evaluation of Smoke Extraction Systems vs. Ventilation in Shipbuilding and Repair.

AUTHOR: National Steel and Shipbuilding Company.

DATE: January 1990

ABSTRACT: This reports' evaluations found that the costs associated with the currently applied methods of ventilation are documenting systems with at best 30-40 percent of

NSRP BIBLIOGRAPHY

"true-source" ventilation or extraction of welding fumes. Thus, the direction of the conclusions and recommendations are structured to the truer overall objective which is to have an increased level of source ventilation or extraction, including improved methods for both, as well as to depict areas for reducing costs for any level or type of service. (108 p.)

KEYWORDS: Smoke extraction, ventilation systems

NSRP 0309

UMTRI 80454

TITLE: Impact of V.O.C. Regulation on Shipbuilding and Ship Repair.

AUTHOR: National Steel and Shipbuilding Company.

DATE: January 1990

ABSTRACT: This study investigated the impact of two new volatile organic compound (VOC) regulations on the U.S. Shipbuilding industry. These new regulations, the first aimed specifically at the protective coating of ships and other marine structures, have potentially widespread effects on many facets of the industry including raw material suppliers and coatings manufacturers as well as end users. (167 p.).

KEYWORDS: Volatile organic compound regulations, environment

NSRP 0311

UMTRI 80456

TITLE: Performance Testing of Marine Coatings: New Test and Evaluation Procedures.

AUTHOR: National Steel and Shipbuilding Company.

DATE: June 1990

ABSTRACT: Since there are environmental and health restrictions on conventional marine coatings, there is an urgent need for reliable short-term procedures to evaluate performance and durability of coatings for ship tank exteriors and other exposed surfaces in marine environments. Currently used methods are considered inadequate. Long-term immersion or outdoor tests, though generally reliable, are much too time-consuming for today's regulatory timetable. Commonly used accelerated test methods produce results in a short time frame (1-4 months) but have been shown to give poor reproducibility and poor prediction of long-term service performance. (86 p.)

KEYWORDS: Corrosion, surface preparation, testing/measures

NSRP 0312

UMTRI 80457

TITLE: Evaluation of New Surface Preparation and Coating Repair Techniques in Ballast Tanks.

AUTHOR: National Steel and Shipbuilding Company.

DATE: July 1990

ABSTRACT: Ship ballast tanks present special problems as concerns corrosion control. In addition, ballast tanks are one of the most costly areas in which to apply coatings in both new ship construction and ship maintenance. Being subjected to intermittent wet and dry cycles of aerated sea water places extreme demands on corrosion control methods. Harsh service environments are coupled with necessarily complex tank geometries, especially in Navy combatants with difficult accessibility. The SP-3 Panel of SNAME recognized these problems and formulated a series of research and development projects to investigate alternate, cost effective corrosion control solutions. (35 p.)

KEYWORDS: Surface preparation and coating, repair techniques, ballast tanks

NSRP 0313

UMTRI 80458

TITLE: The Cost Effectiveness of Flame Sprayed Coatings for Shipboard Corrosion Control.

AUTHOR: National Steel and Shipbuilding Company.

DATE: July 1990

ABSTRACT: Corrosion control takes up about 30 percent of the cost of maintaining ships. The maritime industry must respond by utilizing the most effective and economical methods of corrosion control available. Wire sprayed aluminum (WSA) has proven to be an effective corrosion control method for many shipboard applications. Data provided which will assist ship owners in comparing the cost of WSA coatings with selected representative paint systems regarding application, repair, and life cycle costs. This report also describes methods used to repair WSA and compare the life cycle cost of these coatings to conventional paint coating systems. This report also helps the user determine ship areas best suited for WSA. (161 p.)

KEYWORDS: Cost, corrosion control, flame sprayed coatings

NSRP 0316

UMTRI 82212

TITLE: The Economics of Shipyard Painting, Phase III.

AUTHOR: Gary Higgins and Steven Garlick.

DATE: October 1990

ABSTRACT: The purpose of this study was to develop a system for a paint department that could provide shop supervision with timely information concerning cost performance. Phase III shows that a labor system can be used to identify cost variances at an early stage to avoid cost overruns. Three areas were investigated in Phase III; lost time, abnormal conditions, and hotwork identification. (51 p.)

KEYWORDS: Shipyard painting, cost performance

NSRP 0329

UMTRI 82761

NSRP BIBLIOGRAPHY

TITLE: The Effect of Substrate Contaminantes on the Life of Epoxy Coating Submerged in Sea Water.

AUTHOR: Dr. Gerald Carl Soltz.

DATE: June 1991

ABSTRACT: The purpose of this project was to study the effects that contaminants, commonly occurring in the marine environment, have on epoxy coating systems. Three standard ballast tank coatings plus a clear epoxy coating were tested. Three chemicals and various size blasting grit particles were used as contaminants. Sea salt and sodium chloride were found to be much more detrimental to epoxy coatings, than was ferrous sulfate or the grit particles. (160 p.)

KEYWORDS: Epoxy coating, coating contamination, clear epoxy coating

NSRP 0332

UMTRI 82202

TITLE: Evaluation of New Surface Preparation and Coating Repair Techniques in Ballast Tanks Interim Report (Three Year Results). Techniques in Ballast Tanks Interim Report (Three Year Results).

AUTHOR: Associated Coating Consultants Inc.

DATE: May 1991

ABSTRACT: This report details the interim results of a research and development program to investigate alternate cost effective corrosion control solutions. The report also includes the performance results of new approaches to surface preparation and coating repair techniques for preservation of in-service ships' ballast tanks using VOC compliant coatings after three years of testing. (23 p.)

KEYWORDS: Coating repair techniques, ballast tanks

NSRP 0341

UMTRI 82758

TITLE: Procedure Handbook for Shipboard Thermal Sprayed Coating Applications.

AUTHOR: Roger Snyder, Larry Shul and Les Hansen.

DATE: March 1992

ABSTRACT: This handbook is intended to guide a shipyard that is preparing to establish a first time thermal spray program that is in accordance with current U. S. Navy requirements. The second is to assist shipyards that are currently involved in an active thermal spray program by providing information and data that can be used to analyze and reassess their current methods, thus leading to potential improvements or cost savings. (191p.)

KEYWORDS: Coating, thermal spray, coating applications, repair procedures

PANEL SP 4: Design/Production Integration

NSRP 0122

UMTRI 70684-85

TITLE: Shipbuilding Design/Production Integration Workshop. Vol. I and II.

AUTHOR: Ship Production Committee Panel 4 (SP-4).

DATE: January 1981

ABSTRACT: This is a report of the proceedings of a Design/Production Integration Workshop held in Atlanta, Georgia, in January 1981. It was at this workshop that the need was identified for an industry wide approach to this subject. The formation of Panel SP-4 was also recommended for continued program direction in this area. (Vol I, 36 p.; Vol II, 36 p.)

KEYWORDS: Ship design, design/production integration

NSRP 0148

UMTRI 70683

TITLE: Design/Production Integration.

AUTHOR: Newport News Shipbuilding.

DATE: March 1982

ABSTRACT: This document reports the meeting minutes of the Design/Production Integration meeting which was held in March, 1982. This meeting was a follow-on to the January 1981, workshop. (80 p.)

KEYWORDS: Design/production integration

NSRP 0197

UMTRI 71620

TITLE: Software Tools for Shipbuilding Productivity.

AUTHOR: Grumman Data Systems Corp., for Newport News Shipbuilding.

DATE: December 1984

ABSTRACT: The objectives of this study are to define and identify software tools, and to impart to the shipbuilding community the knowledge to use them to aid in the design/production integration of the shipbuilding process. The material presented is followed by a catalog of software tools, and a recommended means of distributing results to the shipbuilding community. A glossary of acronyms is also included. There is no attempt made to specify currently in use, or projected hardware/software systems in either the computer, or CAD/CAM device arena. This task has been undertaken in approximately the same timeframe as this study by the CAD/CAM Survey Study performed by the Chicago-based IIT Research Institute which is reported separately. (250 p. approx.)

KEYWORDS: CAD/CAM, design/production integration, productivity

NSRP BIBLIOGRAPHY

NSRP 0236

UMTRI 73529-31

TITLE: Design for Production Manual. 3 Volumes.

AUTHOR: Bethlehem Steel Corporation, Sparrows Point, A and P Appledore Ltd, and J.J. Henry Co., Inc. for Newport News Shipbuilding.

DATE: December 1985

ABSTRACT: This manual is a collection of ideas and techniques involved with shipbuilding, all having the common directive of Design/Production integration. The manual structure and content were developed with representation from large and small shipyards, design agents, and the Maritime Administration to insure that the manual responds to identified needs. It has been produced in three volumes: Volume I - Concepts, Volume II - Design/Production Integration, and Volume III - The Application of Production Engineering. (859 p.)

KEYWORDS: Design/production integration

NSRP 0255

UMTRI 74897

TITLE: Product Work Classification and Coding.

AUTHOR: Todd Shipyards Corporation, Seattle, for Newport News Shipbuilding.

DATE: June 1986

ABSTRACT: For many years, group technology has been endorsed by shipbuilders as one of the cornerstones of the shipyard of the future. Tools for implementation of group technology work methods are essential for improvement in the shipbuilding industry because they make technology more accessible. This manual and the classification and coding system contained therein were developed to be used as tools. The manual discusses group technology and its application to shipbuilding. It presents a classification and coding system based upon the concepts of Product Work Breakdown Structure (with examples illustrating its use in manual and computer-aided formats), discusses subjects related to its use, and lists resources for further information. (200 p.)

KEYWORDS: Product work breakdown structure, group technology, classification systems

NSRP 0258

UMTRI 78695

TITLE: Specification-Driven Pipe Detail Design.

AUTHOR: Ingalls Shipbuilding, Inc. for Newport News Shipbuilding.

DATE: July 1989

ABSTRACT: Traditional Shipboard piping design begins with a piping system diagram. The piping system diagram is a drawing, at a level of detail which gives guidance and basic limiting parameters. Consequently, the detailed design products which follow may contain errors, unintended differences from—and contradictions to—the system level design specifications. This study was authorized to determine the feasibility and examine the

implications of creating a computer-controlled environment in which the system level design can be programmatically correlated to the detail design. The approach taken would be to create up-front, computer-resident sets of piping specifications and design rules. These sets would form the basis for computer software processes and checks, to ensure that detail design practices are not allowed to deviate from the intent of the system design. Performing piping design in such a computer-controlled environment has been titled "specification-driven design". (110 p.)

KEYWORDS: CAD/CAM, pipe design.

NSRP 0266

UMTRI 74886

TITLE: Computer Aided Process Planning for Shipyards.

AUTHOR: Bath Iron Works Corporation, for Newport News Shipbuilding.

DATE: August 1986

ABSTRACT: The future success of the U.S. shipbuilding industry depends on quantum leaps in productivity. The application of group technology (GT), process lanes, accuracy control, and Computer Aided Process Planning (CAPP) are essential ingredients to such productivity increases. Computer Aided Process Planning and its requirement to organize manufacturing data in a logical, structured manner has brought the shipbuilding industry back to the GT concept in the structural fabrication shop. The subdivision of a ship into manageable subsets of interim products, allows for the further grouping of interim products into families requiring similar manufacturing processes. This breakdown of parts into families is the tool that ultimately supports the effective implementation of a CAPP system. The introduction of CAPP to a shipyard brings with it a structured discipline that can result in a significant productivity increase. (400 p.)

KEYWORDS: Process planning, computer technologies, productivity

NSRP 0259

UMTRI 74880

TITLE: Implementation of Advanced Technology in the Shipbuilding Industry—Pilot Workshop Report.

AUTHOR: The University of Michigan for Newport News Shipbuilding.

DATE: April 1987

ABSTRACT: This report outlines the development of a pilot workshop on the dynamics of organizational response to advanced technology implementation for the U.S. shipbuilding industry, the tools that were utilized in executing the workshop design, and the lessons learned. The purpose of the workshop was to provide the process for management to gain a better understanding of the consequences of implementing advanced shipbuilding methods into the shipyards. The process used was based on industrial engineering and management science relevant to organizational change. In addition to the tutorial lectures, a series of working sessions is outlined, and recommendations are made for future workshops. (124 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: Ship production, organizational change, socio-technical, technology, quality control

NSRP 0274

UMTRI 77473

TITLE: Shipyard Engineering and Planning Organizations.

AUTHOR: Bath Iron Works Corporation.

DATE: August 1987

ABSTRACT: U.S. shipyards have recognized the advantages of zone-oriented production methods and are using them to some extent. This research study analyzes and compares current planning and engineering organizations in both U.S. and foreign shipyards. Based on the results of questionnaires and personal contacts with the shipyards, evaluations were made of the various organizations and their inherent strengths and weaknesses. From these results, a model organization was developed which is considered to be more efficient at providing zone-oriented design products directly to the production trades. (63 p.)

KEYWORDS: Zone construction, organizational change

NSRP 0285

UMTRI 78700

TITLE: Interface Impacts System to Zone Transition.

AUTHOR: Todd Pacific Shipyard Corporation for Newport News Shipbuilding.

DATE: May 1989

ABSTRACT: The productivity of the U.S. commercial shipbuilding industry has been analyzed and established as approximately half that of the leading foreign competition. In contrast, the productivity of the U.S. naval shipbuilding industry is not well documented. Methods used in constructing naval combatant ships need to be analyzed and evaluated so efforts to improve productivity can be focused on specific problems and opportunities. Technology transfer of the Ishikawajima-Harima Heavy Industries (IHI) System is generally directed towards commercial shipbuilding. Naval shipbuilding has far different constraints that impact producibility improvements during the design process and the construction of the naval ship. Todd Shipyards made a decision to implement one of the IHI principles, Zone Outfitting Methods (ZOFM), on an FFG Class Frigate and compare actual production information with that of an early ship (FFG-19) constructed in accordance with conventional shipbuilding methods. This report is a result of that study. (90 p.)

KEYWORDS: IHI, zone outfitting, productivity

NSRP 0286

UMTRI 78696

TITLE: Zone-Oriented Drawings for Life Cycle Management.

AUTHOR: Wilkins Enterprise, Inc. for Newport News Shipbuilding.

DATE: September 1988

ABSTRACT: This report records the results of a study conducted to determine whether the drawings being developed and used by shipbuilders using modern zone oriented (modular) construction techniques will satisfactorily meet the needs of each of the U.S. Navy's organizations having some type of responsibility in the Navy's life cycle maintenance management process. The question was raised because certain of these drawings are very different from the type of system-oriented drawings developed and used by shipbuilders in the past. The report provides recommendations for the type of information which must be provided in drawings of various types to best meet the needs of the life cycle management process. (52 p.)

KEYWORD: Zone-oriented design, life cycle management

NSRP 0293

UMTRI 80442

TITLE: The Information Flow Requirements for Integrating Schedules for Drawing Development and Equipment Procurement in Shipbuilding Programs.

AUTHOR: Newport News Shipbuilding Company.

DATE: June 1989

ABSTRACT: This report describes the principle purpose of work performed in order to develop tools that are necessary for integrating the schedules by which drawings are developed and equipment is procured in shipyards. (86 p.)

KEYWORDS: Drawing development, equipment procurement, scheduling

NSRP 0300

UMTRI 80446

TITLE: Advanced Measurement Techniques for U. S. Shipbuilding.

AUTHOR: National Steel and Shipbuilding Company.

DATE: March 1990

ABSTRACT: Modern shipbuilders have embraced the concept of modular construction and are realizing the gains in productivity associated with these methods. Further gains in productivity can be achieved if these modules can be built and erected "neat," that is, without the traditional excess material normally trimmed at erection. Construction of "neat" hull block requires rigid control of accuracy throughout the production cycle. Interim product from the fabrication of parts through the erection of hull block, must be carefully measured to strict tolerances to assure minimal rework. (125 p.)

KEYWORDS: Module construction, measurement techniques, measurement cost construction, advanced measurement techniques, measurement cost

NSRP 0319

UMTRI 82206

NSRP BIBLIOGRAPHY

TITLE: Investigation of the Application of Computer Aided Process Planning to Ship Modernization, Overhaul and Repair.

AUTHOR: H. L. Yound and M. R. Gluse

DATE: May 1991

ABSTRACT: The purpose of this study is to investigate and evaluate the use of Computer Aided Process Planning, the extension of Group Technology concepts, to ship repair and modernization. Industry experience has demonstrated that when computer-aided process planning is applied to a zone-based, product oriented work structure, significant cost savings can be realized. (75 p.)

KEYWORDS: Computer aided process planning (CAPP), overhaul, repair

NSRP 0323

UMTRI 82204

TITLE: Information Required from Planning Yards to Support Zone Logic.

AUTHOR: Richard Storch and L. D. Chirillo.

DATE: June 1991

ABSTRACT: This report has gathered information from planning yards on how to support zone logic. It recommends ways to improve the manufacturing system and how to develop generic strategies per ship class. Also discussed are the importance of establishing production engineering in planning yards and institute zone oriented design stages and the implementation of product oriented material management. The study recognizes planning yard activities as part of the manufacturing system. (93 p.)

KEYWORDS: Zone logic, planning

NSRP 0333

UMTRI 82209

TITLE: The Definition of a Shipyard's Engineering Requirements to be Met by a Design Agent.

AUTHOR: James Wilkins

DATE: July 1991

ABSTRACT: This report provides a generic listing of the requirements for a shipyard's engineering support contract. The generic list of requirements was developed in conjunction with eight shipyards and five design agents. The report details the goals, approach, and conclusions of the study. (41 p.)

KEYWORDS: Ship engineering requirements, ship design

PANEL SP 5: Human Resources Innovation

NSRP 0056

UMTRI 48976

TITLE: Study for the Improvement of Motivation in the Shipbuilding Industry.

AUTHOR: Dr. George A. Muench, for Newport News Shipbuilding and Dry Dock.

DATE: June 1976

ABSTRACT: Objective research in the area of employee motivation has contributed significantly to our knowledge of human behavior in business and industry. Many companies have discovered a more efficient utilization of their work forces through a deeper understanding of worker motivation provided by research. Although some of the motivational research may be applicable to industry in general, minimal research has been conducted concerning employee motivation directly within the shipbuilding industry. The research reported in this study is one attempt to determine motivation techniques existing in the shipbuilding industry and to recommend alternative procedures which may offer potential for increased worker job satisfaction and productivity. (174 p.)

KEYWORDS: Employee motivation, human behavior, job satisfaction

NSRP 0252

UMTRI 74894

TITLE: Problem-Solving Teams in Shipbuilding (Bethlehem Steel Corporation, Beaumont Yard).

AUTHOR: Bethlehem Steel Corporation.

DATE: November 1986

ABSTRACT: This report describes in detail the process involved at Bethlehem Steel Corporation's Beaumont Yard in developing and implementing an effective method of establishing problem-solving teams which can draw upon the knowledge of all shipyard employees. The process was modeled after the classic "quality circle" concept, employing major modifications adapted to the business conditions at Beaumont. (30 p.)

KEYWORDS: Quality Circles, employee involvement

NSRP 0254

UMTRI 74896

TITLE: Decentralizing Statistical Accuracy Control Responsibility to the Ship Production Workforce.

AUTHOR: National Steel and Shipbuilding Company, for Bethlehem Steel Corporation.

DATE: January 1987

ABSTRACT: This paper presents the organizational structure, methods and results of National Steel and Shipbuilding Company's efforts to decentralize the responsibility of statistical accuracy control from a central Accuracy Control Department to the hourly

NSRP BIBLIOGRAPHY

production workforce. It includes an accounting of the problems and successes encountered during implementation. The results are both quantitative and qualitative in form, including methods for measuring reductions in rework. (37 p.)

KEYWORDS: Accuracy control, statistical control

NSRP 0263

UMTRI 74881

TITLE: Gainsharing--Employee Involvement in a Shipyard/Assembly Yard.

AUTHOR: Kaiser Steel Corporation.

DATE: June 1987

ABSTRACT: This report describes and offers commentary on the process employed to accomplish the following objectives: to develop and test within a ship-building or ship-repair environment, one or more techniques of improving productivity through group sharing of consequent productivity gains. It was the first attempt ever documented of a gainsharing program in a product-oriented environment. The purposes of the project were to: 1) increase blue collar productivity by giving workers a voice in decision-making affecting their work; 2) provide a model productivity-enhancing employee involvement activity that can be adopted by other shipyards; and 3) offer a successful option to industries hesitant to change their management styles. (32 p.)

KEYWORDS: Productivity, gainsharing, problem-solving, employee involvement

NSRP 0264

UMTRI 77471

TITLE: Multi-Skilled Self-Managing Work Teams in A Zone Construction Environment.

AUTHOR: National Steel and Shipbuilding Company. Corporation.

DATE: August 1987

ABSTRACT: This report documents National Steel and Shipbuilding Company's (NASSCO'S) efforts to develop self-managing multi-skilled work teams. The objective of this effort was to develop and test a new production workforce organization corresponding to the technical requirements of product-oriented work breakdown structure, otherwise known as zone construction. (31 p.)

KEYWORDS: Zone construction, work teams

NSRP 0265

UMTRI 74884

TITLE: Organizational Innovations in Shipyard Safety.

AUTHOR: Peterson Builders, Inc., with Bethlehem Steel Corporation.

DATE: May 1987

ABSTRACT: This publication details the creation, within Peterson Builders, of a Safety Action Team using Quality Circle training and techniques. The report includes: policy guidelines, candidate selection, training, identification of problems and team projects. The results show the benefits of the Safety Action Team concept for any shipyard regardless of size or location. (38 p.)

KEYWORDS: Quality circles, safety

NSRP 0282

UMTRI 77481

TITLE: Employee Involvement and Work Redesign in U.S. Shipbuilding: Analytical Review.

AUTHOR: Cornell University for Bethlehem Steel Corporation.

DATE: April 1988

ABSTRACT: This report presents the results of a 1986 survey of innovations occurring within U.S. shipyards in the areas of human resources and manufacturing processes, commonly referred to as employee involvement and work redesign activities. It documents the nature of the economic challenge and the variety of responses chosen to meet that challenge within the shipbuilding industry and other industries facing similar pressures, in the U.S. and abroad. It begins with a general description of traditional shipyard organization. It then presents the industry's movement in the direction of a new, more flexible organizational design which better meets current economic demands. (77 p.)

KEYWORDS: Employee involvement, work redesign activities

NSRP 0283

UMTRI 77482

TITLE: Problem-Solving Teams in Shipbuilding (General Dynamics, Electric Boat Division).

AUTHOR: Win/Win Strategies and General Dynamics, Electric Boat for Bethlehem Steel Corporation.

DATE: May 1988

ABSTRACT: Abstract: The purpose of this report is to document General Dynamics Electric Boat Division's efforts in developing and implementing an effective method of establishing problem solving teams in the shipyard. The purposes of the project are several and include: increasing blue collar productivity by giving workers a voice in the making of decisions that affect their work; providing a model productivity-enhancing employee involvement activity which is transportable, in whole or in part, to other yards in the industry; and perhaps also piquing the curiosity of those in the industry who are hesitant to test or expand changes in management style. (19 p.)

KEYWORDS: Problem solving, employee involvement

NSRP 0296

UMTRI 80443

NSRP BIBLIOGRAPHY

TITLE: Product Oriented Workforce.

AUTHOR: Bethlehem Steel Corporation.

DATE: November 1989

ABSTRACT: This report represents documentation by General Dynamics Electric Boat Division to develop and implement a plan to achieve a multi-disciplined work force. The intent was to determine the mechanics of developing a work force in which employees have more than one skill, identify the skills, and skill levels, then determine the manner in which to assign those employees so their skills are optimally utilized. (17 p.)

KEYWORDS: Total quality management (TQM)

NSRP 0301

UMTRI 80447

TITLE: Employee Involvement/Safety.

AUTHOR: Bethlehem Steel Corporation.

DATE: June 1990

ABSTRACT: The purpose of this report is to document General Dynamics-Electric Boat Division's efforts in employing problem solving teams, under the leadership of union representatives, to improve safety performance, thereby reducing injuries to their personnel and the associated costs of medical treatment and claims due to occupational injuries and illnesses. Electric Boat was awarded a grant from the Human Resource Panel (SP-5) of the Ship Production Committee of the Society of Naval Architects and Marine Engineers (SNAME) to test, in a shipyard environment, the effectiveness of such problem solving teams in the safety area. (25 p.)

KEYWORDS: Employee involvement, safety

NSRP 0318

UMTRI 82207

TITLE: A Survey: The Principal Elements of Safety Program of Nine Major American Shipyards.

AUTHOR: Frank Long

DATE: January 1991

ABSTRACT: A questionnaire and the results thereof on health and safety programs at the following shipyards are contained in this report: Avondale, Bath Iron Works, Bethlehem Steel/Sparrows Pt, General Dynamics-Electric Boat, Ingalls Shipbuilding, Mare Island Naval Shipyard, National Steel and Shipbuilding Company, Newport News, Norfolk Naval Shipyard, Norshipco, Philadelphia Naval Shipyard, and Puget Sound Naval Shipyard. (43 p.)

KEYWORDS: Safety, training,

NSRP 0331

UMTRI 81923

TITLE: National Workshop on Human Resource Innovations in Shipbuilding/Ship Repairs.

AUTHOR: Frank Long

DATE: July 1991

ABSTRACT: This report details the proceedings of the workshop held October 16-18, 1990 at the Maritime Institute of Technology in Linthicum Heights, Maryland. Participants included representatives of private and public shipbuilding repair organizations, labor unions, universities, the United States Navy, Maritime Administration, and United States Government Agencies. (233 p.)

KEYWORDS: Human resource innovations, training

NSRP 0337

UMTRI 82199

TITLE: Employee Involvement - White Collar Work Force.

AUTHOR: Rodney Robinson

DATE: August 1991

ABSTRACT: This report details the investigation into the improvement of white collar productivity in a shipyard through employee involvement. Two functional areas of the host shipyard, electrical and structural (hull), were investigated through the use of Action Teams composed of both white-collar and blue-collar workers. The approach was (1) to improve communications in both directions, and (2) to strengthen working relationships among the groups represented on the teams. The teams met one hour per week for six months. This report explains the actions taken to set up and implement the action teams, and the advantages that can be gained by doing so.

KEYWORDS: Employee involvement, productivity

NSRP BIBLIOGRAPHY

PANEL SP 6: Marine Industry Standards

NSRP 0042

UMTRI 70714

TITLE: Propulsion Plant Feasibility Study Report - Subtask I - Forecast for Propulsion Plant Standards.

AUTHOR: M. Rosenblatt and Son, Inc., for Bath Iron Works.

DATE: June 1974

ABSTRACT: This report contains the commercial shipbuilding forecast for the Propulsion Plant Standards Feasibility Study and estimates the requirements for propulsion equipment installations by U.S. shipyards between 1975 and 1985. The results of this forecast indicated that the volume of shipbuilding was sufficient to warrant the application of propulsion plant standards. (42 p.)

KEYWORDS: Propulsion plants, standards, feasibility studies

NSRP 0046

UMTRI 70716

TITLE: Propulsion Plant Feasibility Study - Subtask II - Technical Analysis on Determination of Standards Candidates.

AUTHOR: M. Rosenblatt and Son, Inc., for Bath Iron Works.

DATE: January 1975

ABSTRACT: This report consists of a technical evaluation of the propulsion plants which reflect the requirements of the ships forecast to be ordered in U.S. shipyards in 1986. The main purpose of this task was to select viable standards candidates for further economic analysis. This reported noted that emphasis for standards on propulsion plants should be first placed on steam turbine and then diesels and gas turbines. The selection of standards for economic analysis was based on the potential savings to be expected from each of the following four groups of standards: Equipment Standards, including the main condensate pump, starting air compressor and main boiler; Total Plant Standards on two plant systems including a 26,000 SHP steam turbine and a 14,000 SHP medium speed diesel; "Equipment Envelope Standards" for a 26,000 SHP geared steam turbine. (200 p. approx.)

KEYWORDS: Propulsion plants, feasibility studies, steam turbines, gas turbines, standards

NSRP 0047

UMTRI 70717

TITLE: Propulsion Plant Feasibility Study Report - Subtask III - Economic Analysis of Selected Standards Candidates.

AUTHOR: M. Rosenblatt and Son, Inc., for Bath Iron Works.

DATE: February 1975

NSRP BIBLIOGRAPHY

ABSTRACT: This report contains the results of an economic analysis performed on four groups of standards relating to propulsion plants as recommended in Subtask II - Determination of Standards Candidates. The overall potential cost savings were predicted by using an economic analysis on the four groups of propulsion plant standards, and generalizing on the predicted savings of other similar standards in each group which were not economically analyzed. (200 p. approx.)

KEYWORDS: Propulsion plants, feasibility studies, standards

NSRP 0049

UMTRI 48961

TITLE: Executive Summary - Propulsion Plant Standards Feasibility Study.

AUTHOR: M. Rosenblatt and Son, Inc., for Bath Iron Works.

DATE: June 1975

ABSTRACT: This executive summary highlights the objective, recommendations, and conclusions of this feasibility study. (10 p.)

KEYWORDS: Propulsion plants, feasibility studies, standards

NSRP 0050

UMTRI 70715

TITLE: Ship Producibility Task S-1: Propulsion Plant Standards Feasibility Study.

AUTHOR: Ingalls Shipbuilding, for Bath Iron Works.

DATE: June 1975

ABSTRACT: The report supplements a major effort by M. Rosenblatt and Son, Inc., on the same subject. The major efforts of the report were to define and lay out four propulsion plants for a 150,000 dwt. tanker, including steam, medium speed diesel, heavy duty gas turbine, and an aircraft derivative gas turbine plant. Each of these four propulsion plants contains three levels of standards: a full description of the component by a data package; performance specification for overall components of a given size range; and standard procurement specification. This report also studies the cost differential by applying these three levels of standards to each propulsion plant and summarizes the merits of each type of proposed standard, the acceptability of the types of standards, and the approximate cost of developing the data for each type of standard. (100 p. approx.)

KEYWORDS: Propulsion plants, feasibility studies, standards, steam turbines, diesel plants, gas turbines, cost differentials

NSRP 0052

UMTRI 48962

TITLE: Final Report - Propulsion Plant Standards Feasibility Study.

AUTHOR: Ingalls Shipbuilding Division, for Bath Iron Works Corporation.

DATE: August 1975

ABSTRACT: The purpose of the study was to assess the technical feasibility and economic benefits and/or drawbacks of the development and implementation of propulsion plant standards. Emphasis was placed on reducing shipbuilding costs and delivery time in the United States by defining standards which could be useful to the maritime industry. (100 p. approx.)

KEYWORDS: Propulsion plants, feasibility studies

NSRP 0057

UMTRI 48971

TITLE: Standard Structural Arrangements.

AUTHOR: General Dynamics/Quincy, for Bath Iron Works.

DATE: July 1976

ABSTRACT: This report determined the value of standard structural arrangements and was to be used in reducing the cost of U.S. built ships by producing a series of standard structural arrangements. This report is divided into three sections: Structural Detail Guidelines, Misalignment Tolerance Guidelines, Tripping Bracket Guidelines. (250 p. approx.)

KEYWORDS: Standard structural arrangements, structural details accuracy control, tripping brackets

NSRP 0059

UMTRI 48958

TITLE: Executive Summary - Feasibility of Shipbuilding Standards.

AUTHOR: Bath Iron Works Corporation.

DATE: October 1976

ABSTRACT: This report summarizes findings and conclusions regarding the feasibility of a shipbuilding standards program. Conclusions are that standards already exist and are in use, but additional standards are needed. Recommendations include the development and support of a national shipbuilding standards program. (8 p.)

KEYWORDS: Standards, feasibility studies

NSRP 0061

UMTRI 48959

TITLE: Castine Report S-15 Project: Shipbuilding Standards.

AUTHOR: Bath Iron Works Corporation.

DATE: October 1976

ABSTRACT: This is a report on the proceedings of a workshop on the feasibility of developing national shipbuilding standards which was held in Castine, Maine, in June,

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1976. It was at this workshop that the need for a national coordinated effort for the development of shipbuilding standards was identified. (100 p. approx.)

KEYWORDS: Shipbuilding standards, feasibility studies

NSRP 0078

UMTRI 71146

TITLE: A Compendium of Shipbuilding Standards - Consolidated Pilot Phase Report.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: October 1978

ABSTRACT: One of the first studies to be done before commencing a coordinated national standards development effort was to identify those standards which existed and were being utilized by the industry. This report was a compendium of all existing standards which have applications in marine sectors. The objectives of this pilot phase were to design a catalog system, process a sample of U.S. and foreign standards, and analyze a sample number of standards for completeness, duplication, and conflict. (300 p. approx.)

KEYWORDS: Shipbuilding standards

NSRP 0082

UMTRI 71147

TITLE: Interim Report on Subtask I, Regulatory Body and Classification Body Shipbuilding Standards.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: 1979

ABSTRACT: This report is part of a three-subtask effort to review shipbuilding and other industrial standards for possible use in the National Shipbuilding Standards Program. This report catalogues existing shipbuilding standards which predominate U.S. shipbuilding. The three organizations whose standards are most commonly promulgated; the American Bureau of Shipping, the Maritime Administration, and the U.S. Coast Guard, are included in this report. (59 p.)

KEYWORDS: Shipbuilding standards

NSRP 0087

UMTRI 71149

TITLE: Interim Report on Subtask III, Foreign Shipbuilding Standards.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: March 1979

ABSTRACT: This report is part of a three-subtask effort to review shipbuilding and other industrial standards for possible use in the National Shipbuilding Standards Program.

This report is a compendium of foreign shipbuilding standards which are valuable for reference or are suitable for use in the United States. The report concludes that there are many ISO standards which are suitable for immediate use in the U.S. shipbuilding industry with little or no changes in the text of the standard. (150 p.)

KEYWORDS: Shipbuilding standards (foreign)

NSRP 0088

UMTRI 70718

TITLE: A Compendium of Shipbuilding Standards - Index to Shipbuilding Regulations and Standards.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: April 1979

ABSTRACT: This catalog of standards contains 2,580 entries from regulatory sources. These standards have been sorted in four ways: Organization, Ship Work Breakdown Structure, Recommended F-25 Subcommittee, and Subject. (600 p. approx.)

KEYWORDS: Shipbuilding standards, shipbuilding regulations, product work breakdown structure, SWBS

NSRP 0089

UMTRI 71148

TITLE: Interim Report on Subtask II, Industrial Standards in Shipbuilding Use.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: May 1979

ABSTRACT: This report is part of a three subtask effort to review shipbuilding and other industrial standards for possible use in the National Shipbuilding Standards Program. This report identifies industrial standards which are in use by the shipbuilding community and catalogues them by originating organization, by Ship Work Breakdown Structure (SWBS) number, by subject, and by the subcommittee of the ASTM Committee F-25 on Shipbuilding. (38 p.)

KEYWORDS: Standards (industrial), product work breakdown structure, ASTM

NSRP 0093

UMTRI 48960

TITLE: A Compendium of Shipbuilding Standards - Final Report.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: September 1979

ABSTRACT: This summary report outlines the results of the Compendium of Shipbuilding Standards. This summary report recommends a management system for the development of an integrated family of U.S. shipbuilding standards under ASTM Committee F-25 on

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Shipbuilding. This report also summarizes the charts and data tables from the Compendium with several recommendations made from reviewing these charts and tables. (44 p.)

KEYWORDS: Shipbuilding standards, ASTM

NSRP 0107

UMTRI 48968

TITLE: Weld Defect Tolerance Study.

AUTHOR: Dr. Leslie W. Sandor (Sun Ship), for Bath Iron Works.

DATE: June 1980

ABSTRACT: The objective of this project was to examine the possibility of decreasing the high cost of weld repair in commercial shipbuilding through the development and application of weld defect tolerance standards. A comprehensive survey was made of international literature and existing codes. In addition, quality control data was acquired from four major U.S. shipbuilders. The fitness-for-purpose philosophy represents an important advancement over present weld acceptance standards, which, in general, are much too conservative and workmanship-based. (124 p.)

KEYWORDS: Welding, weld defect tolerance, weld repair

NSRP 0108

UMTRI 48963

TITLE: National Shipbuilding Standards Program Status Report No. 1.

AUTHOR: Bath Iron Works.

DATE: June 1980

ABSTRACT: This first status report of the National Shipbuilding Standards Program covers activities from the origin of the Program in June, 1976 until June, 1980. The report includes information on the reactivation of Panel SP-6 and the formation of ASTM Committee F-25 on Shipbuilding Standards. (24 p.)

KEYWORDS: Shipbuilding standards program, ASTM

NSRP 0116

UMTRI 48963

TITLE: National Shipbuilding Standards Program Status Report No. 2.

AUTHOR: Bath Iron Works.

DATE: November 1980

ABSTRACT: The second status report of the National Shipbuilding Standards Program covers developments from July to November, 1980. This report covers the development of many SP-6 draft standards that were input into Committee F-25 for processing as National Shipbuilding Standards. (250 p. approx.)

KEYWORDS: Shipbuilding standards program, ASTM, status reports

NSRP 0126

UMTRI 48967

TITLE: Navy Weld Defect Tolerance Study.

AUTHOR: Dr. Leslie W. Sandor (Sun Ship), for Bath Iron Works.

DATE: March 1981

ABSTRACT: This study is a statistical analysis of quality control data collected from six major U.S. shipyards involved in naval ship construction. This analysis is confined to non-combatant naval vessels built out of mild steel only. The purpose of the study was to assess the significance of weld discontinuities with a view toward optimizing weld acceptance standards so as to minimize unnecessary weld repair. (30 p.)

KEYWORDS: Weld defect tolerance, quality control

NSRP 0133

UMTRI 48963

TITLE: National Shipbuilding Standards Program Status Report No. 3.

AUTHOR: Bath Iron Works.

DATE: November 1981

ABSTRACT: This document reports the status of the National Shipbuilding Standards Program from December, 1980 to November, 1981. Developments in this report include the publication of ten ASTM standards on shipbuilding and the incorporation of an ASTM F-25 standards into the U.S. Navy GENSPECS. (18 p.)

KEYWORDS: Shipbuilding standards program, ASTM, U.S. Navy GENSPECS

NSRP 0144

UMTRI 48966

TITLE: Recommended U.S. Shipbuilding Standards Program Long Range Plan - Final Report.

AUTHOR: IHI Marine Technology, for Bath Iron Works.

DATE: February 1982

ABSTRACT: While significant progress has been made during the preliminary phase of this program, it was the consensus of the program participants and other key industry representatives that expert assistance should be solicited to formally recommend a standards long-range plan for the U.S. shipbuilding industry. A plan that would include standard program goals, objectives, plans, priorities, and other necessary courses of action. With this background, IHI Marine Technology, Inc., an American subsidiary of Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI), Japan, was selected to perform the task as described above. The principal objective of this task is to present a written recommended long-range plan for the U.S. Shipbuilding Standards Program based upon

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the knowledge and experience of the Japanese shipbuilding industry, specifically, IHI. (230 p. approx.)

KEYWORDS: Shipbuilding standards program, long-range planning

NSRP 0160

UMTRI 48970

TITLE: Consensus QA/QC Acceptance Standards.

AUTHOR: Newport News Shipbuilding and Dry Dock Co., for Bath Iron Works.

DATE: November 1982

ABSTRACT: This report identifies areas where the development of consistent quality assurance/quality control (QA/QC) acceptance standards can benefit the U.S. commercial shipbuilding industry. This project is limited to commercial shipbuilding, overhaul, and repair; Naval shipbuilding is not addressed. (55 p.)

KEYWORDS: Quality control, acceptance standards, standards

NSRP 0161

UMTRI 70691

TITLE: Jigs and Fixtures Handbook Development.

AUTHOR: Bath Iron Works Corporation.

DATE: August 1982

ABSTRACT: This report was inadvertently included in the first edition of the *NSRP Bibliography of Publications* and has been withdrawn at the request of Bath Iron Works Corporation.

NSRP 0174

UMTRI 48969

TITLE: Feasibility Study for the Commercialization of U.S. Navy GENSPECS - 1982 Edition.

AUTHOR: John J. McMullen Associates, Inc., for Bath Iron Works.

DATE: July 1983

ABSTRACT: This report critically analyzes the imposed military and federal specification requirements in the U.S. Navy GENSPECS to determine the feasibility of converting to commercial standards. This report recommends over 285 commercial standards that could effectively replace the cited Navy standards in the GENSPECS, and recommends that this report be extensively reviewed by industry and NAVSEA to determine if these recommended standards could be implemented in lieu of the current military specifications. Copies available from SP-6. (124 p.)

KEYWORDS: Feasibility studies, U.S. Navy GENSPECS, standards (commercial)

NSRP 0212

UMTRI 72256

TITLE: Computerized Application of Standards.

AUTHOR: Newport News Shipbuilding

DATE: 1985

ABSTRACT: The computerized application of standards project successfully proved that MOST-developed standards could be applied by an existing computer-aided design system to eliminate manual application of standards. Several groups, including the Computer Center, Industrial Engineering, and Production Engineering, worked together to develop a computer program to apply standards to the pipe detail work package for the bending, fabricating, welding, and machining operations in the pipe shops. The implementation of this program into the computer-aided pipe detail design systems has resulted in improved accuracy and consistency of standards applications. (94 p. approx.)

KEYWORDS: Standards, Computer Aided Design (CAD)/Computer Aided Manufacturing (CAM), MOST

NSRP 0344

UMTRI 82757

TITLE: Marine Industry Standards Planning Workshop.

AUTHOR: Thomas Soik and Douglas Rusch

DATE: March 1992

ABSTRACT: This report is the proceedings of a Marine Industry Standards Planning Workshop. Twenty representatives from the shipbuilding industry and government met to formulate and coordinate a marine industry standardization process by improving the global competitive position of the U. S. shipbuilding industry. (71p.)

KEYWORDS: Standards

NSRP 0349

UMTRI 82574

TITLE: Balloting of Hull and Mechanical Standards.

AUTHOR: William O'Sullivan Associates

DATE: June 1992

ABSTRACT: This report involves the description of various hull and mechanical standards, their effectiveness, and reliability under Project P-52. A general idea on the improvement, or elimination of each standards listed can be drawn. There is an emphasis on the referencing of other standards and documents. (237p.)

KEYWORDS: Hulls, standards

NSRP 0354

UMTRI 82755

NSRP BIBLIOGRAPHY

TITLE: Standard Practice for the Selection and Application of Marine Deck Coverings.

AUTHOR: Joseph F. O'Donnell

DATE: July 1992

ABSTRACT: This project is intended for use as a guide to assist in product selection, writing specifications, determining budgetary costs, purchasing and installation of marine deck covering. Data sheets are provided that include description and features of the deck material, specification references, trade names and manufacturers. Budgetary cost coefficients, physical properties, applications methods, cautionary notes, warranty information and construction detail are included. A section of the various marine bodies of influence in the United States, as well as the International Maritime Organization (IMO), briefly describing their activities in the marine industry, has also been included. (305 p.)

KEYWORDS: Standards, marine deck coverings

PANEL SP 7: Welding

NSRP 0039

UMTRI 70793

TITLE: One Side Welding - Flux Development and Study of Multiple Arc Behavior.

AUTHOR: Linde Division of Union Carbide Corporation, Tarrytown, New York, for Bethlehem Steel, Sparrows Point.

DATE: 1974

ABSTRACT: One side welding in thicknesses up to 3/4 inch had been successfully performed at the time this study was performed, but there were no available American and European fluxes which could accommodate the higher currents and larger molten pool necessary for one pass welding of thicker plates. In addition to the flux problem, the proper control of arc behavior with separately powered multiple arcs was also a significant problem. This publication indicates that a one side welding flux and a set of operating parameters were both successfully accomplished. The report contains information relative to flux composition, base material type and thickness, number, type and size of weld wires, type of current for each wire, volts, amps, travel speed and the mechanical properties of the welds achieved with the various combinations of fluxes and welding parameters. (126 p.)

KEYWORDS: Welding, one side welding, flux, multiple arc behavior

NSRP 0040

UMTRI 70330

TITLE: Development of Extended Length Continuous Wire Feed System.

AUTHOR: Hobart Brothers, Troy, for Bethlehem Steel, Sparrows Point.

DATE: May 1974

ABSTRACT: The objective of this project was to develop a semi-automated welding system with appropriate hardware to permit an operator to weld over 200 feet away from the source of both power and electrode with a gun and cable light enough to provide flexibility comparable to that of manual welding with stick electrode. The publication claims to have accomplished the objective, based on field tests made by Hobart Brothers Company and Bethlehem Steel's Sparrows Point Shipyard. (128 p.)

KEYWORDS: Automatic welding, welding (wire feed)

NSRP 0041

UMTRI 70792

TITLE: Development of a Portable AC/DC Welding Power Supply Module.

AUTHOR: Celesco Industries, Inc., for Bethlehem Steel, Sparrows Point.

DATE: June 1974

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ABSTRACT: This publication describes the development of an AC/DC power supply capable of the following: supply 250 amps of welding current for AC-SMAW welding within that power requirement, provide a minimum DC welding current of 250 amperes of parallel connected with other modules to provide up to 1000 amperes DC for SMAW and SAW, and the primary module or combination of the primary module to be designed to support shipyard production welding. This program was partially successful. (75 p.)

KEYWORDS: Welding machines, submerged arc welding (SAW)

NSRP 0044

UMTRI 70791

TITLE: Applicability of Laser Welding to Ship Production, Volume I.

AUTHOR: United Aircraft Research Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: August 1974

ABSTRACT: The objective of this project was to determine the present state of the art concerning laser applications to welding and curing processes with a view toward adapting this new technology to shipyard production operations. The results of this feasibility study appear to warrant further investigation of the laser welding parameters in greater depth. Destructive and non-destructive tests and analysis of the results clearly indicate that laser welding can meet shipbuilding specifications. (51 p.)

KEYWORDS: Welding (laser), laser welding

NSRP 0048

UMTRI 70337

TITLE: Toughness Evaluation of Electroslag and Electroslag Weldments.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: March 1975

ABSTRACT: These high deposition, more uniform and better appearing welds are achieved primarily by higher heat input and slower travel speed and at substantially lower cost than shielded metal arc welding. Unfortunately, these same attributes adversely affect the toughness properties of the weld and the heat affected zone (HAZ). The primary objective of the program was to develop a basis for relaxing some of the then current limitations on the applicability of these processes to commercial shipbuilding. Results of the program indicate several areas of information which should prove helpful in developing technology to extend the use of these processes in commercial shipbuilding. The information contained in this publication is pertinent and applicable today in commercial shipbuilding. (130 p. approx.)

KEYWORDS: Electrogas welding, electroslag welding, toughness properties, heat affected zones (HAZ)

NSRP 0051

UMTRI 70336

TITLE: Applicability of Firecracker Welding to Ship Production.

AUTHOR: Battelle-Columbus Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: July 1975

ABSTRACT: The objective of this project was to develop the procedures, facility requirements, consumables and general specifications for the application of firecracker welding to shipyard fabrication. Based on a list of fifteen constraints regarding the results of this study, firecracker welding is considered a workable procedure for use in shipyards. (120 p.)

KEYWORDS: Firecracker welding, welding (firecracker)

NSRP 0054

UMTRI 70318

TITLE: Plasma Processes of Cutting and Welding.

AUTHOR: Linde Division of Union Carbide Corporation, Tarrytown, New York, for Bethlehem Steel, Sparrows Point.

DATE: February 1976

ABSTRACT: This program was concerned with applying to the shipbuilding industry the latest technology in high speed shape cutting machines, plasma welding and plasma cutting. The following objectives have been accomplished as set forth in the original proposal: establish cutting conditions for alloys and thicknesses representative of an ABS steel ship; calculate cutting costs based on cutting conditions, known consumable usage rates, and representative labor costs; compare plasma cutting costs to those for standard and high speed oxy-gas cutting nozzles on a cost-per-foot basis; visit several shipyards to determine potential plasma cutting and welding applications, and investigate the mechanism of dross formation in plasma cutting of mild steel; and establish general guidelines for reducing dross formation by studying the influence of plate chemistry, surface condition and process parameters. This report presents the results of those investigations. (83 p.)

KEYWORDS: Plasma welding, plasma cutting, shape cutting machines, dross formation

NSRP 0062

UMTRI 70338

TITLE: Development of an All Position Automatic Welding Machine.

AUTHOR: M. T. Gilliland Company, for Bethlehem Steel, Sparrows Point.

DATE: December 1976

ABSTRACT: The objective of this project was to develop a welding machine capable of making continuous fully automatic welds on traverse butt joints economically any place on the shell of a ship. The objective was accomplished by the development of a machine capable of propelling and controlling the welding heads. This publication describes this machine. (88 p.)

KEYWORDS: Welding machines, automatic welding, butt welds

NSRP BIBLIOGRAPHY

NSRP 0063

UMTRI 70327

TITLE: High Metal Deposition Per Ampere.

AUTHOR: Linde Division of Union Carbide Corporation, for Bethlehem Steel, Sparrows Point.

DATE: 1977

ABSTRACT: The objective of this program was to evaluate a number of commercially available "high metal deposition per ampere" welding materials and processes. In addition to the evaluation of commercially available processes, several experimental high deposition efficiency electrodes were evaluated. All materials and processes are being considered for their potential use in shipyards. The effective utilization of these systems/materials is the key to their successful application for specific weld joints. (38 p.)

KEYWORDS: Welding materials, electrodes

NSRP 0072

UMTRI 70332

TITLE: High Metal Deposition Welding, Volume I and II (Expanded version of NSRP 0063).

AUTHOR: TAPCO International, for Bethlehem Steel, Sparrows Point.

DATE: December 1978

ABSTRACT: The objective of this project was to develop a machine capable of utilizing the process of automatically dispensing iron powder in a butt weld joint welded from one side with ceramic backing. The machine must be able to pass through a 10 x 4 inch opening. The objective was accomplished and this publication describes the development of the machine and the welding procedure developed for the machine. (51 p.)

KEYWORDS: Metal deposition, iron powder, butt welds, backing strips

NSRP 0080

UMTRI 70794

TITLE: Dynamic Tear Test Correlation with Explosion Bulge Test at the Same Temperature.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: January 1979

ABSTRACT: Dynamic Tear Test (DT) performance of weldments was compared to explosion bulge test performance at the same temperature. The applicable sections in the report "Toughness Evaluation of Electroslag and Electrogas Weldments" were revised to include the additional data and analysis for a further toughness estimate. (33 p.)

KEYWORDS: Tear tests, dynamic tear tests, explosion bulge tests, electroslag welding, electrogas welding, toughness, welding

NSRP 0083

UMTRI 70341

TITLE: Investigation of Welding Processes for Low Temperature Applications.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: January 1979

ABSTRACT: The primary objective of this project was to evaluate and determine the lower temperature limits of satisfactory explosion bulge performance of the Manual Metal Arc (MMA) and Submerged Arc (SAW) weldments of Grade CS and EH 36 material with a view toward determining their usefulness for low temperature service applications. (28 p.)

KEYWORDS: Submerged arc welding (SAW), explosion bulge tests

NSRP 0085

UMTRI 70335

TITLE: Applications of Plasma Arc to Bevel Cutting.

AUTHOR: Hypertherm, Inc., for Bethlehem Steel, Sparrows Point.

DATE: 1979

ABSTRACT: This report describes the plasma process for bevel cutting including the following: types and use of equipment, techniques for square cutting, single, double and triple torch beveling, environmental considerations, and economics. (62 p.)

KEYWORDS: Plasma welding, plasma cutting, edge preparation,

NSRP 0086

UMTRI 70329

TITLE: Mechanized Gas Metal Arc Welding of Light Plate.

AUTHOR: M. T. Gilliland Company, for Bethlehem Steel, Sparrows Point.

DATE: February 1979

ABSTRACT: The objective of this project was to develop a prototype mechanized gas metal arc welding machine complete with motorized carriage, torch holders and related accessories to consistently and reliably weld butts and fillet welds on mild steel and aluminum sheets ranging from .119 to .188 and plates ranging from .188 to .625. This report describes the machine's specifications, design, operational tests, and the results of those tests. (49 p.)

KEYWORDS: Welding machines, gas metal arc welding, fillet welds

NSRP 0095

UMTRI 70334

TITLE: Applicability of Laser Welding to Ship Production, Volume II.

NSRP BIBLIOGRAPHY

AUTHOR: United Aircraft Research Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: December 1979

ABSTRACT: This report describes an experimental laser welding investigation which was conducted on ship steel and was directed toward evaluation of practical aspects of laser welding in a shipyard environment. This was a follow on program to previous flat position laser welding tests carried out under optimum joint cleanliness and fitup conditions. In this program, welds were formed with non-perfect fitup between plasma cut surfaces and between surfaces deliberately mismatched to provide a varying joint gap, and under out of position welding conditions. (25 p.)

KEYWORDS: Welding (laser), laser welding, welding tests, flat position welding

NSRP 0099

UMTRI 70344

TITLE: Property and Productivity Improvements in Electroslag and Electrogas Welding.

AUTHOR: Material Sciences Northwest, Inc., for Bethlehem Steel, Sparrows Point.

DATE: January 1980

ABSTRACT: This report describes automatic vertical welding in the electroslag and electrogas modes with the addition of powdered metal filler. Flux-cored and metal powder cored electrodes were evaluated in both modes are presented. Also weldment mechanical properties for procedures employing metal powder filler are given. (96 p.)

KEYWORDS: Welding (automatic), electroslag welding, electrogas welding, automatic welding

NSRP 0110

UMTRI 70346

TITLE: Ceramic Weld Backing Evaluation.

AUTHOR: Offshore Power Systems, for Bethlehem Steel, Sparrows Point.

DATE: June 1980

ABSTRACT: The objective of this program was to establish if ceramic tiles backing in flux cored arc welding (FCAW) and submerged arc welding (SAW) butt weld applications could provide visually acceptable weldments such as welded back side contours requiring no cosmetic grinding repair, and volumetrically acceptable weldments requiring no grinding and welding repair. (104 p.)

KEYWORDS: Backing strips, flux core arc welding (FCAW), submerged arc welding (SAW)

NSRP 0112

UMTRI 70345

TITLE: The Development of a Composite Consumable Insert for Submerged Arc Welding.

AUTHOR: IIT Research Institute, for Bethlehem Steel, Sparrows Point.

DATE: August 1980

ABSTRACT: The objective was to develop a joint design and modified submerged arc welding process that would enable full penetration welding from one side. The modified process would eliminate that need for repositioning of the plate. The concept devised was to develop a flux filled composite wire structure that could be used as a preplaced insert or backing strip to support the molten puddle during welding and enable formation of a sound root area reinforcement. As a backing strip, the composite could be easily removed after welding by light grinding. (17 p.)

KEYWORDS: Submerged arc welding (SAW), one side welding, backing strips, inserts

NSRP 0113

UMTRI 70340

TITLE: Extension of E7024 Electrode Application in Shipbuilding.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: August 1980

ABSTRACT: The primary objective of this project was to determine the extent to which use of AWS type E7024 electrodes could be broadened in regard to fillet welding applications with particular emphasis on single pass fillet welding. The secondary objective was to determine the extent to which use of AWS E7024 electrodes could be broadened in regard to unlimited use for fillet and butt welding in Grades A, B, D, DS, AH and DH steels. (39 p.)

KEYWORDS: Electrodes, fillet welds, butt welds

NSRP 0118

UMTRI 70333

TITLE: Self-Shielded Flux-Cored Wire Evaluation.

AUTHOR: Offshore Power Systems, for Bethlehem Steel, Sparrows Point.

DATE: December 1980

ABSTRACT: The primary objectives of this project were to evaluate the state-of-the-art adaptability of gasless flux cored wire to the shipyard environment and to evaluate the deposited weld metal mechanical and toughness properties. A secondary objective was to provide a measure of process cost evaluation via a deposition rate comparison between gasless and flux cored wires and E7108 electrodes in flat and vertical positions. (95 p.)

KEYWORDS: Electrodes, welding, toughness, flux-cored wire, flux core arc welding, flat position welding, vertical welding

NSRP BIBLIOGRAPHY

NSRP 0121

UMTRI 70342

TITLE: Proceedings of First Conference on Fitness-For-Service in Shipbuilding.

AUTHOR: Leslie W. Sandor, ed.

DATE: January 1981

ABSTRACT: This report contains the proceedings of the conference on Fitness-for-Service in Shipbuilding sponsored by SP 7. The purpose of the conference was to generate U. S. shipbuilding policy on New Weld Acceptance Standards. Included are synopses of the 14 speakers' addresses to the conference, conclusions and recommendations, and a list of conference delegates. (62 p.)

KEYWORDS: Welding, weld defect tolerance, standards

NSRP 0145

UMTRI 70339

TITLE: SMAW Ceramic Weld Backing Evaluation - Final Report.

AUTHOR: Offshore Power Systems, for Newport News Shipbuilding.

DATE: March 1982

ABSTRACT: Representative ceramic weld backing systems were evaluated with several SMAW process variations to determine their efficacy to produce volumetrically sound root beads and visually acceptable back bead weld contours not requiring consequent back side welding or repair. Ceramic tile backing was found to bring the use of open root, low hydrogen SMAW within the realm of practicality. Operator training and/or retraining was found to be especially critical. Special technique considerations were necessary to assure soundness in restart areas. Chevron porosity and piping was much less frequent than in FCAW. Ceramic tile backing was additionally found promising with cellostic type (i.e., E6010) electrodes. Promising joint designs, parameters and techniques were identified for SMAW over ceramic backing. (56 p.)

KEYWORDS: Submerged arc welding (SAW), backing strips, electrodes, root beads, weld contours

NSRP 0166

UMTRI 70324

TITLE: Acceptance Standards for Nondestructive Test Not Required by Classification - Phase I.

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: March 1983

ABSTRACT: The objective of Phase I of the project was to determine the quality of welds in existing ships that had proven satisfactory and use this information as a basis for developing appropriate guidance for nondestructive testing criteria for locations outside classification requirements. The quality of submerged arc (SAW) deck welds in 18 ships

built between 1943 and 1973 were evaluated by ultrasonic inspections. Their relationship to an existing ABS Rule and a tentative guideline were determined. (20 p.)

KEYWORDS: Standards, submerged arc welding (SAW), non-destructive testing

NSRP 0168

UMTRI 70343

TITLE: Visual Reference Standards for Weld Surface Conditions, Phase I.

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: April 1983

ABSTRACT: Samples were produced illustrating three types of weld surface conditions at three levels of severity in butt and fillet welds. The samples can be related to existing descriptive acceptance standards used in the marine industry, and could form the basis for a guide for the evaluation of weld surface conditions which could be applicable to various structural and pressure vessel requirements of the marine industry. The use of such illustrations, replicated as plastic models, could reduce the frequency of making physical measurements of weld surface conditions, and also reduce the subjective considerations in evaluating weld surfaces. This phase of the project covers the conditions of cluster porosity, scattered porosity, and undercut. (31 p.)

KEYWORDS: Butt welds, fillet welds, weld surface conditions, standards (visual), plastic models, porosity

NSRP 0173

UMTRI 70607

TITLE: Study Mission to Japan - Trip Report.

AUTHOR: Bruno L. Alia, Benjamin C. Howser, C. L. Null, and R. K. Richie.

DATE: July 1983

ABSTRACT: This report presents the observations of four members of the SNAME/SPC Welding Panel SP-7 during a study mission to Japan to investigate welding and welding technology in Japanese shipyards. (77 p.)

KEYWORDS: Welding technology (Japan), Japanese shipyards

NSRP 0182

UMTRI 70252

TITLE: Unimation "Apprentice" Welding Robot for Shipyard Application.

AUTHOR: Todd Pacific Shipyards Corporation, Los Angeles Division, for Newport News Shipbuilding and Dry Dock.

DATE: December 1983

ABSTRACT: The overall objective of this study was to evaluate the applicability of the portable Unimation Apprentice Welding Robot for the shipbuilding industry. This

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evaluation was then to serve as a guide for introducing this technology into shipbuilding with an expected increase in productivity. The anticipated result was to have a base of information which shipbuilders might use to further the application of flexible welding automation in shipbuilding. Unfortunately, because of events discussed in this report, the planned progress to meet the objectives experienced setbacks. The SP-7 Panel therefore thought it best to cancel this study before the objectives could be reached. (42 p.)

KEYWORDS: Welding machines, automatic welding, flexible automation, automation, Unimation Apprentice Welding Robot, robots

NSRP 0183

UMTRI 70253

TITLE: Cincinnati Milacron T³ Robot for Shipbuilding Welding.

AUTHOR: Todd Pacific Shipyard Corporation, Los Angeles Division, for Newport News Shipbuilding and Dry Dock.

DATE: January 1984

ABSTRACT: The purpose of this report is to aid in the formulation of laboratory programs reflecting customer's needs, and effectively communicate the considerations/issues to appropriate levels of management. This report documents the rationale for strong/weak points, deficiency notices, and offers what is believed to be an improvement in reference to operational performance of the robot and its work station (compliance with functional requirements), and degree of usefulness of the arc welding robot system in the shipbuilding industry. (79 p.)

KEYWORDS: Robots, automatic welding, Cincinnati Milacron T³ Robot, welding

NSRP 0184

UMTRI 70251

TITLE: Out-Of-Position Welding of 5000 Series Aluminum Alloys Using Pulse GMAW Power Sources.

AUTHOR: Todd Pacific Shipyard Corporation, Seattle Division, for Newport News Shipbuilding and Dry Dock.

DATE: January 1984

ABSTRACT: This report describes the weld test work conducted during the development of welding procedure qualification data, welding techniques and welding procedure specification relative to full penetration, one-side, out-of-position, manual pulsed gas metal arc butt welding of 5000 series aluminum alloy sheets and plates for maritime fabrication. (332 p.)

KEYWORDS: One side welding, out-of-position welding, gas metal arc welding (GMAW), aluminum alloys

NSRP 0195

UMTRI 71457

TITLE: Study of Fitting and Fairing Aids of U.S. Shipyards.

AUTHOR: Todd Pacific Shipyard Corporation, Los Angeles Division, for Newport News Shipbuilding.

DATE: August 1984

ABSTRACT: This document is an attempt to list and categorize fitting and fairing aids used in the U.S. shipbuilding industry. It also provides implementation rationale for a select group of aids which are considered highly effective. This document was written for shop and area managers, foremen, and engineers interested in methods and devices for handling, fitting, and fairing problems developed by their counterparts throughout the industry. The need for greater accuracy, and the reduction for the need of these methods, must be emphasized. Fitting and fairing must be performed to increase production, and this can be achieved through the use of fitting to support welding, and by avoiding dependence on welding to compensate for inaccurate fitting. (55 p.)

KEYWORDS: Fitting, fairing, welding, fixtures

NSRP 0209

UMTRI 72024

TITLE: Higher Strength Steels Specially Processed for High Heat Input Welding.

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: February 1985

ABSTRACT: A study was completed to test improved head affected zone (HAZ) toughness characteristics of ABS Grade EH36 steel plates welded with electroslag high heat input welding processes. It was found that ABS Grade EH36 steel plates specially formulated and produced with advanced metallurgical techniques have significantly greater resistance to weld heat affected zone degradation than conventional EH36 steel plates. Welds made in ABS Grade EH36 steel with electroslag welding at high heat input rates retained adequate toughness in the heat affected zone at -4 degrees F (-20 degrees C). Similar welds in conventional EH36 steel exhibited excessive HAZ toughness loss. These conclusions were confirmed on the basis of Charpy V-notch and large scale explosion bulge testing. In view of their superior resistance to HAZ degradation, ABS Grade EH36 steels should be useful for applications where HAZ degradation is of concern, such as for ABS, Coast Guard, and International Maritime Organization (IMO) weld requirements for Liquefied Natural Gas Carriers. (53 p.)

KEYWORDS: Welding, metallurgy, electroslag, testing, toughness, heat affected zones (HAZ), plates, high-strength steel

NSRP 0211

UMTRI 72089

TITLE: Evaluation of an Automatic Seam Tracking/Adaptive Control Welding System for Shipyard Applications - Phase 1 Report.

AUTHOR: General Dynamics, Electric Boat Division, for Newport News Shipbuilding.

DATE: February 1985

NSRP BIBLIOGRAPHY

ABSTRACT: An automatic seam tracking/adaptive control welding system, the M-1000, was evaluated by weld testing, using the vertical position high heat input pulsed gas metal arc welding process. During the course of the evaluation period, numerous hardware and software modifications were made by the machine designer/builder, CRC Automatic Welding, in response to Electric Boat suggestions. Significant improvements were made in bead shape and size, and in the automatic selection of the type of bead required and in the parameters to use as a function of the prevailing groove technology. It was concluded that the through-the-arc concept of seam tracking/adaptive control used by the M-1000 was a viable technology, and potential savings in welding time may be possible if the M-1000 could be made competitive with current mechanized systems in terms of weld quality and bead size deposited. (82 p.)

KEYWORDS: Welding, pulse arc, automation, process control, testing

NSRP 0215

UMTRI 72706

TITLE: Acceptance Standards for Nondestructive Test Not Required by Classification (Phase II).

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: June 1985

ABSTRACT: The objective of Phase II was to determine the quality of manual welds made in the vertical position and additional automatic submerged arc welds made in the flat position, in ships that had proven satisfactory in service, and compare these results with those obtained in Phase I (automatic submerged arc welds made in the flat position). To accomplish this, ultrasonic examinations were made of side shell weld intersections in twenty ships built during the 1943-1976 period. (16 p.)

KEYWORDS: Non-destructive testing, standards, submerged arc welding (SAW)

NSRP 0220

UMTRI 73045

TITLE: Visual Reference Standards for Weld Surface Conditions (Phase II).

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: August 1985

ABSTRACT: Samples were produced illustrating three types of weld surface condition. Roughness and irregular contour samples were produced at three severity levels in butt and fillet welds; re-entrant angle samples of butt and fillet welds were produced illustrating various angles around 90 degrees. The samples could form the basis for a guide for the description and evaluation of weld surface conditions which could be applicable to various structural and pressure vessel applications. The use of such illustrations, replicated as plastic models, could reduce the frequency of making physical measurements of weld surface conditions, and also reduce subjective considerations in evaluating weld surface conditions. (19 p.)

KEYWORDS: Standards, butt welds, fillet welds, roughness, weld surface conditions

NSRP 0241

UMTRI 73751

TITLE: Investigation of Tubular Electrodes Designed for Submerged Arc Welding Applications - Final Report.

AUTHOR: Newport News Shipbuilding.

DATE: July 1985

ABSTRACT: The primary objective of this project was to evaluate the operating characteristics of flux core and metal core electrodes designed for use with the Submerged Arc Welding Process. The purpose is to describe the methods used to weld the test samples and to present the results of the physical and metallurgical tests performed in this research and development program. It covers the investigation of the operating characteristics of tubular welding electrodes designed for Submerged Arc Welding applications. Efforts were directed toward comparing the relative merits of tubular submerged arc welding electrodes as compared to solid submerged arc welding electrodes. (250 p.)

KEYWORDS: Tubular electrodes, flux core arc welding

NSRP 0253

UMTRI 74895

TITLE: Automatic Submerged Arc Welding With Metal Powder Additions to Increase Productivity and Maintain Quality.

AUTHOR: Newport News Shipbuilding.

DATE: June 1986

ABSTRACT: The focus of this report is directed toward the evaluation, testing, and qualification of Automatic Submerged Arc Welding (SAW-AU) with metal powder additions for shipyard use. The project consisted of both carbon steel and HY-80 test weldments using one-sided, double-bevel, and fillet joint designs at several heat inputs and powder-to-wire ratios. It was concluded that controlled metal powder additions are indeed a production concept that can reduce shipbuilding costs through increased deposition rates and reduced consumables costs, while at the same time, maintaining or improving quality. (149 p.)

KEYWORDS: Submerged arc welding, metal deposition

NSRP 0257

UMTRI 74887

TITLE: Consumable Guide Electroslag Welding of 4 to 24 Inch Thick Carbon Steel Castings.

AUTHOR: Newport News Shipbuilding.

DATE: August 1986

ABSTRACT: The focus of this project was directed toward the development, testing and qualification of consumable guide Electroslag Welding of carbon steel castings from 4 to 24

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inches in thickness. Consumable Guide Electroslag Welding is a high deposition rate welding process that is ideally suited for use on thick members. This process has increased resistance to hot cracking, porosity, and underbead cracking, and results in minimal angle distortion. Joint preparation and fitup requirements are simplified and result in high quality weld deposits. Non-destructive testing included magnetic particle and radiographic inspection. Destructive testing included tensiles, Charpy V-notch impacts, and side bends. It is concluded that the use of consumable guide Electroslag Welding is an efficient process for joining thick carbon steel castings when postweld heat treatment can be used to achieve acceptable mechanical properties. (160 p.)

KEYWORDS: Electroslag welding

NSRP 0261

UMTRI 77469

TITLE: Evaluation of the Usability and Benefits of Twist Wire GMAW and FCAW Narrow Gap Welding.

AUTHOR: Puget Sound-Naval Shipyard.

DATE: March 1988

ABSTRACT: Butt welding of thick plates with narrow gap fit-ups in lieu of conventional U-groove and V-bevel angles is recognized as one approach to reducing the time and cost of welding in shipbuilding. The use of multiple twisted filler wires as electrodes is found to overcome some of the problems of lack of side wall fusion and slag entrapment associated with single wire arc welding of narrow gap butt welds. The main objectives of this project were to 1) identify known problems which have caused other narrow gap processes to be nonproductive as well as new problems unique to the twist wire process or the shipbuilding industry; 2) identify the welding conditions that cause these problems so that the operating range which provides defect free welds can be identified; and 3) evaluate whether this range will be adequate to provide cost-effective welds in the non-optimum conditions found in the shipbuilding industry. (78 p.)

KEYWORDS: Gas Metal Arc Welding (GMAW), Flux Core Arc Welding (FCAW)

NSRP 0262

UMTRI 77470

TITLE: Evaluation of High Strength Steels Produced by Advanced Metallurgical Processes.

AUTHOR: American Bureau of Shipping.

DATE: September 1987

ABSTRACT: Newly developed high-strength steels produced by advanced steelmaking techniques and thermomechanical processing are shown to have toughness and weldability superior to those of conventionally heat-treated, quenched and tempered steels. The above was confirmed by small-scale toughness testing and by controlled thermal severity testing to determine heat-affected zone cracking susceptibility. Small-scale testing of shielded metal arc weldments was also conducted. In view of their superior toughness and weldability, these newly developed high-strength steels should be useful for applications

such as low-temperature ship service, offshore structure service especially in harsh environments, and as a potential replacement for HY80/100 steels. (54 p.)

KEYWORDS: High strength steel, welding tests

NSRP 0291

UMTRI 78697

TITLE: Tracking System for Automatic Welding—Phase II Improvement of Contact-Tip Life for Through-the-Arc Welding System.

AUTHOR: Ingalls Shipbuilding.

DATE: February 1989

ABSTRACT: In Phase I of this project (NSRP 0211), an automatic seam tracking /adaptive control welding system was evaluated and weld-tested using the high-heat, pulsed gas metal arc welding process. Phase I concluded with the finding that thru-the-arc seam tracking, with computer control and adjustment of welding parameters, was a viable technology. Potential savings in welding time would be possible if further development of hardware and computer software were achieved to more fully realize the potential of the system. Needed improvement in consistency of system response to changing conditions in the weld were recognized. The primary focus of Phase II was the development of weld head contact tips, which could function over longer periods of continuous welding without need for replacement due to wear. The results of this testing are the subject of this report. (29 p.)

KEYWORDS: Welding controls, gas metal arc welding, automatic welding

NSRP 0292

UMTRI 78694

TITLE: Evaluation of the Benefits of HSLA Steels.

AUTHOR: Ingalls Shipbuilding.

DATE: March 1989

ABSTRACT: The need for ships and oil well drilling equipment to operate in the extremes of polar climates has given emphasis to the need for high toughness, weldable steels. Important weight savings become available where designs currently use normalized, medium strength, low alloy steels. Significant cost savings become available if the new steels permit higher production weight welding in heavy fabrication. One of the objectives of this study was to procure plate sections of ASTM A710 steel in yield strength levels of 80 KSI and also ASTM A710 modified in chemistry to yield strengths of 100 KSI minimum yields. Plates over 5 inches thick in both strength levels were procured and welding was performed to evaluate producibility for shipbuilding and marine structures. Effects of high heat welding on heat affected zones toughness was of primary interest. (179 p.)

KEYWORDS: High strength steel, low alloy steel, HSLA steel, welding costs

NSRP 0297

UMTRI 80444

NSRP BIBLIOGRAPHY

TITLE: Evaluation of the Fillet Weld Shear Strength of Flux Cored Arc Welding Electrodes.

AUTHOR: Ingalls Shipbuilding Inc.

DATE: July 1990

ABSTRACT: This paper presents results of a research project conducted by the Welding Engineering Department at Ingalls Shipbuilding. The primary effort of this project was directed toward the development of shear strength data for flux cored arc (FCAW) welding electrodes. The current welding design document for U. S. Navy construction, MIL-STD-1628, does not include fillet weld shear strength values for this widely used process. Presently, the equivalent shielded metal arc (SMAW) welding electrode values are used for design purposes. (52 p.)

KEYWORDS: Welding, flux cored arc welding electrodes

NSRP 0299

UMTRI 80445

TITLE: Flame Bending of Pipe for Alignment Control.

AUTHOR: Ingalls Shipbuilding, Inc.

DATE: March 1990

ABSTRACT: The principles of flame straightening, long in use on plate structures in shipbuilding, have been applied to the problem of precision alignment of fluid system piping in shipbuilding and overhaul. Reduction of residual stresses by elimination of mechanically applied stresses to pipes for alignment prior to welding or bolting in place is a desirable objective. (165 p.)

KEYWORDS: Flame bending, pipe, carbon steel, copper nickel pipe

NSRP 0314

UMTRI 82759

TITLE: Fabrication Accuracy Through Distortion Control In Shipbuilding.

AUTHORS: Ron Besselievre and Lee Norton.

DATE: September 1990

ABSTRACT: The main objective of this project was to acquire and report empirical data on some of the distortion control are in use, but for which quantitative data is non-existent or difficult to find. (186p.)

KEYWORDS: Welding, accuracy, distortion control, weld distortion

NSRP 0326

UMTRI 82197

TITLE: High Yield Strength Cast Steel with Improved Weldability.

AUTHOR: Robin K. Churchill and Jack H. Devletian

DATE: May 1991

ABSTRACT: A number of very low-carbon, higher-nickel modifications of HY-80 and low-carbon modifications of HY-130 were produced and cast into test blocks. Heat treatment studies were performed and mechanical properties were evaluated. Weldability tests were also performed. The experimental alloys appear to be capable of meeting the mechanical property requirements of HY-80 in section thicknesses up to at least 12 in. (55 p.)

KEYWORDS: Welding, cast steel

NSRP 0336

UMTRI 82198

TITLE: Practical Guide for Flame Bending of Pipe.

AUTHOR: Frank Gatto

DATE: August 1991

ABSTRACT: This report sets forth the technology of flame bending of pipes in a format which will serve as a guide for shipyards to use in training personnel and in developing procedures specific to their own requirements. The information contained in this report should enable shipyard personnel to reach the state-of-the-art and to implement this technology with minimal cost and risk of error. (99 p.)

KEYWORDS: Flame bending, pipe fabrication

NSRP 0338

TITLE: Visual Reference Standards for Weld Surface Conditions and User's Guide for Weld Replicas Phase III.

AUTHOR: William Hanzalek, Dr. D.Y. Ku, and R.F. Waite.

DATE: September 1991

ABSTRACT: This project was directed to the production of three dimensional sample illustrations of weld surface conditions, applicable to visual weld inspections. This phase addresses the manufacture of the plastic weld replicas a distribution to the marine industry as reference standards for the evaluation fo weld surface conditions. (27 p.)

KEYWORDS: Welding, weld surfaces, standards,

NSRP 0339

UMTRI 82201

TITLE: Design and Planning Manual for Cost Effective Welding.

AUTHOR: Frank Gatto, Brian Lawlor, and Joyce McMillin.

DATE: October 1991

NSRP BIBLIOGRAPHY

ABSTRACT: The purpose of this manual is to assist in the successful construction of welded products by aiding individuals in: selecting readily weldable materials, providing suitable weldment design, assessing available fabrication resources and managing the construction environment. Basic information is contained within this manual to aid individual in making sound welding decisions. A basic approach for reviewing and accepting work by a fabricator is also provided with common pitfalls highlighted. Information about welding design, welding metallurgy, welding processes, and nondestructive testing is also included. (445 p)

KEYWORDS: Weldable material, welding design, fabrication

UMTRI 82200

NSRP 0343

UMTRI 82321

TITLE: Evaluation of Hitachi Zosen Portable Welding Robotics

AUTHOR: G. J. Blasko, D. J. Moniak, and B. C. Howser.

DATE: April 1992 -

ABSTRACT: In December 1992, a team representing U. S. private and public shipyards and the David Taylor Research Center was sent to observe the Hitachi Zosen robots in operation and complete a technical assessment. The robots' excellent productivity improvement due to their potential for 50 to 70 percent arc time, high deposition rates, and ease of operation and set-up is seen. The technical observation is addressed in this report. (51p.)

KEYWORDS: Robotics, welding, automation

PANEL SP 8: Industrial Engineering

NSRP 0053**UMTRI 70163****TITLE:** Ship Producibility as it Relates to Series Production. Volume I.**AUTHOR:** Ingalls Shipbuilding, for Bath Iron Works.**DATE:** January 1976

ABSTRACT: This study applied industrial engineering technology to the design and construction methods of a series of standard hull forms in order to develop economic models to maximize the cost savings benefits of series production of ships. The major conclusion was that design activities be tailored to output information which best supports planning and production with a minimum of wasted effort. Extensive liason during design with material acquisition, planning, and facility people is vital. (69 p.)

KEYWORDS: Industrial engineering, series production, economic models, design methods

NSRP 0055**UMTRI 70675****TITLE:** Advanced Pipe Technology - Interim Report.**AUTHOR:** Newport News Shipbuilding, for Bath Iron Works.**DATE:** April 1976

ABSTRACT: This study reports on the state-of-the-art piping system design and fabrication methods and installation techniques used throughout the shipbuilding and other related industries in the U.S. and foreign countries. Many of these techniques are now in common usage or are being developed currently in U.S. shipyards. (155 p.)

KEYWORDS: Pipe fabrication

NSRP 0065**UMTRI 70157****TITLE:** Advanced Pipe Technology - Executive Summary.**AUTHOR:** Newport News Shipbuilding, for Bath Iron Works.**DATE:** April 1977

ABSTRACT: Significant findings relative to piping design, fabrication, assembly, and installation are highlighted in this summary of the full technical report. (24 p.)

KEYWORDS: Pipe fabrication, pipe installation, piping design, pipe technology

NSRP 0066**UMTRI 70088****TITLE:** Improved Design Process - Executive Summary and Final Report.

NSRP BIBLIOGRAPHY

AUTHOR: General Dynamics/Quincy, for Bath Iron Works.

DATE: April 1977

ABSTRACT: This study reports the findings of a study of the preliminary and contract design processes. Specific recommendations are made concerning simplification of each step in these processes. Simplification of the USCG, ABS, and MarAd approval process is also outlined. (200 p. approx.)

KEYWORDS: Design (basic), contract design, design process, design methods

NSRP 0067

UMTRI 70088

TITLE: Improved Design Process - Final Report.

AUTHOR: General Dynamics/Quincy, for Bath Iron Works.

DATE: April 1977 -

ABSTRACT: This volume is a duplicate of NSRP 0066 (see above), but omits the Executive management summary. (170 p.)

KEYWORDS: Design (basic), contract design, design processes, design methods

NSRP 0068

UMTRI 70154

TITLE: Executive Summary - Improved Planning and Production Control.

AUTHOR: Management Associates, for Bath Iron Works Corporation.

DATE: May 1977

ABSTRACT: This publication highlights the value of scheduling standards in reducing the cost and time of commercial ship construction. It is an executive summary of the full technical report. (8 p.)

KEYWORDS: Scheduling standards, cost reduction, planning and production control

NSRP 0070

UMTRI 70162

TITLE: Improved Planning and Production Control.

AUTHOR: Bath Iron Works Corporation.

DATE: August 1977

ABSTRACT: This project was the forerunner of the present Industrial Engineering (I.E.) program. It introduced the U.S. shipyards to engineered labor standards and demonstrated the application of these standards for improved planning and production control. Recommendations resulting from this study guided the early works of Panel SP-8. (134 p.)

KEYWORDS: Labor standards, planning and production control

NSRP 0073

UMTRI 70161

TITLE: Shipbuilding Industrial/Production Engineering Workshop. Proceedings.

AUTHOR: American Institute of Industrial Engineers, for Bath Iron Works.

DATE: February 21-24, 1978

ABSTRACT: This is the report of a workshop on the application of Industrial Engineering (I.E.) in shipyards. It was at this conference that U.S. shipyards were formally introduced to the I.E. function and the benefits of the application of I.E. techniques. The conference recommended that a coordinated I.E. development effort be undertaken and Panel SP-8 was formed to provide a continuing direction of this program area. The rationale behind original panel goals and objectives is documented. (113 p.)

KEYWORDS: Industrial engineering, production engineering

NSRP 0076

UMTRI 70155

TITLE: A Manual on Planning and Production Control for Shipyard Use.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: June 1978

ABSTRACT: A "how to" manual for the development and application of engineered labor standards for improved planning and for production control. This publication is intended for middle-level managers and supervisors in large and medium sized shipyards. (133 p.)

KEYWORDS: Labor standards, planning and production control, management techniques

NSRP 0101

UMTRI 70676

TITLE: MOST Work Management Manual - Steel/Aluminum Small Assembly-I.

AUTHOR: Bath Iron Works Corporation.

DATE: May 1980

ABSTRACT: A detailed manual of practices, facilities, material flow and production methods in the Bath Iron Works Harding Plant "C-Bay" for fitting and welding in the small assembly and aluminum small assembly areas. MOST (Maynard Operation Sequence Technique) system calculations are included. (200 p. approx.)

KEYWORDS: Production methods, MOST, Maynard Operation Sequence Technique (MOST), material flow, management manuals

NSRP 0102

UMTRI 70152

NSRP BIBLIOGRAPHY

TITLE: MOST Work Management Manual – General Operations.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: May 1980

ABSTRACT: This document is a general manual covering standard practices and policies, facilities and equipment, layout and material flow, and production methods at National Steel and Shipbuilding Co. A glossary of terms is also included. (100 p.)

KEYWORDS: National Steel and Shipbuilding Co. (NASSCO), MOST, material flow, management manuals

NSRP 0103

UMTRI 70164

TITLE: MOST Work Management Manual – Panel Line.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: May 1980

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the NASSCO Panel Line for the fitting and welding of plates and flat panel assemblies is given. MOST calculations are included. (109 p.)

KEYWORDS: MOST, panels, management manuals, material flow, fitting, welding, flat panel assemblies

NSRP 0104

UMTRI 70677

TITLE: MOST Work Management Manual – Steel/Aluminum Small Assembly-II.

AUTHOR: Bath Iron Works Corporation.

DATE: July 1980

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the Bath Iron Works Harding Plant "B-Bay" for the fitting and welding in the steel small assembly and aluminum small assembly areas is given. MOST system calculations are included. (250 p. approx.)

KEYWORDS: MOST calculations

NSRP 0111

UMTRI 70165

TITLE: MOST Work Management Manual – General Operations.

AUTHOR: Bay Shipbuilding Corporation, for Bath Iron Works.

DATE: August 1980

ABSTRACT: A general manual of practices, facilities, material flow, and production methods at Bay Shipbuilding Corp. is given. A glossary of terms is included. (150 p. approx.)

KEYWORDS: MOST, material flow, production methods, Bay Shipbuilding, shipbuilding

NSRP 0115

UMTRI 71153

TITLE: MOST Work Management Manual – Panel Assembly in Platen Area.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: September 1980

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the NASSCO platen area for layout, burning, fitting, welding and grinding of panel assemblies is given. MOST calculations are included. (300 p. approx.)

KEYWORDS: MOST, MOST calculations, NASSCO, panels, platens, grinding

NSRP 0120

UMTRI 70790

TITLE: Work Management Manual – Steel Shell Assembly.

AUTHOR: Bath Iron Works Corporation.

DATE: 1980

ABSTRACT: The scope of this manual includes the operations of Dept. 50 fitters and Dept. 43 welders in assembling shaped shell assemblies on reusable diaphragm post mocks and miscellaneous small mocked assemblies. (200 p. approx.)

KEYWORDS: Fitting, welders, MOST, labor standards

NSRP 0123

UMTRI 71154

TITLE: MOST Work Management Manual – Pipe Fabrication Shop.

AUTHOR: Peterson Builders, Inc., for Bath Iron Works.

DATE: January 1981

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the PBI pipe fabrication shop for cutting, and preparation, bending, fit-up, welding and brazing of pipe is given. MOST calculations are included. (300 p. approx.)

KEYWORDS: MOST, MOST calculations, pipe fabrication, material flow

NSRP 0125

UMTRI 70799

NSRP BIBLIOGRAPHY

TITLE: MOST Work Management Manual – Hull Erection.

AUTHOR: Bay Shipbuilding Corporation, for Bath Iron Works.

DATE: January 1981

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the Bay Shipbuilding graving dock and platen area for super-section assembly and hull erection and regulation is given. MOST calculations are included. (600 p. approx.)

KEYWORDS: MOST, platen, hull construction

NSRP 0136

UMTRI 71151

TITLE: Methods Engineering Workshop for the Shipbuilding Industry.

AUTHOR: American Institute of Industrial Engineers, for Bath Iron Works.

DATE: November 1981

ABSTRACT: This document entails an Instructor's Guidesheet, a Student Manual, and color slides developed for establishing Methods Engineering training sessions within U.S. shipyards. (180 p. approx.)

KEYWORDS: Methods engineering, industrial engineering

NSRP 0141

UMTRI 71152

TITLE: FY-82 Labor Standards Program – Pipe Fabrication and Blast and Paint Shops.

AUTHOR: H. B. Maynard and Co., for Bath Iron Works.

DATE: January 1982

ABSTRACT: This report is on the development, testing, and method for rapid application of an improved system for using engineered labor standards in estimating and manpower scheduling. Charts of estimating standards for a Conrac Pipe Bender, Greenlee Pipe Bender, and for mechanical pipefitting are included. (72 p.)

KEYWORDS: Labor standards, pipe fabrication, blast and paint shops, Conrac pipe bender, Greenlee pipe bender

NSRP 0146

UMTRI 70325

TITLE: Shipyard Data Application Program Panel Line Schedule and Manloading Incentive Program.

AUTHOR: Bath Iron Works Corporation.

DATE: 1982

ABSTRACT: The basic logic and principles of the development and use of engineered labor standard data is presented. The Maynard Operation Sequence Technique (MOST) system is described. A brief glossary of industrial engineering terminology is also included. (220 p.)

KEYWORDS: Labor standards, MOST, industrial engineering, panels, incentive program

NSRP 0149

UMTRI 70166

TITLE: MOST Work Management Manual - Blast and Coat on Platen and Drydock.

AUTHOR: Newport News Shipbuilding, for Bath Iron Works.

DATE: March 1982

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the Newport News North Yard Platen and 12 Drydock for grit blasting and spray painting of a commercial vessel is given. MOST calculations are included. (150 p. approx.)

KEYWORDS: MOST, blasting and painting, Newport News Shipyard, drydocks, grit blasting, painting

NSRP 0150

UMTRI 70167

TITLE: MOST Work Management Manual - Plate Shop.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: March 1982

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the NASSCO Plate Shop for the cutting and construction of small sub-assemblies is given. MOST calculations are included for foundations, brackets, and ladders. (313 p.)

KEYWORDS: MOST, NASSCO, plates, steel fabrication

NSRP 0151

UMTRI 70788-89

TITLE: MOST Work Management Manual - Main Assembly. Volumes I and II.

AUTHOR: Bath Iron Works Corporation.

DATE: March 1982

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the Bath Iron Works Main Assembly Building for the fitting and welding

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of plates and flat panels is given. MOST calculations are included. (Vol. I, 250 p.; Vol. II, 400 p. approx.)

KEYWORDS: MOST, Bath Iron Works, fitting, welding, flat panels, plates

NSRP 0152

UMTRI 70795-96

TITLE: MOST Work Management Manual - Electrical Work for Shipboard Installation. Volumes I and II.

AUTHOR: Peterson Builders, Inc., for Bath Iron Works.

DATE: April 1982

ABSTRACT: A detail manual of practices, facilities, material flow, and production methods used in the Peterson Builders electric shop, fabrication buildings and aboard ship for preparation and installation of electrical components, wires, and cables is given. MOST calculations are included. (Vol. I, 300 p. approx.; Vol. II, 500 p. approx.)

KEYWORDS: MOST, electric shops, electrical components, cables

NSRP 0154

UMTRI 71198

TITLE: MOST Work Management Manual - Temporary Staging for Group Assembly and Aboard Ship.

AUTHOR: Bethlehem Steel Corporation, Sparrows Point, for Bath Iron Works.

DATE: April 1982

ABSTRACT: A detailed manual of practices, facilities, material flow, and production methods used in the Sparrows Point ground assembly area and aboard ship for the erection and removal of temporary staging is given. MOST calculations are included. (350 p. approx.)

KEYWORDS: MOST, staging, Sparrows Point

NSRP 0157

UMTRI 70153

TITLE: Scheduling Standards Pilot Project Summary Report.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works Corporation.

DATE: September 1981 - April 1982

ABSTRACT: This seven-month project tested the application of scheduling standards in a shipyard pipe fabrication shop. Actual hands-on data was accrued, analyzed, and applied during three separate testing periods. Results show that fabrication man-hours were reduced by about one-third, permitting the fabrication of about fifty percent more pipe with the same number for fabricators. The key to success is the scheduling standard, developed from engineered labor standard data plus a factor to accommodate non-process

considerations. The scheduling standard accurately predicts REAL work content, allowing for major improvements in work loading, planning, and scheduling from which the savings result. (95 p.)

KEYWORDS: Scheduling standards, pipe fabrication, labor standards, cost reduction

NSRP 0159

UMTRI 70156

TITLE: Industrial Engineering Applications in the U.S. Shipbuilding Industry, 1982 Symposium Proceedings.

AUTHOR: Bath Iron Works Corporation.

DATE: May 1982

ABSTRACT: Eight papers are included in this document. These papers were presented at a 1982 symposium concerning: The work of Panel SP-8; The National Shipbuilding Industrial Base; Scheduling Standards; Applications of Labor Standards; and Flexible Automation. This represents a good cross-section of panel work underway at the time of the symposium. (194 p.)

KEYWORDS: Shipbuilding standards, industrial engineering, labor standards, Panel SP-8, flexible automation

NSRP 0172

UMTRI 70798

TITLE: Work Management Manual - Material Handling for Shipyards.

AUTHOR: Bethlehem Steel Corporation, Sparrows Point, for Bath Iron Works.

DATE: July 1983

ABSTRACT: The purpose of this task was to develop engineered labor standard data for material handling with mobile equipment. Types of Mobile Equipment and General Guidelines were: a fork truck with a mast containing a two prong arrangement that may be tilted forward or back and raised up or down for the purpose of picking up pallet loads of material; and a straddle carrier, a unit shaped much like an inverted channel. The lifting device consists of longitudinal angles that can pick up special pallets, bolsters, or unit loads of a standard width. All lifts are picked up at ground level. The riding cab is elevated. (300 p. approx.)

KEYWORDS: Material handling, MOST material handling, fork trucks, straddle carriers

NSRP 0175

UMTRI 70797

TITLE: Work Management Manual - In-Shop Blast and Paint.

AUTHOR: Peterson Builders, Inc., for Bath Iron Works.

DATE: August 1983

NSRP BIBLIOGRAPHY

ABSTRACT: The scope of this manual encompasses all blast and paint activities performed in the blast and paint booth. While the data collected for this manual was procured from the ARS's, special attention was given to its applicability for painting any ship. (120 p. approx.)

KEYWORDS: Blasting and painting, blast and paint equipment

NSRP 0186

UMTRI 71199

TITLE: Temporary Staging for Shipyards.

AUTHOR: Bethlehem Steel Corporation, for Bath Iron Works.

DATE: July 1983

ABSTRACT: This report shows the application of the labor standards for staging developed in Phase II. The staging of the standards will be on an Integrated Tug-Barge (ITB) and will be used for the purpose of production control. (31 p.)

KEYWORDS: Staging, temporary staging, labor standards

NSRP 0189

UMTRI 71196

TITLE: Final Report Back-Up Data for Temporary Staging for Shipyards.

AUTHOR: Bethlehem Steel Corporation, for Bath Iron Works.

DATE: July 1983

ABSTRACT: This manual covers the back-up data necessary for the final report on temporary staging. Areas included are: center tanks, tank staging platform, exterior shell, and pipe staging. (400 p. approx.)

KEYWORDS: Wing tanks, pipe handling

NSRP 0199

UMTRI 71680

TITLE: A Primer on an Approach to Planning and Production Control for the Smaller Shipyard.

AUTHOR: Corporate-Tech Planning, Inc., for Bath Iron Works.

DATE: December 1983

ABSTRACT: Information developed suggests that standards, particularly scheduling standards, can offer major advantages to the smaller shipyard striving to improve production performance, with only a modest investment of time and money. A 6-month pilot program conducted at one smaller shipyard provoked a throughput increase of fifty percent in a pipe fabrication shop. This throughput increase grew to 500 percent in the 18 months following the pilot program, with the same number of production workers in the shop. The success achieved during and after this pilot program, along with several

appeals for assistance from the smaller shipyard community, prompted the development of this primer. (150 p.)

KEYWORDS: Scheduling standards, planning and production control, small shipyards

NSRP 0200

UMTRI 71683

TITLE: Ship Producibility as it Relates to Series Production: Volume II Ship Design Process.

AUTHOR: Ingalls Shipbuilding, for Bath Iron Works Corporation.

DATE: September 1975

ABSTRACT: Studies were completed to investigate potential savings to be realized from design processes in the series production of 150,000 DWT crude carriers. Seven areas were studied: midship design, superstructure design, machinery room standards, structural members, ship elongation, simplified hull forms, and standardized working plans. Practical and cost considerations are discussed. (270 p. approx.)

KEYWORDS: Series production, design processes, cost reduction, ship design

NSRP 0201

UMTRI 71684

TITLE: Ship Producibility as it Relates to Series Production: Volume III Ship Production Process.

AUTHOR: Ingalls Shipbuilding, for Bath Iron Works Corporation.

DATE: October 1975

ABSTRACT: Studies were completed to determine cost savings in fabrication and assembly which may be realized in the series production of ships. Eight areas were studied: facility utilization, production areas and shops, work stations, production planning, material planning, cranes and heavy equipment, jigs and fixtures, and machines. Locations for significant cost savings in series production versus one off production were identified. (350 p. approx.)

KEYWORDS: Series production, facility utilization, cost reduction

NSRP 0221

UMTRI 73048

TITLE: Labor Standards Application Program (Phase IV) Electrical Trade Area.

AUTHOR: Peterson Builders, Inc., for Bath Iron Works Corporation.

DATE: April 1985

ABSTRACT: This report describes the development of labor standards during ship construction in the electrical trade area towards controlling production costs for both shop work and installation work aboard ship. The objective of this project was to improve

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planning, scheduling, production control, and worker productivity through the application of labor standards, and thereby reduce the cost of electrical work in the shop as well as electrical installation work aboard ship. (55 p.)

KEYWORDS: Labor standards, cables, production planning

NSRP 0222

UMTRI 73049

TITLE: Application of Labor Standards for Scheduling, Production Control, and Manpower Leveling.

AUTHOR: Bethlehem Steel Corporation, for Bath Iron Works.

DATE: December 1984

ABSTRACT: This paper presents a method for developing and applying scheduling/manpower models for the fitting and welding of Panel Ship/Ground Assembly standard units. The models are based on a Critical Path Method type network with activity durations expressed as a variable dependent upon the total expected effort required by a particular craft. A software package is presented which aids in the application of the developed models. This package is written in BASIC for the IBM Personal Computer or compatibles. (97 p.)

KEYWORDS: Scheduling, computer model, labor standards

NSRP 0232

UMTRI 73525

TITLE: Work Management Manual - Sheetmetal Shop Ventilation Components (Phase III). 2 Volumes.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: December 1983

ABSTRACT: This report is a detailed manual of standard practices and policies, facilities and equipment, layouts and material flow, and process data at NASSCO's Facilities and Maintenance Department. MOST calculations are included. (853 p.)

KEYWORDS: MOST, management manuals, material flow

NSRP 0233

UMTRI 73526

TITLE: Methods/Labor Standards Application Program - Phase IV. Final Report.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: January 1985

ABSTRACT: This is the final report of an extensive study at NASSCO. The study centered on their Transportation Maintenance area and consisted of three phases. Phase I involved the testing of a micro-computerized Maintenance Management system

(Mainsaver); Phase II involved the transfer of labor standard data across the industry; and Phase III was a manual performance rating reporting system utilizing engineered labor standards which were the result of the Phase II data transfer. (248 p.)

KEYWORDS: Maintenance management, computer technologies

NSRP 0234

UMTRI 73527

TITLE: Methods/Labor Standards Application Program. Final Report.

AUTHOR: National Steel and Shipbuilding Company for Bath Iron Works.

DATE: January 1985

ABSTRACT: This publication is an executive summary of the final report detailed in NSRP 0233. (20 p.)

NSRP 0235

UMTRI 73528

TITLE: Labor Standards Application Program: Blast and Paint Shops. Final Report.

AUTHOR: Peterson Builders, Inc., for Bath Iron Works Corporation

DATE: December 1984

ABSTRACT: The objective of this project in the blasting and painting areas of ship construction was to improve planning, scheduling, production control, and worker productivity through the application of labor standards, and thereby reduce the cost of blasting/painting operations. The seven phases of the project were to: establish baseline data, validate labor standards, formalize queuing procedures, apply labor standards, examine delay time, redefine application procedures, and evaluate cost effectiveness. (53 p.)

KEYWORDS: Blasting and painting, labor standards

NSRP 0242

UMTRI 74898

TITLE: Engineered Labor Standards in the Manufacture of Sheetmetal Case Good Items.

AUTHOR: Bath Iron Works Corporation.

DATE: August 1984

ABSTRACT: This report focuses on evaluating MOST developed labor standards for shop control/scheduling and determining machine/work center capacity. The primary objectives of the project were to apply engineered labor standards: 1) to determine machine efficiencies in order to balance machine loading; 2) as a base for shop floor control procedures to facilitate shop loading, manning, scheduling; and 3) to evaluate make/buy comparisons for sheetmetal case good items. (35 p.)

NSRP BIBLIOGRAPHY

KEYWORDS: MOST, labor standards

NSRP 0243

UMTRI 74899

TITLE: Outside Machinery Standards - Final Report and Work Management Manual.

AUTHOR: Ingalls Shipbuilding for Bath Iron Works Corporation.

DATE: January 1985

ABSTRACT: The purpose of this project was twofold: to provide the shipbuilding industry with a set of universal standards for Outside Machinery operations, and to identify specific areas where methods improvements could be made to benefit both Ingalls and the U.S. shipbuilding industry. The time standards were developed using MOST. The data collected was obtained from observation of work on Ticonderoga (CG 47) class cruisers under construction at Ingalls Shipbuilding. (338 p.)

KEYWORDS: MOST, standards

NSRP 0244

UMTRI 74900

TITLE: Tool List Program Feasibility Study.

AUTHOR: Ingalls Shipbuilding for Bath Iron Works Corporation.

DATE: April 1985

ABSTRACT: This study is the result of a fourteen week feasibility study on a tool identification list program for outside machinery operations. The purpose of the study was to reduce excess labor costs incurred because of workers having to go off ship to acquire additional tools. A system was developed to provide a worker with a complete summary of both tools and material required to complete a given job. (73 p.)

KEYWORDS: Feasibility study, productivity

NSRP 0245

UMTRI 74901

TITLE: Methods Engineering Workshop for the Shipbuilding Industry.

AUTHOR: Institute of Industrial Engineers.

DATE: September 1985

ABSTRACT: (This report is a revision of NSRP 0136.) The thrust of the workshop is to train shipyard personnel in the techniques of methods improvement with the ultimate goal of improving manufacturing productivity in the shipyards. The 104 page manual contained therein has been designed as both a student reference manual and an instructor guidebook. (221 p.)

KEYWORDS: Methods Engineering, Industrial Engineering

NSRP 0247

UMTRI 74878

TITLE: Problem Solving and Training Guide for Shipyard Industrial Engineers.

AUTHOR: Corporate Tech Planning, Inc.

DATE: June 1986

ABSTRACT: This guide is to assist Industrial Engineering Department employees in solving shipyard problems more effectively. The guide does this by organizing or codifying information so that a shipyard problem may readily be related to a source of assistance. These assistances are: several indexes, a bibliography, a training guide, a curriculum, and a list of schools. (117 p.)

KEYWORDS: Problem-solving, training

NSRP 0256

UMTRI 74888

TITLE: Computer-Assisted Methodology for the Determination of the Optimal Number and Location of Tool Sheds.

AUTHOR: University of Washington, for Bath Iron Works Corporation.

DATE: July 1986

ABSTRACT: This report is of a project to provide computer assistance for choosing optimal locations for toolrooms in shipyards. The tool used to accomplish this task is a computer program entitled Computer-Assisted Toolroom Design (CATD). It is executed on the IBM PC with an 8087 co-processor chip. Its operation and maintenance are outlined in the user and technical manual enclosed in the report. By determining optimal toolroom locations, the user gains an insight into the system and the improvements and cost reductions that are made possible by varying the location. (128 p.)

KEYWORDS: Computer-assisted methodology, cost reduction, tools

NSRP 0271

UMTRI 74882

TITLE: Quality Defects Measurement and Control System.

AUTHOR: Bath Iron Works Corporation/Marinette Marine Corporation.

DATE: March 1987

ABSTRACT: This is the final report of a project which called for the development of a computer software package that would be universal for use in any size shipyard. The program was designed to aid in reducing defects and material discrepancies by identifying significant error causes in both rework and material discrepancies, and monitoring results of corrective action taken. The software package chosen for this program was Revelation by Cosmo. Users are required to purchase their own run-time version of Revelation. (90 p.)

KEYWORDS: Software, quality control

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NSRP 0276

UMTRI 77475

TITLE: Basic Principles of Industrial Engineering.

AUTHOR: Standards International, Inc.

DATE: October 1987

ABSTRACT: This report on the basic principles of industrial engineering is divided into three parts. The first part discusses the benefits, function and techniques used by industrial engineering. The second part on operational questions for industrial engineers discusses problem recognition and identification, work sampling and operational analysis. The third section is on the importance of communication and how it is accomplished effectively. (188 p.)

KEYWORDS: Industrial Engineering

NSRP 0277

UMTRI 77476

TITLE: Improved Planning and Shop Loading in Shipyard Production Shops.

AUTHOR: Robinson-Page-McDonough and Associates, Inc.

DATE: September 1987

ABSTRACT: Planning and scheduling work in a shipyard production shop requires a prediction of how much real time will be consumed by a worker (or workers) in accomplishing a work package. The process constitutes one of the more difficult tasks in shipbuilding because the prediction element is so uncertain in practice. This report discusses two ways to improve the quality of the prediction, which in turn will improve the usability of the planning and scheduling determinations: scheduling standard data coupled with a current non-process factor unique to a shipyard, and a statistically-based prediction formula developed from current performance data measured in a shipyard. (61 p.)

KEYWORDS: Planning and scheduling, scheduling standards

NSRP 0278

UMTRI 77477

TITLE: Developing Scheduling Standards Using Regression Analysis: An Application Guide

AUTHOR: Robert J.Graves, University of Massachusetts, and Leon F. McGinnis, Georgia Institute of Technology.

DATE: June 1987

ABSTRACT: This application guide presents a step-by-step introduction to the development of scheduling standards using regression analysis. The presentation employs an example taken from a shipyard sheet metal shop and discusses the issues and procedures in constructing scheduling standards from work order-level data on actual fabrication times. The methods described have been applied in three different shipyard shops, and in each case have produced scheduling standards with a prediction accuracy of

at least 10 percent when applied to a set of work orders representing roughly a manweek of work. The cost to establish scheduling standards using these methods compares very favorably to the cost for other techniques, especially if engineered labor standards or measured labor standards must be available for those other methods. (48 p.)

KEYWORDS: Scheduling standards, regression analysis

NSRP 0279

UMTRI 77478

TITLE: Analysis of Current Manpower Estimating and Control Procedures.

AUTHOR: Robinson-Page-McDonough and Associates, Inc.

DATE: July 1987

ABSTRACT: This report discusses the current situation in shipyards in regard to procedures for estimating and controlling manpower—the largest and most expensive resource in this industry. (Results are grouped by shipyard size.) A survey taken of shipyard managers suggests that the main concern in shipyards is for improving the capability for planning and scheduling work, and for controlling the productive process. (34 p.)

KEYWORDS: Manpower planning

NSRP 0284

UMTRI 77483

TITLE: Feasibility Study of the Application of Operations Research Methods to Solve Complex Shop Scheduling Problems.

AUTHOR: Peterson Builders, Inc.

DATE: December 1987

ABSTRACT: This project was performed to determine the feasibility of solving complex shop scheduling difficulties with Operation Research (OR) techniques. The operations research approach begins by carefully observing and formulating the problem. The nature of the problem is then summarized in a model which is assumed to sufficiently represent the real situation. Any conclusions obtained from the model are therefore assumed to be valid for the real situation. This model is then modified and confirmed with appropriate experimentation. This report details the difficulties encountered in attempting to schedule a shop with complicated variables, and the lessons learned. (23 p.)

KEYWORDS: Operations research, scheduling

NSRP 0304

UMTRI 80450

TITLE: Optimal Use of Industrial Engineering Techniques in Shipyards.

AUTHOR: National Steel and Shipbuilding Company.

DATE: August 1989

NSRP BIBLIOGRAPHY

ABSTRACT: This task has investigated the nature and extent of Industrial Engineering activities currently being carried out within the shipyard community. The task was designed to identify the specific IE techniques being applied in the shipyards relative to the present spectrum of possibilities. That is, if the available techniques are not being applied, then ways to place more emphasis on their implementation would be addressed. (36 p.)

KEYWORDS: Industrial engineering techniques

NSRP 0321

UMTRI 80510

TITLE: The Industrial Perspective: Conference Proceedings Meeting Minutes.

AUTHOR: Ship Production Panel 8 (SP-8).

DATE: September 1989

ABSTRACT: This volume contains proceedings and meeting minutes of the SP-8 Industrial Engineering Conference held in Arlington, VA. Issues addressed are global competitiveness, the U.S. industrial base, productivity, product innovation, customer needs, continuous improvement, quality, innovation, future markets and marketing, and the role of the industrial engineering. Presentations provided represent the Navy, the industry, the SCA, the SPC, and MARAD. (183 p.).

KEYWORDS: Industrial engineering, productivity, quality, competitiveness, market

NSRP 0325

UMTRI 77477

TITLE: Scheduling Standards Pilot Project: Companion Activity Final Report.

AUTHOR: Robert Graves and Leon McGinnis.

DATE: June 1982

ABSTRACT: This pilot project has investigated the use of engineered labor standards, specifically the MOST system, to establish standards useful for shop loading and scheduling. The key element in the investigation is the development of the nonprocess factors. The present report describes the data, procedures, and results of this project. (38 p.)

KEYWORDS: Scheduling standards, standards

NSRP 0347

UMTRI 82784

TITLE: Implementation Guide for Approaching Shop Floor Control.

AUTHORS: Gary Higgins, John Jessup, and K. Diedrick

DATE: June 1992

ABSTRACT: This project develops a detailed implementation guide documenting an approach to integrated Shop Floor Control (SFC) for shipyards. The impetus for the

project was the Ship Production Committee Panel Eight (SP-8) Industrial Engineering recognition that the basic elements of SFC exist in all shipyards however, most have not effectively integrated all these elements into a well structured production monitoring and control system. The panel further recognized that since the shipbuilding job shop environment revolves around the assembly of a single product, it is difficult to bring in "off the shelf" production control software that will speak to shipbuilding's unique needs. This project report provides the guidelines for identifying the information requirements necessary to monitor and control production activity in a shipyard. (80p.)

KEYWORDS: Shop floor control, industrial engineering, production control software

NSRP 0348

UMTRI 82784

TITLE: Improved Techniques for Labor Expenditure Collection.

AUTHOR: Stan Fors, Glen Berger, Christi Burz, David Wright, and Mike Korgie.

DATE: June 1992

ABSTRACT: This report is an investigation and analysis of the U. S. Shipyard labor expenditure systems and procedures, whose purpose is to identify those areas which could potentially benefit by improvement in accuracy, and or cost effectiveness, of the time collection process. The primary deliverable is the definition of those requirements and system features that should be supported in order to provide an optimum approach to labor expenditure collection for a U. S. shipyard. The National Steel and Shipbuilding Company (NASSCO) was used as a model assumed to be representative of the shipbuilding and ship repair industry. Sophisticated procedures more adaptable to a shipyard environment are also recommended. (54p.)

KEYWORDS: Labor collection, cost accounting, cost effectiveness, labor, finance

NSRP 0356

UMTRI 82756

TITLE: Feasibility Study of Small Computer Application of Multi-Trade Scheduling.

AUTHOR: National Steel and Shipbuilding Company.

DATE: July 1986

ABSTRACT: This feasibility study is based upon highly developed systems for ship construction and ship repair, utilizing mainframe hardware and software. These systems are based on yard wide Master Schedules and are oriented to individual ship requirements, therefore, leaving interfacing of multiship scheduling to department level solutions. (24p.)

KEYWORDS: Computer software, production control scheduling

NSRP BIBLIOGRAPHY

PANEL SP 9: Education and Training

NSRP 0170

UMTRI 70620

TITLE: Social Technologies in Shipbuilding Workshop. Proceedings.

AUTHOR: University of Michigan.

DATE: May 1983

ABSTRACT: The human resource is the single most important asset employed in the production of ships. This document is the proceedings of a workshop devoted to an analysis of how American shipyards might more effectively use this resource through application of social technologies. (67 p.)

KEYWORDS: Human resources, social technologies, labor-management relations

NSRP 0180

UMTRI 70619

TITLE: The Status of Skilled Trades Training in U.S. Shipyards.

AUTHOR: Institute of Applied Technology, for The University of Michigan.

DATE: December 1983

ABSTRACT: The purpose of this project was twofold. The primary intent was to determine, through a survey, the status of trades training at all levels in private U.S. shipyards. In turn, the results of the survey were used to indicate where the need exists to improve training programs, primarily by level of training. A secondary purpose was to develop a directory of current trades training programs in private and Navy shipyards, to be made available to all shipyards. (72 p.)

KEYWORDS: Skilled trades training, training programs, directory (trades training programs)

NSRP 0181

UMTRI 70623

TITLE: A Directory of Skilled Trades Training Courses and Training Aids in U.S. Shipyards.

AUTHOR: Institute of Applied Technology, for The University of Michigan.

DATE: December 1983

ABSTRACT: This Directory of Skilled Trades Training Courses and Training Aids in U.S. Shipyards and the companion report list available training in U.S. shipyards and analyze the needs for training at the apprentice, mechanic, and management levels. (225 p.)

KEYWORDS: Skilled trades training, training programs, directory (trades training programs)

NSRP BIBLIOGRAPHY

NSRP 0192

UMTRI 70725

TITLE: Curricular Needs of Shipyard Professionals.

AUTHOR: The University of Michigan.

DATE: June 1984

ABSTRACT: A study of U.S. shipyards was conducted to identify the knowledge and skills required of entry-level graduate professionals in the design, engineering, planning, and production functions. A major conclusion of the study is that additional cooperative engineering curricula need to be established, so that engineering students can acquire broader knowledge and skills through periodic work and/or research assignments in shipyards. Recommendations concerning other curricular changes include addition of certain courses now usually absent—in statistics, materials and metallurgy, production processes, principles of supervision, and engineering economics, along with an increase in realistic exercises in written communications throughout the four or five years of undergraduate studies. A recommended five-year cooperative engineering curriculum for shipbuilding engineers is included. (32 p.)

KEYWORDS: Curricular needs, professional skills, engineering curricula, written communications, cooperative engineering curriculum, technical writing

NSRP 0198

UMTRI 71532

TITLE: Evaluation of Two Multi-Shipyard Cooperative Apprentice Training Programs.

AUTHOR: Data Design Laboratories/ Omni Engineering, for The University of Michigan.

DATE: March 1985

ABSTRACT: Two cooperative training programs have played a valuable role in the Norfolk, Virginia and Seattle, Washington, shipbuilding communities. The programs are, respectively, the Tidewater Maritime Training Institute, and the Cooperative Apprentice Training Program. The purpose of this report is to show the results of an investigation and evaluation of the two separate programs. The project has identified information which will assist those in other geographical areas to establish similar programs. (135 p.)

KEYWORDS: Training programs, apprentice training, Tidewater Maritime Training Institute, Cooperative Apprentice Training Program

NSRP 0216

UMTRI 72461

TITLE: Human Resource Innovation in Shipbuilding and Ship Repair – Workshop Proceedings.

AUTHOR: The University of Michigan.

DATE: May 1985

ABSTRACT: These proceedings document the second national Workshop On Human Resource Innovation in Shipbuilding/Ship Repair, which was held on November 26th-28th, 1984. The text of the proceedings consists of case studies and technical reports presented by shipbuilding labor and management members from around the world. The objective of the workshop was to introduce new management practices and organizational structures designed to better utilize the shipbuilding human resource. This workshop was designed to convey its theme to an audience consisting of representatives from United States and overseas shipyards, labor unions, The United States Department of Labor, The Maritime Administration, and major universities. (57 p.)

KEYWORDS: Labor-management relations, human resources, social technologies

NSRP 0219

UMTRI 72960

TITLE: Engineering for Ship Production.

AUTHOR: Thomas Lamb, for The University of Michigan.

DATE: January 1986

ABSTRACT: This publication represents a consolidation of the views of an experienced shipbuilder on the principles of advanced ship production technology. The application of the design-for-production technique is described and illustrated through examples. The concept that ship designers should develop all design for production is essential. Once the best production-oriented designs are developed, it is necessary to transmit the design information to the various departments in the shipyard that use the information. Improvements to existing shipyard methods are presented. The book was developed from the author's 1978 SNAME paper, "Engineering for Modern Shipyards," and University of Washington lectures on Ship Production Technology. (465 p.)

KEYWORDS: Ship design, shipyards, design-for-production

NSRP 0223

UMTRI 72807

TITLE: Statistical Analysis of Data and Quality Assurance for the Shipbuilding Industry - Tutorial and Workbook.

AUTHOR: University of Massachusetts, for The University of Michigan

DATE: September 1985

ABSTRACT: The Tutorial/Workbook was developed in conjunction with a set of four (4) videotapes to convey the need and applicability of statistical quality control concepts to the shipbuilding industry. The titles of the video tapes are: (1) The Deming Philosophy of Modern Management, (2) Statistical Control Charts, (3) Statistical Techniques for Discrete Random Experiments, (4) Statistical Techniques for Continuous Random Experiments. (129 p.)

KEYWORDS: Statistical control, quality assurance

NSRP BIBLIOGRAPHY

NSRP 0224

UMTRI 73046

TITLE: European Craft Training: A Trip Report.

AUTHOR: The University of Michigan.

DATE: December 1985

ABSTRACT: A study was undertaken to identify training methods used to train shipbuilding craftsmen in Northern European countries: the United Kingdom, Sweden, Denmark, and West Germany. Information was gathered through European training literature and on-site inspection of shipyard training centers. It was found that institutional factors such as history of vocational training, educational systems, regulation, and the status of the shipbuilding industry significantly affect training in the shipbuilding industry. (95 p.)

KEYWORDS: Apprenticeship training, training programs

NSRP 0225

UMTRI 73047

TITLE: Manufacturing Technology for Shipbuilding – Project Condensation.

AUTHOR: Webb Institute of Naval Architecture, for The University of Michigan.

DATE: February 1986

ABSTRACT: As part of the government/industry-supported National Research Program (NSRP), a technical evaluation of the operations of Avondale Shipyards, Incorporated (ASI) was performed by consultants from Ishikawajima-Harima Heavy Industries Company, Limited (IHI), in 1980. ASI subsequently implemented four major IHI systems recommended in that evaluation: Accuracy Control, Production Planning, Design Engineering for Zone Outfitting, and Process Lanes. The implementation of these systems has decreased production time and increased productivity, thus materially reducing costs. ASI's experience with these improvements was shared with the shipbuilding community via four seminars held at the shipyard between 1982 and 1984. This report is a condensation of the lecture notes of those seminars. The complete work is available in the NSRP Microfiche Library (refer to NSRP report numbers 0137, 0138, 0139, and 0140). (176 p.)

KEYWORDS: Zone construction, production control, process lanes, design-for-production

NSRP 0269

UMTRI 78490-92

TITLE: Basic Naval Architecture – Instructor Guide and Problem Set.

AUTHOR: Giannotti and Associates for the University of Michigan.

DATE: January 1989

ABSTRACT: This project is a unique teaching resource for a course in Basic Naval Architecture. It consists of 45 videotapes covering basic topics in naval architecture as well as a 3-volume Instructor Guide and Problem Set containing notes to instructors,

suggested lesson plans, problems and solutions. (The Instructor Guide and Problem Set are only available as a part of a total package with the videotapes. For further information, contact the Audio-Visual Material Available for Shipyard Training (AVMAST) Library at the University of Michigan, (313) 763-2465.)

KEYWORDS: Naval architecture, computer-aided design, computer-aided manufacturing

NSRP 0289

UMTRI 76543

TITLE: Ship Production.

AUTHOR: Richard Storch, C.P. Hammon, and Howard M. Bunch.

DATE: January 1988

ABSTRACT: This book describes the principles and practices of ship production employing state-of-the-art group technology. Topics covered include: shipbuilding management theory; product-oriented work breakdown structure; manufacturing and construction processes; shipyard layout; planning, scheduling, and production control; accuracy control; and ship conversion, overhaul, and repair. While the overall system described by the book is not likely to reflect practice in any one shipyard, it presents a unified shipbuilding system from which understanding of the total process can be obtained. (Note: This book is available from the above address in microfiche format only. Hard copies of the book may be purchased from the publisher: Cornell Maritime Press, P.O. Box 456, Centreville, MD 21617.)

KEYWORDS: Ship production textbook

NSRP 0290

UMTRI 78513

TITLE: Writing Shipyard Reports.

AUTHOR: J. C. Mathes and Dwight W. Stevenson.

DATE: January 1989

ABSTRACT: Written communication is extremely important in increasing shipyard efficiency. However, written communication can reduce productivity because reports take time to write and to read. Writing Shipyard Reports is intended to help shipyard managers, engineers, and other professionals to write and prepare reports in a more efficient manner. This manual is divided into two sections. The first section is a text for use with an in-house course in report writing; the second section is reference information for use in writing reports—checklists, guidelines, and sample reports. This manual was written after extensive interviews with shipyard managers, engineers, and other professionals and specifically addresses their concerns. An accompanying Training Instructor's Guide provides a framework for training instructors in U.S. shipyards to use in developing a course to improve the written communication skills of shipyard professionals. (61 p.)

KEYWORDS: Written communication skills, report writing

NSRP BIBLIOGRAPHY

NSRP 0334

UMTRI 82210

TITLE: Recommendations on the Use of Interactive Instruction for Training Shipyard Trade Skills.

AUTHOR: Richard Cooper

DATE: June 1991

ABSTRACT: This is an overview of interactive instruction, including its applications and cost-effectiveness; (1) describes the characteristics of shipyard trade training; (2) identifies commercial interactive courseware applicable to trade training; (3) discusses the potential use of authoring systems by shipyards; (4) provides guidance for the integration of interactive instruction into existing shipyard training programs; and (5) concludes with detailed recommendations for the development of a two-lesson demonstration of interactive instruction for trade training to be presented to shipyard management and training personnel. (31 p.)

KEYWORDS: Training, authoring systems, interactive instruction

PANEL SP 10: Flexible Automation

NSRP 0081

UMTRI 48978

TITLE: Technology Survey of Major U.S. Shipyards.

AUTHOR: Marine Equipment Leasing, Inc.

DATE: 1978

ABSTRACT: This is a report on a technology survey of 13 major U.S. shipyards and 16 of the best comparable foreign shipyards. A standard procedure is followed in assigning one of four technology levels to a broad range of shipbuilding operations and processes in each shipyard. The results are presented in terms of comparisons among U.S. shipyards and between U.S. and foreign shipyards. (300 p. approx.)

KEYWORDS: Technology survey, shipyards, flexible automation

NSRP 0131

UMTRI 48977

TITLE: Robotics in Shipbuilding Workshop Proceedings with Executive Summary.

AUTHOR: Todd Pacific Shipyards, Los Angeles Division.

DATE: October 1981

ABSTRACT: This report summarizes a three-day workshop held by MARAD and TPLA to initiate the shipbuilding industry into the field of Robotics. It assesses industry needs which could be potentially met by robots. A number of problems were identified, some preliminary projects specified, and an industry direction for developing a program was established. The attendees recommended increased promotion of robotics technology and its application; development of a program led by the industry to apply robotics technology; and establishment of a SNAME/SPC panel to take action on recommendations and continue the work of the workshop. (133 p.)

KEYWORDS: Robots, flexible automation

NSRP 0267

UMTRI 74883

TITLE: Implementation Plan for Flexible Automation in U.S. Shipyards.

AUTHOR: The Charles Stark Draper Laboratory, for Todd Pacific Shipyards, Los Angeles.

DATE: February 1987

ABSTRACT: This implementation plan surveys current design and building practice in the shipbuilding industry and recommends a systematic approach to productivity improvement through flexible automation. Flexible automation, in this context, covers any technique that can deal with a class of similar jobs. It can be applied to associated automation, opportunities in design, production planning, outfit planning, measuring, data

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analysis, process improvement, and other crucial areas that support fabrication, account for a large part of construction cost, and can benefit from automation. (268 p.)

KEYWORDS: Flexible automation, productivity

Levingston Technology Transfer Projects

NSRP 0025

UMTRI 70480

TITLE: Quality Assurance System.

AUTHOR: Levingston Shipbuilding.

DATE: 3 March 1980

ABSTRACT: This document is a summary of a two volume report on quality assurance. This summary provides a condensation of the findings and conclusions of Levingston's study of the Accuracy Control and Quality Control systems currently in use in the shipyards of Ishikawajima-Harima Heavy Industries (IHI) of Japan. (18 p.)

KEYWORDS: Quality assurance, accuracy control, Ishikawajima-Harima Heavy Industries (IHI), IHI

NSRP 0026

UMTRI 70481

TITLE: Quality Assurance - Volume I: Final Report.

AUTHOR: Levingston Shipbuilding.

DATE: March 1980

ABSTRACT: In this examination of the IHI Quality Assurance concept and its application, two discrete but interrelated functions are discussed - Accuracy Control and Quality Control. These two functional elements comprise the organizational aspects of the IHI Quality Assurance concept, although as noted throughout the report the cognizance and execution of quality production pervades all functions and types of work. (79 p.)

KEYWORDS: IHI, quality assurance, accuracy control

NSRP 0027

UMTRI 70482

TITLE: Quality Assurance - Volume 2: Appendices.

AUTHOR: Levingston Shipbuilding.

DATE: 3 March 1980

ABSTRACT: Nine appendices are contained in the second volume: Accuracy Control System; Planning of Vital Points of Accuracy; Base Line for Accuracy; Additional Material Planning; Accuracy Check Sheets; IHI SPAIS-The Shipbuilding Process and Inspection Standard; Standard and Tolerance for Keeping High Accuracy at IHI AIOI Shipyard; Schedule and Particulars of Inspection and Testing (Bulk Carriers); and Procedure of Official Sea Trial (Bulk Carriers). (400 p. approx.)

KEYWORDS: Quality assurance, IHI, accuracy control

NSRP BIBLIOGRAPHY

NSRP 0014

UMTRI 70425

TITLE: Special Report: Accuracy Control Planning for IHI Construction.

AUTHOR: Levingston Shipbuilding.

DATE: 15 March 1980

ABSTRACT: The material contained herein was developed from the study of the Accuracy Control system presently in operation in the IHI shipyards in Japan. Information for this study was derived from source documentation supplied by IHI, information obtained directly from IHI consulting personnel assigned on-site at Levingston, and from personal observation by two teams of Levingston personnel of actual operations at various IHI shipyards in Japan. (62 p.)

KEYWORDS: Accuracy control, IHI, Levingston

NSRP 0016

UMTRI 70426

TITLE: Cost Accounting, Final Report.

AUTHOR: Levingston Shipbuilding.

DATE: March 1980

ABSTRACT: This report is an account of the results of work performed in the first study area of the Shipbuilding Technology Transfer Program, entitled "Cost Accounting". (76 p.)

KEYWORDS: Technology transfer, cost accounting

NSRP 0017

UMTRI 70422

TITLE: Industrial Relations. Executive Summary.

AUTHOR: Levingston Shipbuilding.

DATE: 28 March 1980

ABSTRACT: This "Personnel System" consists of many facets, each contributing to the overall personnel-orientation of IHI and the Japanese shipbuilding industry. The Final Report, of which this report is a summary, examines each of these facets in detail and attempts to place all of the aspects of this "personnel system" into a logical context. (33 p.)

KEYWORDS: Industrial relations, personnel system, management-labor relations

NSRP 0018

UMTRI 70423

TITLE: Industrial Relations. Final Report.

AUTHOR: Levingston Shipbuilding.

DATE: 28 March 1980

ABSTRACT: In this examination of the IHI Industrial Relations practices all aspects of the personnel system, its organization, operating practices, wage structure, personnel benefits, management/labor relations, and training were studied and evaluated for possible application to Levingston and to the U.S. shipbuilding industry. The various sections within this report detail those findings and conclusions. (141 p.)

KEYWORDS: Industrial relations, management-labor relations

NSRP 0015

UMTRI 70424

TITLE: Organization for Production and the Personnel System.

AUTHOR: Levingston Shipbuilding.

DATE: 18 June 1980

ABSTRACT: This document provides copies of the 35mm. slides presented at the Levingston Company Technology Transfer Program Seminar on "Organization for Production and the Personnel System." (107 p.)

KEYWORDS: Technology transfer, personnel system

NSRP 0028

UMTRI 70483

TITLE: Planning and Production Control. Executive Summary.

AUTHOR: Levingston Shipbuilding.

DATE: 24 November 1980

ABSTRACT: The IHI shipyard production system is a composite of facilities, personnel and material which achieves, through the careful integration of these elements, an extremely high rate of productivity. The composite system relies heavily on the thorough planning and scheduling accomplished prior to the start of steel fabrication and which is continually refined throughout a production run of ships. This summary provides a condensation of the findings and conclusions of Levingston's study of the Planning and Production Control practices currently in use at IHI. (41 p.)

KEYWORDS: Planning and production control, production control

NSRP 0029

UMTRI 70484

TITLE: Planning and Production Control. Volume I: Final Report.

AUTHOR: Levingston Shipbuilding.

DATE: 24 November 1980

NSRP BIBLIOGRAPHY

ABSTRACT: In this examination of the IHI Planning and Production Control System all aspects of the IHI production system itself, the production planning process, the scheduling system, manpower planning, and production control are discussed together with a detailed account of Levingston's application of these techniques and methods. The various sections of this report detail these aspects of the IHI system and Levingston's findings, applications, and conclusions. (230 p. approx.)

KEYWORDS: Planning and production control, production planning, manpower planning

NSRP 0030

UMTRI 70485

TITLE: Planning and Production Control. Volume II: Appendices.

AUTHOR: Levingston Shipbuilding.

DATE: 24 November 1980

ABSTRACT: This volume contains 6 appendices comprising data provided to Levingston by IHI as source material for the studies performed on the planning and production control functions in use in the IHI yards. They include: Glossary of Terms; Product-Oriented Work Breakdown Structure; Hull Blocking Plan (Example); Block Assembly Plan (Example); Field Plans (Examples); and Implementation of Gate Systems. (300 p. approx.)

KEYWORDS: Planning and production control

NSRP 0022

UMTRI 70457

TITLE: Engineering and Design. Executive Summary.

AUTHOR: Levingston Shipbuilding.

DATE: December 1980

ABSTRACT: In this examination of the IHI design engineering concepts and applications, particular attention is given to the flow of work beginning with the Basic Design through the Functional Design to the Detail Design. (56 p.)

KEYWORDS: Design engineering, ship design

NSRP 0023

UMTRI 70458

TITLE: Engineering and Design. Volume I: Final Report.

AUTHOR: Levingston Shipbuilding.

DATE: 22 December 1980

ABSTRACT: This report describes the overall design and engineering function which is responsible for ship design and the dissemination of design and construction information to production. This design and engineering activity is accomplished by a "top-down"

refinement procedure which begins with a conceptual ship design determined through research and design teams at the IHI Head Office. This conceptual design is refined to become the basic design. Figure 2-1 describes the flow as the conceptual design is transformed from concept to basic guidelines, to functional diagrammatic design and finally to detail design. It is this flow that is described in this report. (86 p.)

KEYWORDS: Ship design, basic design, engineering design, detail design

NSRP 0024

UMTRI 70459

TITLE: Engineering and Design. Volume II: Appendices.

AUTHOR: Levingston Shipbuilding.

DATE: 22 December 1980

ABSTRACT: Volume II contains 16 appendices: Brief Explanation of IHICS; IHICS-Actual Output Examples; Summary of IHI Shell; LODACS - Ship Frame Data Processing System; SPECS - Ship's Preliminary and Exact Calculation System; SPECS - Actual Output Example; CADS -Piping Design System; IHI Report on Computer-Aided Design System; IHI Report on Numerical Control Steel Fabrication; LSCo Study and Comparison of SPADES vs. IHI System; LSCo Final Report - Sub-Task 2.1 Computer Aided Design Systems; LSCo Final Report - Sub-Task 2.2 Numerical Control Steel Fabrication; IHI Working Flow and Scheme for Hull Structure Design; Explanation of IHI's Design Flow (Piping); Z Plate - General Purpose Program of Plane Stress Analysis by Finite Element Method, and its Application; and Z Vibra - Matrix Method of Vibrational Analysis of Framed Structures, and its Application. (500 p. approx.)

KEYWORDS: Ship design, design engineering

NSRP 0011

UMTRI 70428

TITLE: Facilities and Industrial Engineering. Volume I - Report.

AUTHOR: Levingston Shipbuilding.

DATE: 30 April 1981

ABSTRACT: Levingston and IHI personnel jointly examined the Levingston facilities from steel storage to launchways. These were compared to the IHI facilities to determine the most significant differences between the shipyards and the areas that would benefit most from a change in layout, additional space, new equipment, or other facility improvement. Many of the desired improvements had to be postponed due to budget constraints. A long-range plan was therefore developed for Levingston which incorporated the facility improvement plans emanating from these studies made with IHI. The details of the facility studies and the Long-Range Plan are described in this report. (282 p.)

KEYWORDS: Industrial engineering, facilities engineering, long-range planning

NSRP 0012

UMTRI 70429

NSRP BIBLIOGRAPHY

TITLE: Facilities and Industrial Engineering. Volume 2 - Appendices.

AUTHOR: Levingston Shipbuilding.

DATE: 30 June 1981

ABSTRACT: Included in Volume II are six appendices: Significant Differences and Specific Production Improvement Areas; General View of Levingston; Method Improvement - Welding; Pipe Fabrication - List of Equipment and Explanation of Pictures of Equipment; Concept and Application of Pre-Outfitting; and Ideal Approach for Mold Lofting System in Levingston. (134 p.)

KEYWORDS: Industrial engineering, facilities engineering, long-range planning

NSRP 0019

UMTRI 70452

TITLE: Standards. Executive Summary.

AUTHOR: Levingston Shipbuilding.

DATE: 30 June 1981

ABSTRACT: The purpose of this study was to analyze the Japanese (IHI) concept of Standards and their application in the actual working environment in IHI shipyards. As in the many other areas of study within the Technology Transfer Program (TTP), the objective of the study was to define possible beneficial and cost-saving elements of methodologies which could be instituted in Levingston and in other medium-size shipyards in the United States. (52 p.)

KEYWORDS: Standards, IHI, cost reduction

NSRP 0020

UMTRI 70453

TITLE: Standards. Volume I and Report.

AUTHOR: Levingston Shipbuilding.

DATE: 30 June 1981

ABSTRACT: It was originally intended that the examination of standards would be performed in a number of separate areas within the various tasks, i.e., design and material standards in Task 2, process and cost standards in Task 4, and tolerance standards in Task 5. Early findings, however, revealed that the Japanese approach to standards, like their approach to planning and production control, is that standards and standardization are key features of their overall management philosophy and not merely aspects of different areas of activity. The separate components of the study of standards were therefore brought together to be studied as a single system. (400 p. approx.)

KEYWORDS: Standards, management techniques, cost standards, standardization

NSRP 0021

UMTRI 70454

TITLE: Standards. Volume II: Appendices.

AUTHOR: Levingston Shipbuilding.

DATE: 30 June 1981

ABSTRACT: Seven appendices comprise Volume II: Standardization and Modularization in Shipbuilding; JIS Group F; IHI Index; Examples of IHI Standards - SOT A221XXX Hull Structure Material Application; Example of IHI Standards - SOT B5XXXXXX; Example of IHI Standards in Use; and Levingston Standard Operation Procedure "Initiation, Review, and Issuance of Levingston Standards." (160 p. approx.)

KEYWORDS: Standards, management techniques, cost standards, standardization

NSRP 0013

UMTRI 70427

TITLE: Program Summary Report.

AUTHOR: Levingston Shipbuilding.

DATE: 31 August 1981

ABSTRACT: This report provides a summary of the reports emanating from the Shipbuilding Technology Transfer Program performed by Levingston Shipbuilding under a cost sharing contract with the U.S. Maritime Administration. (276 p.)

KEYWORDS: Shipbuilding technology transfer program reports (summary)

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Special Projects

Note:

Contained in this section are technical papers presented at Annual Symposia. From 1974-1983 the symposia were included in the activities of the Institute for Research and Engineering for Automation and Productivity in Shipbuilding (IREAPS). In 1984 the symposium was held as part of a New York Section Annual Meeting, and abstracts are not included herein. After 1984, the annual meetings were held under the auspices of the National Shipbuilding Research Program (NSRP) Ship Production Symposium, and has been jointly sponsored by the NSRP and local sections of the Society of Naval Architects and Marine Engineers (SNAME) from the host city. Abstracts for paper presented at these meeting are included in this section. The main entry for each Symposium publication is located under the NSRP number, as seen below, and is followed by abstract entries for all papers. The total number of papers abstracted in each is indicated in the main title entry and the papers are then numbered accordingly. Individual papers do *not* have assigned NSRP numbers, but are fully indexed and accessible via author, title, and keyword indexes in the Index section at the back of this volume.

NSRP 0000

UMTRI 70058

TITLE: Research and Engineering for Automation and Productivity in Shipbuilding (REAPS) Technical Meeting. Proceedings. Twenty-one papers. (330 p.)

AUTHOR: Illinois Institute of Technology Research Institute.

DATE: 1974

Paper No. 1:

Title: The REAPS Program – A Concept for Enhanced National Capabilities. Pp. 1-14.

Author: George P. Putnam.

Abstract: The development of the REAPS program is reviewed from its beginnings as an outgrowth of the AUTOKON '71 Program to its status as an independent effort to apply the critical components of AUTOKON '71 to candidate development projects. The REAPS program was aimed at developing a shipyard design/manufacturing system responsive to the needs of American shipbuilders. REAPS goals in hardware and software development, technology transfer, and improved productivity are outlined. (15 p.)

Keywords: Productivity, computer-aided manufacturing

Paper No. 2:

Title: Long Range System Targets for the REAPS Program. Pp. 15-34.

Author: Hunter H. Shu, IIT Research Institute.

Abstract: Figures for the slides used in the presentation are reproduced along with the accompanying headings and explanatory notes and diagrams. Shipyard functions are

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modeled at the productive cell level, and the systems engineering function is outlined in detail. The production control sub-system is broken down into three modules: the planning module, the scheduling and simulation module, and the real-time status module. (20 p.)

Keywords: Long-range planning, production engineering

Paper No. 3:

Title: The AUTOKON System at Newport News. Pp. 39-50.

Author: Richard C. Moore, Newport News Shipbuilding.

Abstract: Copies of transparencies used in a presentation of the application of AUTOKON at Newport News are reproduced here. Included are outlines of the moldloft position in ship construction, AUTOKON's role in moldloft, samples of lofting contours, and shell and template program output. (12 p.)

Keywords: AUTOKON, computer-aided design, moldloft

Paper No. 4:

Title: SPADES System Management and Control Features. Pp. 51-96.

Author: Filippo Cali, Cali and Associates.

Abstract: Management and control features of the 'SPADES' system (Ship Production and Design Engineering System) are presented, with an overview of the system's main modules and their function and linkages with the data base. The introduction outlines the organization and description of the SPADES system, the characteristics of the data base, and the system features and modules. The remainder is comprised of samples of the system output. (46 p.)

Keywords: Ship Production and Design Engineering System, computer-aided design

Paper No. 5:

Title: The MLOFT System at Maryland Shipbuilding. Pp. 97-112.

Author: S. G. Kinkaid, Maryland Shipbuilding.

Abstract: The system of mathematical lofting of ships' plates and shapes used at Maryland Shipbuilding is described. The M-LOFT system, a FORTRAN IV program, was developed in a totally production oriented environment. The operation of M-LOFT in relation to deck and side shell plating, internal structure and the macro system, and nesting and kerfing compensation are discussed. The economic advantages and benefits are realized in terms of increased lofting and production capabilities. The most significant economies were in ground assembly and erection due to tight fit, easier welds, and almost complete elimination of weld rejection. (16 p.)

Keywords: M-LOFT, lofting, moldloft, computer-aided manufacturing

Paper No. 6:

Title: The Steerbear System at Sun Shipbuilding. Pp. 113-119.

Author: E. Schorsch, Sun Shipbuilding.

Abstract: Steerbear is a comprehensive computer-based design system developed at Sweden's leading shipyard, Kockums. A Fortran version of the software was developed and implemented at Sun to control monopol burning machines. This paper describes the successful adaptation of the software, the development of a PL/I production version, and its advantages in hull production application programs: fairing, shell plate expansion, piece parts programming, bending information for longitudinals, hydrostatic calculations, and other administrative information. (7 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), computer-aided manufacturing, numerical control

Paper No. 7:

Title: A Tutorial on Database Management. Pp. 121-134.

Author: L. D. Mead, IIT Research Institute.

Abstract: Basic concepts of database management are outlined, an approach to implementing a pilot application is described, and some techniques for database design are provided. The concept of data independence is introduced and explained in terms of the schema and sub-schema. Nine basic features characterize a database: data structure, data definition, interrogation, update, creation, programmer functions, data administrator, storage structure, and operational environment. An approach to determine the feasibility of database management is outlined. (14 p.)

Keywords: Database management, management techniques

Paper No. 8:

Title: An Improved AUTOKON AUTOBASE at Newport News. Pp. 135-146.

Author: R. E. Utterback and Patrick J. Kelly, Newport News Shipbuilding.

Abstract: AUTOBASE is the data management subsystem of AUTOKON and is a host language system written almost entirely in Fortran. An overview of the subsystem describes its data management capabilities. Also included is a discussion of the problems Newport News addressed using this software in a production environment. (12 p.)

Keywords: Database management, computer software, AUTOKON, AUTOBASE

Paper No. 9:

Title: The SPMIS System for Shipyard Production and Management Information. Pp. 147-154.

NSRP BIBLIOGRAPHY

Author: C. J. Purcell, Designers and Planners.

Abstract: This briefing highlighted the results of work on a shipyard production control and management information system (SPMIS) and covered the system objectives, the design concept, and the proposed development plan. The system objective was to control production by reducing delays, minimizing inventories, avoiding fluctuations in both workload and workforce, and to provide yard management with the tools for more effective estimating, planning, scheduling, and cost monitoring. The design concept was structured around the "work group", defined as a complete package of resources and facilities required to accomplish a specific task, including labor, drawings, tools, scheduled time, materials, etc. It is the central ingredient in the SPMIS database. The development schedule was planned for four years. (7 p.)

Keywords: Computer software, computer-aided manufacturing, production control, SPMIS

Paper No. 10:

Title: A Report on the 1974 AUTOKON Users Club Meeting. Pp. 155-157.

Author: N. Smith, Bethlehem Steel Shipbuilding.

Abstract: This report on the AUTOKON Users Club (AUC) 1974 meeting in Norway includes six appendices. Each is a paper presented at the meeting felt to be of most interest to American shipbuilders. They are abstracted in Papers No. 11-16 below. (3 p.)

Keywords: AUTOKON users club

Paper No. 11:

Title: Report from U.S.A: AUTOKON in the North American Shipbuilding Industry. Pp. 159-167.

Author: Rudolf Doornbos, Shipping Research Services.

Abstract: The status of AUTOKON at six U.S. shipbuilding companies is outlined. The software version and hardware configurations at each yard are given. The six locations are: Newport News Shipbuilding and Drydock Company, Bethlehem Steel Sparrows Point, General Dynamics Quincy and Electric Boat yards, Todd Shipyards Corporation, Seatrain Shipbuilding Corporation, as well as IITRI. Canadian yards are Saint John Shipbuilding and Drydock, and Port Weller Dry Docks. (9 p.)

Keywords: AUTOKON, computer-aided manufacturing

Paper No. 12:

Title: How Can AUTOKON Be a Useful Tool from the Phase of Preliminary Design to Production?: Integrated Use of AUTOKON from Early Design Phase to Production. Pp. 169-204.

Author: M. Balchen, Aker Group.

Abstract: Included in this paper is a short description of the computer programs used by the Aker Group in Norway during ship production. Each of the activities involved, from basic design criteria through nesting and assembly, is outlined and is defined as to purpose, method, input, and output. (36 p.)

Keywords: AUTOKON, design/production integration

Paper No. 13:

Title: The Introduction and Usage of AUTOKON 71 at 3.MAJ Shipyard and Diesel Engine Factory, Rijeka, Yugoslavia. Pp. 205-215.

Author: Franjo Spincic, 3.MAJ Shipyard and Diesel Engine Factory.

Abstract: A description of the organization and the different equipment installed at "3.MAJ" is provided. This includes computer installations as well as the organization structures and training provided for use of AUTOKON. An application of the program in production of a 40,000 dwt tanker is also described. (9 p.)

Keywords: AUTOKON

Paper No. 14:

Title: Report on AUTOKON Status. Pp. 215-216.

Author: M. Koopmans, IHC.

Abstract: A one-page briefing outlines IHC experience with AUTOKON. (2 p.)

Keywords: AUTOKON

Paper No. 15:

Title: Interactive Computer Graphics in Shipbuilding. Pp. 217-230.

Author: Frank Lillenhagen, CIIR.

Abstract: This paper outlines activities in ship design where Interactive Computer Graphics could improve the design process and system performance if used in conjunction with the AUTOKON CAD system. These activities include extremely fast visual representation of results, rapid verification of data, accurate construction by assembly of pre-defined objects, and the establishment of flexible man-computer interactive communication. Also described are present (1974) projects in the AUTOKON system where interactive computer graphics were being used and future developments in which new technologies would be incorporated. (14 p.)

Keywords: AUTOKON, computer graphics

Paper No. 16:

NSRP BIBLIOGRAPHY

Title: Report on Dimension Accuracy Control. Pp. 231-237.

Author: Morten Ringard, Stord Verft A/S.

Abstract: The general problem of dimension accuracy control in the assembly of ocean-going steel ships is outlined. The problem is manifested in unpredictable final dimensions of assemblies and modules due to inaccurate positioning, deformations due to rough transportation, non-rigid structure support, and welding. The problem is characterized as one of dynamic decision-making under uncertainties. The use of systems such as AUTOKON is recommended to control this problem. The elements of a dimension control system are then outlined: design reference system, measurement and alignment tooling, error prediction, error propagation, tolerancing, and data gathering processes. (7 p.)

Keywords: Accuracy control, AUTOKON

Paper No. 17:

Title: Some Planned Improvements to LANSKI. Pp. 239-244.

Author: Patrick J. Kelly and R. E. Utterback, Newport News Shipbuilding.

Abstract: The implementation and use of AUTOKON '71, including the LANSKI program, at Newport News Shipbuilding is described. Errors in LANSKI were corrected and some program modifications were made. A partial list of these changes is provided in an appendix. Efforts were concentrated on operating cost-reduction. Disk storage was reduced by half and run time by a third. Turnaround time accordingly improved. A list of desirable enhancements is also included, along with the necessary changes to the program. (6 p.)

Keywords: AUTOKON, LANSKI, cost reduction

Paper No. 18:

Title: New PRELIKON Capabilities. Pp. 245-270.

Author: S. A. Hansen, Shipping Research Services.

Abstract: The PRELIKON System is a stand-alone subsystem of the AUTOKON '71 System connected to the rest of the system via one of its modules. PRELIKON is an integrated modular system consisting of 21 different modules divided into three logical groups: input modules, defining hull form; working modules, performing calculations and preparing output; and service modules, performing data utility functions. This paper describes a U.S. Maritime Administration-sponsored development project to enhance PRELIKON. The main tasks of the project were: redesign and improvement in the system design; improvements in the existing batch modules; development of new modules; connection of the MARAD Hull Scientific Project to PRELIKON; and installation and training. Each task is described. (26 p.)

Keywords: PRELIKON, AUTOKON

Paper No. 19:

Title: A Sculptured Surface Approach for Hull Representation. Pp. 271-273.

Author: Hunter H. Shu, IIT Research Institute.

Abstract: The Sculptured Surface mathematical technique, used to describe surfaces whose original shapes may be based on approximate modeling or experimentation, is suggested as a method for hull form representation. This technology has successful applications in the design of airframes, numerical control machining of automobile body dies, and design and fabrication of ship propellers. The shortcomings of representing hull forms by space curves which form a wireframe, as is done in AUTOKON, are listed, and it is suggested that a sculptured surface approach would eliminate most of them. (3 p.)

Keywords: Hulls

Paper No. 20:

Title: Seatrain's Pin Height Program. Pp. 275-290.

Author: M. H. Altberg, Seatrain Shipbuilding.

Abstract: The FORTRAN IV program used to calculate heights of pin fixtures for supporting curved panel assemblies at Seatrain Shipbuilding is described. Also included is a brief outline of shop procedures in the fabrication shop. The program isolates a section of the shell and determines the optimum plane. When pin heights are desired, the most efficient grid pattern over that section is determined. Pin heights are calculated and graphic representation, three orthographic views and one isometric view, is output relative to the grid pattern. Appendices provide sample output, pin height views, and drawings. (16 p.)

Keywords: Pin heights, panels

Paper No. 21:

Title: An Improved Frame Bending Program. Pp. 291-313.

Author: Richard C. Moore, Newport News Shipbuilding.

Abstract: This paper presents a preliminary set of specifications and examples for an improved frame bending program that would provide twisting and shaping information in a form to suit the user's needs. Newport News Shipbuilding used a program linked to AUTOKON '71 and prepared this proposal to urge MARAD to contract for and procure an improved version. Included in this presentation are lists of the data required and output generated. Cost effectiveness of the program is in areas related to the mold loft and fabrication shops: reduction in labor required from the Loft to produce a body plan for the development; mold storage and repair on multiple ship contracts; and reduced bending costs resulting from elimination of the need for full size shape molds. (23 p.)

Keywords: Frame bending, AUTOKON, cost reduction

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NSRP BIBLIOGRAPHY

TITLE: REAPS 2nd Annual Technical Symposium. Proceedings. Twenty-four papers. (420 p.)

AUTHOR: IITRI.

DATE: 1975

Paper No. 1:

Title: Accomplishments and Expectations for the REAPS Program. Pp. 1-10.

Author: John C. Williams, IIT Research Institute

Abstract: The history of REAPS as a program is briefly described, including its origin, aims, funding sources, and rationale for existence. The accomplishments of REAPS up to the point of this conference included software support and development for AUTOKON '71 users, implementing enhancements to AUTOKON '71, provisions of ALKON course books, AUTOKON '71 users manuals, development of the REAPS library, ALKON users courses, as well as courses in PRELIKON. (10 p.)

Keywords: REAPS, AUTOKON

Paper No. 2:

Title: The Updated REAPS AUTOKON System. Pp. 11-51.

Author: Patricia D. Taska, IIT Research Institute.

Abstract: This paper reproduces the slides and commentary used in defining the general structures of AUTOKON and its programs. Each module is discussed in terms of its applications. The procedures employed in updating the system by processing REAPS Analysis Request forms is explained. The updated AUTOBASE, ALKON, FAIR, and DUP routines are also described. (41 p.)

Keywords: AUTOKON, computer-aided manufacturing

Paper No. 3:

Title: REAPS Long Range Planning: What Do Yards Want? What Is Being Done? Pp. 53-61.

Author: Hunter H. Shu, IIT Research Institute.

Abstract: The overheads and slides used in this presentation are reproduced here. In order to identify opportunities and formulate plans of research and development for the REAPS community, the following topics were addressed: types of projects; project life cycles; functions in a shipyard; critical components (by function and as a percent of total labor); desired system capabilities; target system objectives; and a list of potential projects. (9 p.)

Keywords: Long-range planning

Paper No. 4:

Title: Applications of Minicomputers in the Shipbuilding Industry. Pp. 63-87.

Author: Thomas Nystrom, Shipping Research Services.

Abstract: This paper discusses some areas and applications in a shipyard where state-of-the-art (1975) minicomputers could be favorably introduced. Applications and developments in Norway serve as examples. Within the larger framework of developing a Shipyard Information System, examples of applications are presented for the functions of Master Scheduling, Job Shop Scheduling, Scheduling Dock Erection and Outfitting, Material Administration, and Steel Administration. In addition, the NEST module of AUTOKON is run on a microcomputer. Other CAD applications are also discussed. (25 p.)

Keywords: Minicomputers, computer-aided design, material control

Paper No. 5:

Title: Software Engineering for a Digitizer/Minicomputer-Based Piping Data System. Pp. 89-110.

Author: Patrick W. Rourke, Newport News Shipbuilding.

Abstract: The preliminary system design phase reported here consisted of an in-depth study of the hardware and software requirements for piping digitizing, and for pipe manufacturing documents generation, followed by evaluations of hardware and software vendors. The first task of the system design was to define a feasible set of capabilities for the digitizer-minicomputer system. A number of simulations of different input languages were performed using a mockup digitizer and design station. A key feature of the in-house design is software capability. A study of response times, disk accesses, and computational requirements shows that implementation of the front-end software on a minicomputer is the most economical approach. (22 p.)

Keywords: Minicomputers, computer-aided design, piping design

Paper No. 6:

Title: Fastdraw Interactive Graphic System. Pp. 111-138.

Author: Gerald W. Folk and Odell A. Pritchett, McDonnell Douglas Automation Company.

Abstract: This paper consists of reproduced slides used in describing the Fastdraw system. Fastdraw is an interactive graphics system that allows users to build complex models using scaled sketches or build convenient data generation features, review and update models created from analysis input data, as well as review analysis output. Features of the system are described and samples of program output are provided. (28 p.)

Keywords: Computer software, graphics systems

Paper No. 7:

NSRP BIBLIOGRAPHY

Title: Considerations for Using AUTOKON at a Remote Site. Pp. 139-150.

Author: Bernard J. Breen and John M. Wallent, General Dynamics/Quincy.

Abstract: Reproductions of the slides used in this presentation are provided. Included are charts listing turnaround factors, personnel and hardware requirements, user considerations, site selection considerations, and the steps necessary to establish procedures and production work flow. (12 p.)

Keywords: AUTOKON, computer technologies

Paper No. 8:

Title: A State of the Art Review of N/C. Pp. 151-159.

Author: John C. Williams, ITT Research Institute.

Abstract: A summary of the state-of-the-art (1975) in numerical control cutting technology is given. Changes and improvements from 1960 to the date of writing are summarized and presented. Productivity figures for the period are related to NC inventory. The trend appeared to be to more growth of NC into small job shops with future possibilities in direct N/C (DNC) systems, CNC systems, and CAM systems. (8 p.)

Keywords: Computer-aided manufacturing, numerical control

Paper No. 9:

Title: PRELIKON at MARAD. Pp. 161-173.

Author: Fred T. Johnson and Emmanuel N. Castrinakis, Maritime Administration.

Abstract: Included is a summary of the mission of MARAD's Office of Ship Construction and the goals of MARAD. The agency purchased AUTOKON '71 and arranged to free PRELIKON, a module of AUTOKON, from proprietary status. The paper discusses the results of those negotiations. PRELIKON is defined, the various modules presented, and changes made to the system for U.S. use are described. (13 p.)

Keywords: PRELIKON, computer-aided design.

Paper No. 10:

Title: Use of CAPICS for Cable Laying and Sizing in Tankers. Pp. 175-196.

Author: R. M. Priborsk, Electrical Research Association, and J. McIver, Cammell Laird Shipbuilders.

Abstract: CAPICS (Computer Aided Processing of Industrial Cabling Systems) is a set of linked computer programs designed to handle different aspects of the work involved in designing, installing, and commissioning electrical cabling projects. Its development was sponsored by the British National Research and Development Council. Its application to

the problem of cable system design in ships is described. A summary of the advantages to shipbuilders and future CAPICS development is provided. (22 p.)

Keywords: Computer software, electrical components, CAPICS

Paper No. 11:

Title: Unified Hull Definition System. Pp. 197-207.

Author: Michael Aughey, Naval Ship Engineering Center.

Abstract: This paper is adapted from an Arthur D. Little, Inc., report "Approaches to Computerized Lines Fairing" dated February 1971 and sponsored by the U.S. Navy. The report discusses the mathematical techniques used in lines fairing and details the known problems, deficiencies, and objections to these methods. The recommendation was not to design a new approach to lines fairing but to develop a single procedure of producing a mathematical hull definition from offset data. A system based on the "quick-look" component of the Navy's CASDOS system was suggested but rejected. A new Unified Hull Definition System was initiated. Preliminary results from the new system were favorable. (11 p.)

Keywords: Computer software, fairing

Paper No. 12:

Title: Robots in Shipbuilding. Pp. 209-217.

Author: Dennis W. Hanify, IIT Research Institute.

Abstract: The application of robots to the shipbuilding process is discussed. Two programs developed at IIT are described. Four areas of shipbuilding are identified as feasible to automate using robot-like systems: painting, sandblasting, grinding, and welding. (9 p.)

Keywords: Robots, paint systems, blasting and painting, grinding, welding

Paper No. 13:

Title: The Case Western Reserve N/C Frame Bending Machine. Pp. 219-246.

Author: Donald C. Braun, Case Western Reserve University.

Abstract: A ship frame bending machine that can operate under self-adaptive computer control is described. Advantages over conventional cold-forming and hot-slabbing bending processes include: elimination of the need for lofting or templates; compatibility with AUTOKON; reduced construction costs and time; and reduction of assembly costs. The primary emphasis of this paper is on the computer control algorithm used to accomplish the bending. (28 p.)

Keywords: Frame bending, numerical control

NSRP BIBLIOGRAPHY

Paper No. 14:

Title: Use of the SPADES System during the Engineering, Design, and Detail Phases. Pp. 247-254.

Author: Lonnie W. Lowery, Cali and Associates.

Abstract: This paper outlines a procedure for using SPADES software during the engineering design and detailing effort in shipbuilding. The following engineering functions are performed: hull form definition; scoutlings definition; detailed working drawings; and drawings revisions. (9 p.)

Keywords: SPADES, engineering design

Paper No. 15:

Title: Where is Computerization of Shipbuilding Today? Where is it Going? Pp. 255-260.

Author: W. Barkley Fritz, Sun Shipbuilding.

Abstract: A summary of Sun Ship usage of computer applications is presented. Applications are organized by technology or engineering discipline. It is suggested that computers will play an increasingly larger role in the industry. (6 p.)

Keywords: Computer technologies

Paper No. 16:

Title: An Interactive Graphics Minicomputer Based Ships Arrangements Program. Pp. 261-298.

Author: James R. Vander Schaaf, CADCOM, Inc.

Abstract: Some developments in the use of computer programs for arrangements design in the shipbuilding industry are listed. This paper describes a particular arrangement program, COGAP, written by Lockheed-Georgia for the Naval Ship Engineering Center, and the implementation by CADCOM, Inc., of a portion of COGAP on a minicomputer-based graphics system. (38 p.)

Keywords: Minicomputers, computer-aided design, graphics

Paper No. 17:

Title: AUTOFIT Computer Aided Design and Production of Piping Systems. Pp. 299-311.

Author: Ove Eng, Shipping Research Services.

Abstract: AUTOFIT is the name of a development project started in 1973 to study the problems of computer assistance to outfitting, particularly the design and production of

pipe systems. There are six freestanding subsystems: Systems design; Systems analysis; Systems arrangement; Arrangement calculations; Production preparation; and Material take-off. Each subsystem and its implementation are summarized. (13 p.)

Keywords: AUTOFIT, computer-aided design

Paper No. 18:

Title: A Report on the 1975 AUTOKON Users Club Meeting. Pp. 313-318.

Author: Haakon Saetersdal, Shipping Research Services.

Abstract: This report on the May 27-29, 1975, meeting in Bremen, Germany includes six appendices. Each is a paper presented at the meeting felt to be of most interest to American Shipbuilders. They are abstracted in Papers No. 19-24 below. (7 p.)

Keywords: AUTOKON Users Club

Paper No. 19:

Title: BEPLA - A Long Range Capacity Planning System. Pp. 319-326.

Author: Yngve Strom, Shipping Research Services.

Abstract: The Aker Group in Norway developed a long-range capacity planning system to handle the increasingly complex task of planning the long-range construction schedule at a shipyard. BEPLA is based on interactive network technique. Scheduling can be done on several levels of detail. An overview of the system is provided. (8 p.)

Keywords: Long-range planning, scheduling

Paper No. 20:

Title: PRELIKON - AUTOKON as Undivided Working Process. Pp. 327-332.

Author: Franjo Spincic, "3.MAJ" Shipyard and Diesel Engine Factory, Rijeka, Yugoslavia.

Abstract: The use of PRELIKON connected with related AUTOKON modules at the "3.MAJ" Shipyard is discussed. A system of programs, INDES, Initial Design of Ships, is used to help the designer when choosing main dimensions, the form of ships, when calculating hydrostatic values, speed, capacity, weight, position of center of gravity, and trim. FAIR2 is used to develop faired frames. The LANSKI and SHELL2 programs were also used with success. (6 p.)

Keywords: Computer software, PRELIKON

Paper No. 21:

NSRP BIBLIOGRAPHY

Title: Computer Controlled Numerical Control for Flamecutting: IHC Holland's Experience. Pp. 333-337.

Author: G. H. Doornink, IHC Holland.

Abstract: This paper describes the hardware and software used in flamecutting operations at the Smit yard. A CNC installation controls two flamecutters and one plotter. The software operates on a minicomputer and allows for a variety of input codes, scaling, listing on paper tapes, changes in data, and produces error listings. Reasons for choice of this configuration were based on price, performance, error detection and correction, and downtime risk. A brief summary of experience with the systems is included. (5 p.)

Keywords: Numerical control, cutting

Paper No. 22:

Title: Automation of Design and Production of Piping Systems. Pp. 339-358.

Author: Guido Baccara, Aldo Toso, and Pacle Naschio, Italcantieri, S.p.A., Italy.

Abstract: This paper presents a procedure for automated design and production of piping lines used in the Italcantieri yard in Italy. It is comprised of the following stages: definition of the functional diagrams; definition of the piping runs; issue of the operational documents and materials lists; manufacturing of the piping elements; and installation of the piping elements. (20 p.)

Keywords: Pipe fabrication, pipe handling

Paper No. 23:

Title: An Interactive Computer Graphics Approach to the Problem of Nesting of Plate Parts on a Raw Steel Format. Pp. 359-383.

Author: Jorn Oian, SRS, Bjorn Hasselknipe, CIIR, and Frank Lillenhagen, CIIR.

Abstract: This paper presents an approach to the problem of nesting plane parts. The system is tailored for nesting production parts prepared by ALKON 71/74. The system was implemented on the Norwegian minicomputers NORD-1 and SM-4 with a Tektronix 4014-1 graphics display unit. The system is designed to ease conversion to other computer and graphics displays and to interface with other parts generation systems with or without databases. (25 p.)

Keywords: Nesting, plates, computer graphics

Paper No. 24:

Title: The Application of AUTOKON to Drilling Rigs. Pp. 385-406.

Author: Jan F. Mack, Aker Group.

Abstract: This paper presents a summary of research in the Aker Group to apply the AUTOKON system to types of steel structures other than ships and, in particular, to drilling rigs. ALKON's capability of dealing with general data in matrix form and of applying pre-coded subroutines (NORMS) make it useful in describing general structures as well as ships. A project designed to produce the necessary database and to establish production procedures is described. (22 p.)

Keywords: AUTOKON, drilling rigs

NSRP 0002

UMTRI 70060

TITLE: REAPS 3rd Annual Technical Symposium. Proceedings. Twenty-six papers. (500 p.)

AUTHOR: IITRI.

DATE: 1976

Paper No. 1:

Title: Practical Shipbuilding Research and Development. Pp. 7-11.

Author: Ellsworth L. Peterson, Peterson Builders, Inc.

Abstract: The objectives and goals of SNAME's Ship Production Committee are described and the panels which make up the committee are listed. The Committee is made up of representatives from shipbuilders, the American Bureau of Shipping, the U.S. Coastguard, U.S. Navy Research and Development, and the Maritime Administration. The Panels make recommendations on projects to be conducted and the Committee then polls industry for application and usage potential. Finally, a prioritized list is submitted to MARAD. (6 p.)

Keywords: SNAME, Ship production committee panels

Paper No. 2:

Title: The New REAPS Program for U.S. Shipbuilders. Pp. 13-20.

Author: John C. Williams, IIT Research Institute.

Abstract: IITRI's involvement in support and maintenance for the AUTOKON 71 system is described as part of the REAPS program. The new REAPS program is a non-systems oriented effort to develop stand-alone automation modules without regard for specific hardware or software. New program elements are: Advance Planning; Technology Assessment; a Development Program; Technology Information Service; and a Discretionary Development Program. (6 p.)

Keywords: REAPS, IITRI

Paper No. 3:

NSRP BIBLIOGRAPHY

Title: A Status Report: The Reaps AUTOKON System. Pp. 21-51.

Author: Patricia D. Taska, IIT Research Institute.

Abstract: This report summarizes current (1976) REAPS AUTOKON supported versions. The features of standard U.S. Version B are described for each module. Another project is a simplified ALKON language with a shorter, more basic vocabulary to provide the beginner with a simpler approach to parts specification. Other projects in development are also described. (31 p.)

Keywords: AUTOKON, REAPS

Paper No. 4:

Title: Study for the Improvement of Motivation in the Shipbuilding Industry. Pp. 53-64.

Author: George A. Muench, San Jose State University.

Abstract: The primary results of a study on worker motivation in the shipbuilding industry are presented in executive summary. Motivation is analyzed in terms of various factors beginning with job satisfaction, the core factor around which all the other dimensions of the motivational process evolve. Other factors include job commitment and morale, job importance, working conditions and benefits, workers' perceptions of co-workers, promotion, and supervisor-worker relations. (12 p.)

Keywords: Employee motivation, human behavior, job satisfaction

Paper No. 5:

Title: SPARDIS - A Shipyard Production and Control System. Pp. 65-101.

Author: John J. McQuaide and Charles S. Jonson, National Steel and Shipbuilding Company.

Abstract: SPARDIS (Scheduling, Planning, and Reporting Data Information System) is a tool designed to assist in the scheduling and planning associated with the construction of ships at NASSCO. SPARDIS provides for explicit schedules, management reports, projection of material requirements, consolidation of workload by operation, control of the in process inventories, a consistent part-task identification method, and an engineering progress record. (37 p.)

Keywords: SPARDIS, production planning

Paper No. 6:

Title: SPADES System Current Developments. Pp. 103-132.

Author: Albrecht Schulze, Cali and Associates.

Abstract: Enhancements to the SPADES ship production and design system are described. The new modules are: Ship Production and Control Module (SPAC), a management information system; Detail Engineering Module (DEMO), that not only produces engineering drawings, but also aids in data collection and loading of the data base with information generated by the Engineering Department; and Pipe Length and End-Cuts Program (PLEC), a special program to aid in fabrication of complex three-dimensional pipe structures. Each module is fully described and sample output is included. (30 p.)

Keywords: SPADES, computer software, computer-aided manufacturing

Paper No. 7:

Title: AUTOKON's Approach to Interactive Nesting. Pp. 133-155.

Author: Jorn Oian, Shipping Research Services.

Abstract: This paper presents an approach to the problem of nesting plane parts. The system is tailored for nesting production parts prepared by ALKON 71/74. The system was implemented on the Norwegian minicomputers NORD-1 and SM-4 with a Taktronix 4014-1 graphics display unit. The system is designed to ease conversion to other computer and graphics displays and to interface with other parts generation systems with or without databases. This is a more recent version of Paper No. 23 of the REAPS 2nd Annual Technical Symposium. (see p. 12.014) (23 p.)

Keywords: Nesting, plates, computer graphics

Paper No. 8:

Title: The ADAGE Nesting and Drawing System. Pp. 157-182.

Author: Ned O. Shattuck, Adage, Inc.

Abstract: The ADAGE Interactive Nesting and Drawing System is based on the ADAGE GS/300 Interactive Graphics System and a main host computer. The main computer contains the ship's design routines, such as AUTOKON, and the Graphics Display System is used to display individual parts calculated by AUTOKON, to draw new parts as required, to visually nest these parts on a sheet metal plate and to display the tool path required to cut the nested parts layout. The configuration and software to be used at Italcantieri yard is described. (26 p.)

Keywords: Computer software, nesting, interactive graphics

Paper No. 9:

Title: SPADES Interactive Graphics at Avondale. Pp. 183-186.

Author: Filippo Cali, Cali and Associates.

Abstract: A brief survey of the production oriented Interactive Graphics version of the SPADES system for N/C Lofting at Avondale is given. Included are requirements and goals, and specifications for mainframe, disk storage, and CRT. (4 p.)

NSRP BIBLIOGRAPHY

Keywords: Interactive graphics

Paper No. 10:

Title: Implementing the U.S. Navy's Hull Definition Program in U.S. Shipyards. Pp. 187-203.

Author: John C. Gebhardt, CADCOM Inc.

Abstract: This paper describes the effort by CADCOM, Inc., to transfer the technology of the U.S. Navy's Unified Hull Definition System to the U.S. shipbuilding industry. Sections in the paper describe the following tasks: enhancing the program to make it responsive to the needs of the U.S. commercial shipbuilding industry; generation of four standard versions; creating full and complete program documentation; and conducting training seminars to speed the technology transfer process. (17 p.)

Keywords: Fairing, unified hull definition system

Paper No. 11:

Title: AUTOKON at a Small Yard. Pp. 205-215.

Author: Jesse Harkey, Port Weller Dry Docks, Ltd.

Abstract: The justification for purchase of a computerized numerical control system is related to increased savings. An account of the implementation of such a system at a small yard is given. (11 p.)

Keywords: AUTOKON, numerical control

Paper No. 12:

Title: NASA's Dissemination of Technology. Pp. 217-222.

Author: Louis N. Mogavero, NASA Headquarters.

Abstract: This paper describes NASA's Technology Utilization Program. The program is divided into three major activities. The technology database is made available via "Tech Briefs". In addition, a national network of dissemination centers designed to serve industry was established. Another component is COSMIC, the Computer Software Management Information Center. (6 p.)

Keywords: NASA, technology transfer

Paper No. 13:

Title: Automation and Productivity in Discrete Part Manufacturing. Pp. 223-235.

Author: John M. Evans, Jr., National Bureau of Standards.

Abstract: The state of automation and its significance in relation to productivity is discussed. Productivity increases through automation. The dominant technical strategy emerging in the automation of discrete part batch manufacturing is seen to be the integration of automated computer controlled materials handling systems with NC machine tools. (13 p.)

Keywords: Computer-aided manufacturing, automation, numerical control

Paper No. 14:

Title: Shipbuilding Equipment at Mitsubishi. Pp. 237-271.

Author: A. Kamata, Mitsubishi Heavy Industries, Ltd.

Abstract: Shipyard applications of the Mitsubishi horizontal fillet welding robot are reported in Part I. The system enables continuous automatic welding on the circuit of the lattice. The function, construction, and rotating mechanisms of the robot are described. Also included is a flow chart for a model yard, and welding applications for an actual ship. Part II describes an automatic subassembly machine that lifts, hauls, positions, and tack welds stiffening members to a conveyor-transported web plate to fabricate a deck, side or bottom transverse of the ship web frame. Part III describes a centrally controlled pipe processing system. (35 p.)

Keywords: Welding, automatic welding, fillet welds, robots

Paper No. 15:

Title: Use of PRELIKON at Zigler Shipyards. Pp. 273-283.

Author: Syed Mohammed, Zigler Shipyards.

Abstract: This paper discusses a small shipyard's use of PRELIKON in integrated ship design. Sections included are: The Shipyard and its capabilities; Necessity for a system such as PRELIKON; and PRELIKON and its capabilities. (11 p.)

Keywords: PRELIKON, ship design

Paper No. 16:

Title: The Navy's Cabling and Wiring Computer Program. Pp. 285-297.

Author: James Nellis, Naval Ship Engineering Center.

Abstract: This paper describes the Navy's Cabling and Wiring (C/W) program. The principal objective of the C/W System is the creation of a central configuration data management capability that will reduce drawing and installation time and revision and data transfer errors. The C/W System aids the installation process by providing the electrical and electronic information on listings that can be arranged into issuable work packages. (13 p.)

Keywords: Electrical components, cables, computer-aided design

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Paper No. 17:

Title: NASSCO Organization for the SPADES System. Pp. 299-310.

Author: George A. Uberti and Jack Wasserboehr, National Steel and Shipbuilding Co.

Abstract: This paper outlines NASSCO's internal company organization for the use of the SPADES system in ship production. An effective working relationship was established among the affected departments: Engineering, Production, and Computer Services. Four company functions were defined with respect to SPADES: Users; System Control; Computer Services; and Consultants. User functions are divided by the Production department (Mold loft) and the Engineering department (Hull division). System Control responsibility is vested with the Computer Support Group within the Engineering department. The Computer Services department provides all computer support except for scientific and technical programs. (12 p.)

Keywords: SPADES, organizational approach, management

Paper No. 18:

Title: Organizing for Numerical Control Production. Pp. 311-331.

Author: Vincent H. Nuzzo, Avondale Shipyards.

Abstract: Avondale's organization and experience in using SPADES for numerical control production is related. The structure of the principal management groups (Administrative, Engineering, and Production) is discussed. Sample output from the programs is included. Recommendations for the organizational pattern in a shipyard using numerical control techniques are appended. (21 p.)

Keywords: SPADES, organizational approach, management.

Paper No. 19:

Title: The Application of Numerical Control Systems to Plan Production, or N/C Part Definition Can Mean Plans Too! Pp. 333-367.

Author: Albert P. Wickham and Raymond W. Kucharski, General Dynamics/ Quincy.

Abstract: In AUTOKON the Parts Program "codes" individual parts using the system language and processes them in the computer to prepare N/C control data. This paper shows how parts definition language used to describe ships' parts for N/C fabrication can also be used to assist the designer/draftsman in producing ship's plans. Expanded coding techniques developed by General Dynamics that allow the efficient application of the AUTOKON Parts Program module to provide the interface between the drafting function and the numerically controlled flat-bed plotter are described. (35 p.)

Keywords: Numerical control, AUTOKON

Paper No. 20:

Title: A Report on the 1976 AUTOKON Users Club Meeting. Pp. 369-373.

Author: Haakon Saetersdal, Shipping research services.

Abstract: This report on the AUTOKON Users Club (AUC) 1976 meeting at the Chantiers Navals de la Ciotat yard near Marseille, France, includes six appendices. Each is a paper presented at the meeting felt to be of most interest to American shipbuilders. They are abstracted in Papers No. 21-26 below. (5 p.)

Keywords: AUTOKON Users Club

Paper No. 21:

Title: Report from Chantiers Naval de la Ciotat. Pp. 375-403.

Author: M. Gaillard, CNC, France.

Abstract: This paper details the use of AUTOKON at the CNC yard. Problems encountered by users and developments during implementation and use are included. One section evaluates use in terms of resources and expense. Data on man-hours and computer time for the construction of a large tanker at CNC is reported. (29 p.)

Keywords: AUTOKON, cost reduction

Paper No. 22:

Title: Hull System at Italcantieri Company. Pp. 404-418.

Author: Renzo Di Luca, ITC, Italy.

Abstract: This paper reports the Italcantieri (ITC) yard use of AUTOKON. Because some functions are not provided in the software, ITC developed SCAFO, a system that solves problems related to the shell structures and some related to the internal paneling. ITC used this system as an alternative to LANSKI and related programs because it reduced data volume and allowed easy maintenance for design alterations. ITC's experience using the various AUTOKON modules, including FAIR, is also reported. (15 p.)

Keywords: AUTOKON, SCAFO

Paper No. 23:

Title: User's Guide to the Norm Packages. Pp. 419-445.

Author: Jan F. Mack, Aker Group, Norway.

Abstract: This paper serves as a user's guide to the NORMS of the ALKON language. NORMS are advanced commands in the ALKON language that, when invoked, describe parts of a ship's steel structure. An example of a simple norm is a hole of a certain shape but with variable parameters. Examples of more complex norms are those building up a complete numerical description of all cutouts for longitudinals through a bulkhead as well as those defining floors and girders in the double bottom. The AUTOKON library contains

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600-700 norms. This user's guide explains the system and gives practical examples in its use. (29 p.)

Keywords: ALKON, AUTOKON, norms

Paper No. 24:

Title: ALKON from Lay-Out to Production on the Example of a Double-Bottom. Pp. 447-460.

Author: J. P. Boisard, Chantier de l'Atlantique, France.

Abstract: This paper reports the use of ALKON at Chantier de L'Atlantique (C.A.) yard. A specific application is described: the double-bottom, both in engine room and in the cargo area, of a container ship convertible to a cargo ship. The advantages of using ALKON norms to design a double bottom are presented. The steps involved are: preparation and drawing of the layout; automatic dividing of floors and girders at intersections; execution of a block-drawing of the double-bottom block; and transfer of double-bottom parts to production phase. (15 p.)

Keywords: ALKON, norms

Paper No. 25:

Title: Computer Graphics Hardware and Application in Shipbuilding. Pp. 461-472.

Author: Ove Eng, Shipping Research Services.

Abstract: Work of the Aker Group and SRS on planning and options in computer graphics hardware in shipbuilding is reported. The most significant results from this project are: an operational interactive parts nesting program; subroutine packages for handling of input commands, database administration, etc.; specification of a general tool for editing and presentation of drawings from databases containing geometry elements; and know-how about the computer graphics technology and available hardware and software. (12 p.)

Keywords: Computer graphics, interactive graphics

Paper No. 26:

Title: Interactive Graphics at IHC. Pp. 473-483.

Author: Mr. Maisson, IHC, Holland

Abstract: This paper describes IHC-Holland's use and future applications of graphics display units. Experiences with a Tektronix 4014-1 graphics display unit, installed to investigate the possibilities of interactive graphics are reported. Included are: characteristics of the terminal and software; applications for rapid graphic verification of PRELIKON and AUTOKON output, and the design of piping systems and developable hull forms; future plans for use in norms and parts verification and in interactive nesting. (11 p.)

Keywords: Interactive graphics

NSRP 0003

UMTRI 71134

TITLE: REAPS 4th Annual Technical Symposium. Proceedings. Twenty-five papers. (473 p.)

AUTHOR: Illinois Institute of Technology Research Institute.

DATE: 1977

Paper No. 1:

Title: The REAPS Program – Progress and Prospects. Pp. 1-12.

Author: Douglas J. Martin, IIT Research Institute.

Abstract: The origins of the REAPS program and its evolution since 1974 are reported. Projects underway in 1977 are briefly summarized. In addition, future projects scheduled to be started are listed. (13 p.)

Keywords: REAPS

Paper No. 2:

Title: N/C Justification in the Shipyard. Pp. 13-34.

Author: Charles M. French, Bath Iron Works.

Abstract: The experience at BIW in changing to computer-aided lofting and N/C burning is related. The approach taken was to evaluate present real needs, needs for the next five years, and the cost and benefit comparisons of N/C with 1/10 scale optical burning machines. BIW quantified the dollar savings in the areas significantly affected and measured the results in an audit. The approval of the project at BIW rested almost completely on the return shown in the financial analysis. (22 p.)

Keywords: Numerical control, computer-aided design, cost reduction

Paper No. 3:

Title: A Low Cost Parts Definition System. Pp. 35-39.

Author: Arthur F. Kaun, Newport News Shipbuilding.

Abstract: Slides used in this presentation are reproduced here. Benefits of the development of a low cost parts definition system are: utilization of graphical skills; reduction of computer costs; increased throughput; reductions in plotting; and the introduction of new capabilities. An interactive graphics approach was utilized by NNSDD. (5 p.)

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Keywords: Interactive graphics, cost reduction

Paper No. 4:

Title: Computer-Aided Engineering and Drafting in Shipbuilding. Pp. 41-68.

Author: Robert A. Cowan, Computervision Corporation.

Abstract: This paper addresses the problems and solutions facing companies in terms of the cost of creating design documentation, parts programming, the time wasted on tedious, repetitive tasks, long product lead times, lack of standardization, and the rising cost of manpower. The use of computers to aid in engineering and drafting is described with reference to the functional system requirements, system hardware and software, and design and drafting on an interactive graphics system. (28 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), interactive graphics, computer-aided design

Paper No. 5:

Title: User Requirements for the Newport News Interactive Pipe Design System (RAPID). Pp. 69-79.

Author: Patrick J. Kelly and Patrick W. Rourke, Newport News Shipbuilding.

Abstract: An overview of the minicomputer-based project for improved piping design called RAPID is presented in this paper. The aim of the program was to provide a low cost system for the capture and error checking of ship piping design in order to produce manufacturing documents for the piping shop. A summary of menus is included, as well as a discussion of the major user requirements for the system. General requirements included software portability, adaptability to other yards' requirements, software expandability, low cost, multiple use, efficiency, and response time. (11 p.)

Keywords: Interactive graphics, computer-aided design, piping design

Paper No. 6:

Title: Hierarchical Application of Computers for an Automated Pipe Shop. Pp. 81-88.

Author: Hirohiko Aya, Mitsui Engineering and Shipbuilding.

Abstract: The status of automation at Mitsui Engineering and Shipbuilding (MES) was the focus of this presentation. In 1972 MES developed and implemented the semi-automated pipe fabricating shop system (MAPS) at the Chika Shipyard. MAPS consists of two subsystems. The Numerical Information System furnishes the full numerical data required for fabrication of various kinds of pipes in the pipe shops. The Automated Pipe Fabricating System, the "hardware" of the system, is operated by data cards, requiring no experience or judgement by pipe workers. The basic objective of MAPS was to increase productivity and reduce costs. (8 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), pipe fabrication

Paper No. 7:

Title: Considerations for an Automated Pipe Fabrication Facility. Pp. 89-99.

Author: Ollie H. Gatlin, Avondale Shipyards.

Abstract: Avondale's study to design a cost effective and automatic method of fabricating pipe with the objectives of reducing labor, material handling, storage space, and the required fabrication area is described in this paper. The functions necessary to such a system are detailed. A chart, listing and comparing the existing and proposed time involved in manufacturing selected sample pipe pieces, is included as an addendum. (11 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), pipe fabrication

Paper No. 8:

Title: WORK-PAC: Work Planning and Control System. Pp. 101-134.

Author: Laurent C. Deschamps, SPAR Associates.

Abstract: The WORK-PAC program, developed by SPAR Associates, is a computer software package designed to improve shipyard labor planning and to monitor labor charges against planned estimates, measure job progress, and give notice to both real and potential labor over-runs and schedule slippages. It is designed to operate in parallel with SPAR's Material Requirement Planning and Control System, a project scheduling system, and SPAR's Basic Ship Estimating and Budgeting System. (34 p.)

Keywords: Planning and production control, scheduling, WORK-PAC

Paper No. 9:

Title: The Ingalls Production Planning and Control System. Pp. 135-166.

Author: James F. Davidson, Ingalls Shipbuilding Division.

Abstract: Ingalls' Production Planning and Control System assists in planning, budgeting, and tracking each work authorization developed to support the construction of each ship. The system is comprised of modules that have specific functions within the system as well as modules that interface with other modules. This paper provides a definition of terms, a description of each module's function, and diagrams of the module interfaces. The modules are: consolidated database module; budget allocation module; labor progressing module; labor manning module; labor rescheduling module; and labor reporting module. (32 p.)

Keywords: Planning and production control, labor standards

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Paper No. 10:

Title: SPCS – A Comprehensive System for Shipyard Production Control. Pp. 167-189.

Author: Roger Vaughn and Ronald Smith, A and P Appledore International.

Abstract: SPCS is a flexible approach to production control, aiming to supplement management rather than replace management decision by black-box decision rules. It consists of a set of inter-linked modules, each of which is executed either manually, by batch computer processing, or on line. The tasks addressed by the modules are: corporate planning and scheduling; contract scheduling; steelwork production scheduling and control; block assembly and steelwork erection scheduling and control; outfit installation scheduling; outfit installation parts control; outfit manufacturing scheduling and control; and purchase and stores control. (23 p.)

Keywords: Planning and production control, SPCS, management techniques

Paper No. 11:

Title: SPADES' Progress in Shipbuilding. Pp. 191-195.

Author: Vincent H. Nuzzo, Avondale Shipyards.

Abstract: The use of SPADES in ship construction at Avondale, NASSCO, Lockheed, and Levingston yards is related. The type/class of vessel is included. New features, such as part generation and nesting routines, are described. (5 p.)

Keywords: SPADES

Paper No. 12:

Title: On-Line Data Entry at Port Weller. Pp. 197-201.

Author: Jesse Harkey, Port Weller Dry Docks.

Abstract: The elimination of stored punched card files, the mechanical card reader and their replacement with electronic CRTs for online data entry to disk files is described in this report. A Varian V-76 model computer was purchased and coupled with CRTs in various departments to reduce the need for remote batch data transmission. (5 p.)

Keywords: CRTs, online data entry

Paper No. 13:

Title: The Bethlehem Damaged Stability Program. Pp. 203-223.

Author: Francis J. Slyker and Bruce G. Bohl, Bethlehem Steel.

Abstract: The need to meet damaged stability requirements for vessels other than passenger carriers resulted in Bethlehem's damaged righting arm program. The data base

consists of a mathematical model of the ship and its compartmentation. Calculations are made on the constant displacement principle. Net centers of buoyancy after damage are calculated at the equilibrium draft and trim for each angle of heel. From these, a righting arm curve can be constructed. Each module used in the package and the tasks it performs are outlined in the paper. (24 p.)

Keywords: Ship design, damaged stability

Paper No. 14:

Title: SPADES as an Aid in Ship Design. Pp. 225-252.

Author: Jan Ulsteen, Cali and Associates.

Abstract: This paper is intended to demonstrate how an existing N/C system, such as the SPADES system, can benefit design and engineering work during the design cycles prior to the production oriented N/C lofting. Because of the system's large data storage capability and the use of a common data base for storage and retrieval of all hull geometry and structural related data, such a use benefits engineering through the reduced amount of input required at each stage during the design. It also reduces the work necessary during the final engineering and lofting process. (28 p.)

Keywords: SPADES, ship design, design processes

Paper No. 15:

Title: Present and Future AUTOKON. Pp. 253-269.

Author: Jan F. Mack, Aker Engineering A/S.

Abstract: The AUTOKON 76 program is described and the main functions are outlined. Two new additions, AUTOFIT and Interactive AUTOKON, were development projects ongoing in 1977. The effort was directed at design of the product model and design and implementation of the first application programs. The key aspects of the product model were its ability to handle the iterations in the design process and the user interface. Priority in applications was given to an interactive part coding system, a general purpose drafting tool, an interactive nesting system, and a system for material specification. (14 p.)

Keywords: AUTOKON

Paper No. 16:

Title: New Features for REAPS AUTOKON. Pp. 271-286.

Author: Patricia D. Taska, IIT Research Institute.

Abstract: This paper describes the background of REAPS AUTOKON from its roots in the AUTOKON-71 System developed by Shipping Research Services (SRS) of Norway. The most recent developments to the REAPS version are outlined, including work by the Norms Enhancement Task Group on the ALKON module to produce a Simplified ALKON

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and the conversion of costly norms into ALKON commands. Work on the Standard U.S. Version C of REAPS ALKON is also described. (16 p.)

Keywords: REAPS AUTOKON, Simplified ALKON

Paper No. 17:

Title: User Experience With Simplified ALKON. Pp. 287-292.

Author: Bernard J. Breen, General Dynamics Corporation.

Abstract: The overheads used in the presentation of this paper are reproduced. Simplified ALKON is described as a method of offering a relatively simple parts generation language for N/C flame cutting demands while simultaneously allowing a sophisticated language for design and advanced manufacturing requirements. (6 p.)

Keywords: Simplified ALKON

Paper No. 18:

Title: Group Technology as Related to the Shipbuilding Industry. Pp. 293-317.

Author: Inyong Ham, Department of Industrial and Management Systems Engineering, Pennsylvania State University.

Abstract: Group Technology is an essential element of the foundation for the successful development and implementation of integrated computer-aided manufacturing through the application of the part-family concept. It is a manufacturing philosophy which identifies and exploits "the underlying sameness" of parts and the manufacturing process. By grouping similar parts into part families based on either their geometries or processes, it is possible to reduce costs through more effective design rationalization and design data retrieval, fewer stocks and purchases, simplified and improved production planning and control, reduction of tooling and set-up times, less in-process inventory, reduction of N/C programming, and a more efficient N/C machine utilization. (21 p.)

Keywords: Group technology, cost reduction, computer-aided manufacturing

Paper No. 19:

Title: The SFI Coding and Classification System. Pp. 319-333.

Author: Antonio Manchinu and Frank E. McConnell, Shipping Research Services.

Abstract: The SFI Group System is a classification system for ship technical and cost information. It was developed by a group of shipbuilders and shipping companies in Norway as a common ground for specification indexing, drawing, numbering, and cost accounting. The basic criteria were that it be applicable to all users, all types of ships, be simple and easy to understand, and be capable of understanding. It is designed to conform to a logical ship's specification, to accurately collect direct costs during the design, planning, and production phases, and to organize the return costs in a way that can easily be used as a basis for estimating the cost of similar ships in the future. (15 p.)

Keywords: Classification systems, cost reduction

Paper No. 20:

Title: How Smaller Shipyards Are Profitting Through N/C. Pp. 335-348.

Author: Donald P. Ross, Cali and Associates.

Abstract: The use of N/C lofting by nine small shipyards and boatbuilders as a tool to increase production efficiency and reduce costs is described in this paper. Each of the yards concluded that there had been a definite improvement in the quality of fitting and that, along with a reduction in fitting man-hours, there was also a reduction of welding man-hours. Actual cost savings are not included, but it is estimated that savings on the order of twenty percent of total steel construction is a conservative and reasonable expectation with the use of N/C lofted and cut parts. (6 p.)

Keywords: Numerical control

Paper No. 21:

Title: Computer Aided Ship Design and Construction in the Navy. Pp. 341-364.

Author: Thomas Corin, David W. Taylor Naval Ship Research and Development Center.

Abstract: The paper discusses a number of facets of Computer-Aided Ship Design and Construction (CASDAC). A brief history of computers in the Navy is given, some notes on the CASDAC project, summaries of two recent programs, Navy planning and philosophy in detail design and construction, some notes on the Computer-Aided Piping Design and Construction (CAPDAC) project, and finally some notes on the increasingly important role of computer science. (24 p.)

Keywords: Computer-aided design, piping design, detail design

Paper No. 22:

Title: Recent Developments in Computer Based Systems at Kockums. Pp. 365-399.

Author: Kai Holmgren, Kockums Computer Systems AB.

Abstract: Kockums Computer Systems' organization and operation is illustrated in this presentation. The slides and overheads used to describe the company and its programs are reproduced here, along with samples of typical processing routines utilized in ship design and production. (35 p.)

Keywords: Computer-aided design, ship design, computer technologies

Paper No. 23:

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Title: Applications of Water Jet Technology to Shipbuilding. Pp. 401-416.

Author: Thomas J. Labus, IIT Research Institute.

Abstract: The use of hydraulic techniques for ship hull cleaning/surface preparation and coating of primary metals is addressed in this paper. Two types of jets were investigated for the hull cleaning applications: conventional continuous jets and cavitation jets. Metal cutting development requires additional investigation to establish system performance capabilities and to assess its economic impact. (16 p.)

Keywords: Surface preparation, water jet cutting

Paper No. 24:

Title: The Application of a CNC Frame Bender in an Automated Shipyard. Pp. 417-446.

Author: James B. Acton, NASSCO, and Thomas P. MacKey, Hyde Products.

Abstract: The CNC frame bender is a machine utilizing a computer controlled method for the cold-forming of ship frames, especially large steel beams. This technology is designed to: shape steel frames by applying mostly pure bending moment to the members; use computer control with feedback to carry out the bending, including corrections for springback; eliminate out-of-plane deformation by built-in computer routines that correct incipient errors detected during the bending; and straighten beams in both horizontal and vertical planes. (31 p.)

Keywords: Frame bending

Paper No. 25:

Title: Special Interest Group Reports. Pp. 447-453.

Author: Douglas J. Martin, John C. Williams, and George P. Putnam, IIT Research Institute.

Abstract: Brief reports are given summarizing special interest group meetings on interactive graphics for lofting and drafting (Martin), production control systems (Williams), and pipe detailing and fabrication systems (Putnam). (6 p.)

Keywords: Interactive graphics, production control, pipe fabrication

NSRP 0004

UMTRI 71155

TITLE: Final Report: Feasibility of Forming Twist in Structural Ships for Shipbuilding.

AUTHOR: S. Rajagopal, IITRI.

DATE: March 1978

ABSTRACT: The objective of this venture was to investigate the feasibility of forming the twist, preferably at room temperature, using a set of forming dies in a hydraulic press. The structural T-sections were to be scaled down linearly by a factor of 5 to enable the experiments to be conducted in IITRI's 75 ton press. The main requirement on the twist was that it be accurate enough to allow joining of two consecutive members with as little mismatch as possible. Successful application of the twist forming technique would result in a higher production rate, elimination of heating furnaces and elimination of the oxidation problem caused by heating to elevated temperatures, through the use of existing hydraulic processes (250, 1000, and 2500 ton capacities) at NNS. (52 p.)

KEYWORDS: Structural shapes, forming, hydraulic press

NSRP 0005

UMTRI 70061

TITLE: REAPS 5th Annual Technical Symposium. Proceedings. Twenty papers. (565 p.)

AUTHOR: IITRI.

DATE: 1978

Paper No. 1:

Title: Reducing Production Man-Hours Through Design Office Procedures: Structural Designer-Fabricator Relationship. Pp. 11-31.

Author: Thomas P. Gallagher, Naval Ship Engineering Center.

Abstract: The author's experiences in participating in the development and implementation of a specialized computer system designed to reduce shipbuilding costs through automation of the design, detailing, and fabrication process is related. Included are observations and conclusions concerning the interrelationship of the design offices and the building yard. It is concluded that every person hour used in design should have a direct savings in production manhours. The goal of the designer's output should be a necessary and direct part of the construction program. (21 p.)

Keywords: Cost reduction, design-for-production

Paper No. 2:

Title: An Approach for the Use of Interactive Graphics in Part Definition and Nesting. Pp. 33-40.

Author: Arthur F. Kaun, Newport News Shipbuilding.

Abstract: The difficulties encountered in implementing an interactive graphics parts definition and nesting program are described. The two major areas of complexity are project constraints and marketplace constraints. Project constraints are differing parts definition approaches, shipyard sizes, different software (AUTOKON, Steerbear, SPADES), portability constraints, and accuracy considerations. The marketplace

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constraints are related to the changing technology of the software and hardware available. (8 p.)

Keywords: Parts definition, interactive graphics

Paper No. 3:

Title: Computers in Ship Design and Production: Necessary Steps to the Payoff. Pp. 41-65.

Author: Bernard M. Thomson, David W. Taylor Naval Ship Research and Development Center.

Abstract: Numerically controlled flame cutting systems are an integral part of the shipbuilding industry. Software systems to generate N/C instructions are also available. This paper cites directions of new developments in a number of leading systems and identifies several general trends in the development of shipbuilding software systems. (25 p.)

Keywords: Numerical control

Paper No. 4:

Title: MAPS-GP (Graphic Piping) Present and Future Capability. Pp. 67-80.

Author: Kenzou Kobayashi, Mitsui Engineering and Shipbuilding.

Abstract: This paper describes the Mitsui Advanced Production System (MAPS). It is comprised of these components: MAPS-GP, graphic piping system; MAPS-NC, graphic steel plate cutting system; MAPS-DATA, MD7000 workstation terminal; MAPS-GRAPH, YM9000 satellite graphic terminal; and MAPS-M, modularized plant production. (14 p.)

Keywords: Piping design, interactive graphics, Mitsui advanced production system (MAPS)

Paper No. 5:

Title: New SRS N/C Software Systems Development. Pp. 81-143.

Author: Paul F. Sorensen, Shipping Research Services.

Abstract: The Norwegian Central Institute for Industrial Research (CIIR) and the Aker Group formed a cooperative group called SIAG in the early 1960's. SRS is a member of SIAG and participates in the development projects. The two major projects are AUTOKON and AUTOFIT. This presentation consisted of four parts: (1) basic assumptions for the SIAG/CAD developments; (2) a description of interactive AUTOKON; (3) a description of AUTOFIT; and (4) hardware considerations. (63 p.)

Keywords: AUTOKON, AUTOFIT

Paper No. 6:

Title: Detail Engineering Module (DEMO) and Other SPADES Developments. Pp. 145-185.

Author: Albrecht Schulze, Cali and Associates.

Abstract: DEMO, the Detail Engineering Module, was planned to be capable of verifying the data base by means of drawings, and to develop a program oriented towards engineering needs which could be utilized in generation of the detail drawings. Actual detail drawings of the side frames of a vessel are reproduced, along with other samples of web frames and a bulkhead, all generated by DEMO. (41 p.)

Keywords: DEMO, SPADES, detail design

Paper No. 7:

Title: Computer-Aided Design Systems Applied to Ship Piping Design. Pp. 187-193.

Author: Arnold G. Reinhold, Computervision Corporation.

Abstract: This paper presents an overview of computer application in piping design and lists the characteristics of batch systems, interactive drafting, and interactive design. The outputs from an interactive design system are detailed and the advantages of off-the-shelf vs. custom designed systems are presented. It is concluded that off-the-shelf third generation interactive design systems are the right starting point for automating the ship piping design process. (7 p.)

Keywords: Computer-aided design, piping design

Paper No. 8:

Title: The Hitachi HICAS System. Pp. 195-246.

Author: Masaru Ueda, Hitachi Zosen Information Company.

Abstract: The slides used in this presentation are reproduced. They include schematics of the automatic piping design system, the system flow chart, shop machinery arrangements, and sample design output of pipe passages plans and pipe routes in a sample vessel. Also included are diagrams showing typical flow of the N/C pipe fabrication system and the pipe fabrication hardware system. (52 p.)

Keywords: Piping design, pipe fabrication

Paper No. 9:

Title: The SPADES Ship Production and Control (SPAC) Module. Pp. 247-286.

Author: Filippo Cali, Cali and Associates.

Abstract: This paper reports the status and development of the SPAC module, originally developed in 1976 to better control schedules and production. Modifications were made to

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expand the database for all ship systems other than steel; to allow SPAC integration with PARTGEN, the frame bending, plate development, and nesting program; and to add lofting reports and other output to the reports features. Various examples are appended of working documents for a notch tug in the process of being lofted. (40 p.)

Keywords: SPADES, SPAC, planning and production control

Paper No. 10:

Title: Improved Shipyard Control With TOMAS (Total Management System). Pp. 287-302.

Author: Antonio Manchinu, Shipping Research Services.

Abstract: The Total Management System is a shipyard management model developed from a detailed analysis of the integral functions of a shipyard. It is an integrated yet modular and flexible model of the yard's management functions and information systems. TOMAS is composed of seven main functions: planning, marketing, personnel, finance, engineering, material administration, and production. (6 p.)

Keywords: Management, management information systems

Paper No. 11:

Title: New Developments in CNC and DNC Controller Equipment for the Shipbuilding Industry. Pp. 303-312.

Author: Joseph W. Belanger, Kongsberg Systems, Inc.

Abstract: The ultimate goal of the project at Kongsberg was to produce controller equipment that would function in a Direct Numeric Control network and allow the end user to begin to achieve an "integrated manufacturing approach" to the flame cutting process. The aim is to provide paths for an automatic flow of information between computer-aided design functions, direct numeric control, and computer-aided manufacturing functions. (10 p.)

Keywords: Numerical control, computer-aided manufacturing

Paper No. 12:

Title: DNC/CNC Plate Cutting at Bath Iron Works. Pp. 313-348.

Author: George H. Peck, Bath Iron Works, and Russel M. Morgan, Union Carbide Corporation.

Abstract: This report provides an overview of the DNC/CNC cutting configuration employed at Bath Iron Works. Topics addressed include: the required system capabilities; the system configuration; the job file structure/design; the actual operation of the system; and the general results obtained. (36 p.)

Keywords: Numerical control, plates, cutting

Paper No. 13:

Title: A User's View of the SPADES HULLLOAD Program for Specifying Ship Structure. Pp. 349-372.

Author: E. Eugene Mayer, Levingston Shipbuilding Co.

Abstract: The HULLLOAD program defines the location of decks, sight edges, longitudinal bulkheads, and all structures that comprise a marine vessel. It is part of the SPADES N/C lofting system designed to automatically mark and cut steel ship parts. This paper describes its use from the viewpoint of the user. An appendix contains examples of deck coding, longitudinal bulkhead coding, shell seam coding, and a HULLLOAD body plan. (24 p.)

Keywords: Numerical control, SPADES, HULLLOAD

Paper No. 14:

Title: Steel Handling at National Steel and Shipbuilding Company. Pp. 373-405.

Author: Lee E. Hoffman and Charles W. Jensen, National Steel and Shipbuilding Company.

Abstract: This paper concerns the NASSCO steel handling facilities at San Diego. It describes the installation of an integrated, controlled system for the handling of shipbuilding steel from receipt of material through subassembly. The system both enables and demands a high order of production planning at the detail level. The conceptual strategy for the mechanized steel handling system is to achieve the desired capacity by moving steel rapidly, continuously, sequentially, and on pre-selected lines. (33 p.)

Keywords: Material handling, planning and production control

Paper No. 15:

Title: Improving Labor Productivity in Small Shipyards with Computer Assisted Structural Detailing. Pp. 407-422.

Author: M. R. Ward, RTL, Inc.

Abstract: This report describes a system involving an application of small computers in improving steelwork productivity in small shipyards. The major emphasis of the system is directed toward the improvement of the most important labor components of steelwork - fitting, welding, and erection - rather than the steelwork areas normally cited as candidates for productivity improvement - layout and cutting. The system requires a few people with some skill in layout and planning, but less shipbuilding knowledge on the part of the majority of the production force. (16 p.)

Keywords: Productivity, cost reduction

Paper No. 16:

NSRP BIBLIOGRAPHY

Title: AUTOKON on a Minicomputer. Pp. 423-433.

Author: Dennis K. Medlar, Designers and Planners, Inc.

Abstract: This paper describes the conversion of AUTOKON from a Univac 1100 to a Prime 400 system minicomputer. The previous system and its disadvantages are outlined. The new configuration is then presented along with a list of the benefits gained. Finally, the conversion of the software and the necessary changes are outlined. (11 p.)

Keywords: AUTOKON, minicomputers

Paper No. 17:

Title: Apprentice - A Portable Welding Robot for the Shipbuilding Industry. Pp. 435-443.

Author: Torsten H. Lindbom, Unimation, Inc.

Abstract: The Apprentice is a programmable welding manipulator. An operator places the robot where work is to be done, programs the machine to do the job, and oversees the operation. This paper describes the size and capabilities of the machine and includes a specifications sheet and photographs. (9 p.)

Keywords: Welding machines, robots

Paper No. 18:

Title: Improving Shipbuilding Productivity Through the Use of Standards. Pp. 445-472.

Author: John C. Mason, Bath Iron Works.

Abstract: The objective of this report is to provide an overview of the National Shipbuilding Standards Program effort and to illustrate the potential benefits of the use of standards. Included is an explanation of the ASTM Committee F-25 on Shipbuilding, the standards development procedure, and a summary of the Ship Producibility Research Program Shipbuilding Standards projects. (28 p.)

Keywords: Shipbuilding standards, shipbuilding standards program

Paper No. 19:

Title: User Guide to Interactive Lines Generation (HULGEN) with a Storage Tube. Pp. 473-515.

Author: Arthur F. Fuller, Advanced Design Branch, Naval Ship Engineering Center.

Abstract: The Ship Hull Form Generator (HULGEN) computes all of the initial parameters and control curves required to produce a body plan and provides the starting point for variations the user wishes to make. This paper is a guide to the features, capabilities, and uses of the program. (43 p.)

Keywords: HULGEN, hulls, computer-aided design

Paper No. 20:

Title: Users' Experience with the HULDEF Program. Pp. 517-543.

Author: Kenneth W. Pleasant, Newport News Shipbuilding.

Abstract: This paper reports the comparison of HULDEF, a program for fairing ships' lines, with other computer-aided methods at Newport News. It was used in conjunction with AUTOKON modules. An appendix contains fairing examples for a tanker with a bulbous bow, the forward section of an ocean liner, and a hard chined boat. (27 p.)

Keywords: Fairing, hulls, HULDEF

NSRP 0006

UMTRI 70062

TITLE: REAPS 6th Annual Technical Symposium. Proceedings. Thirty-one papers. (557 p.)

AUTHOR: ITRI.

DATE: 1979

Paper No. 1:

Title: Alternatives for Effective CAD/CAM Utilization. Pp. 11-21.

Author: Bernard J. Breen, General Dynamics Corporation.

Abstract: This presentation outlined the alternatives available in CAD/CAM utilization. The aims and objectives of CAD/CAM were listed, events in the defense industry forecasted, an estimate made of CAD/CAM potential savings, and an outline of how to proceed in scheduling the implementation of a system. (11 p.)

Keywords: Computer-aided manufacturing

Paper No. 2:

Title: The Shipbuilding Technology Transfer Program. Pp. 23-35.

Author: Robert R. Roper, Levingston Shipbuilding Company.

Abstract: Levingston Shipbuilding Company (LSCO) contracted with IHI for on-site engineering services to transfer Japanese production technology to American shipbuilders. A cost-sharing contract with MARAD was subsequently initiated to provide documentation and industry seminars to distribute program findings and production improvement results. The program was organized into six major task areas: Cost Accounting; Engineering and Design; Planning and Production Control; Facilities and Industrial Engineering; Quality Assurance; and Industrial Relations. (13 p.)

NSRP BIBLIOGRAPHY

Keywords: Technology transfer

Paper No. 3:

Title: Navy Manufacturing Technology Program. Pp. 37-58.

Author: David H. Carstater, Navy Manufacturing Technology.

Abstract: This paper presents an overview of the Navy's Manufacturing Technology program. Basic objectives of the program are to lower acquisition costs, support Navy needs, increase productivity, and to implement new technology. It provides seed money to accelerate the transition of emerging technology to industrial capability. Included is a summary of program highlights, completed studies, the technology transferred, and the program outlook. (22 p.)

Keywords: Manufacturing technology, technology transfer

Paper No. 4:

Title: The Role of Operations Research in Shipbuilding. Pp. 59-79.

Author: James Low and Steve Knapp, National Steel and Shipbuilding Company.

Abstract: This paper was intended to demonstrate possible applications of operations research techniques to the shipbuilding industry. A linear programming model and a discrete event oriented simulation technique are employed to provide alternative solutions to a set of hypothetical problems involving shipyard production. (21 p.)

Keywords: Operations research, simulation, linear programming

Paper No. 5:

Title: The Shipyard Product Information System as an Aid to Implementing More Productive Strategies. Pp. 81-101.

Author: Douglas J. Martin, IIT Research Institute.

Abstract: The heart of the Shipyard Product Information System is a logically structured product-oriented database called a product model. The model consists of a set of models which represent logically complete database subsets tailored to the needs of specific yard functions. The database is structured on the network model. How such a system would work is explained in this paper. (21 p.)

Keywords: Database management, management techniques

Paper No. 6:

Title: Semi-Automatic Pipe Production in a Small Shipyard. Pp. 103-121.

Author: Brian G. Waring, Port Weller Dry Docks.

Abstract: This paper was written with the small shipyard in mind, and suggests approaches to new piping systems incorporating the latest developments in production equipment and computer aids. The system described in this paper represents a first step towards semi-automatic pipe fabrication in a small yard. The programs are small, inexpensive to run, and represent initial attempts to support semi-automatic pipe production equipment with computer derived production data. (19 p.)

Keywords: Automation, pipe fabrication

Paper No. 7:

Title: The Avondale Pipe Shop: Hardware and Software Status. Pp. 123-128.

Author: Harris F. Arnold, Avondale Shipyards.

Abstract: The hardware configuration and software used in Avondale's semi-automatic pipe fabricating facility are outlined in this report. The functions such a system fulfills are listed in the first section. The software chosen was CAD/CAM, Lockheed's Computer-Aided Design and Manufacturing system. Reasons for selection and enhancements made to the system are included. (6 p.)

Keywords: Pipe fabrication, computer-aided manufacturing

Paper No. 8:

Title: A Progress Report on the CNC Ship Frame Bender. Pp. 129-149.

Author: Donald W. Wall, National Steel and Shipbuilding Company, and Filippo Cali, Cali and Associates.

Abstract: The U.S. Navy and NASSCO cooperated in building and testing a CNC Ship's Frame Bender, a hydraulically powered, computer controlled machine for cold-forming typical angle and "Tee" shapes used in the hulls of ships. The operation of the machine and the software and documentation for the system are outlined in this paper. (21 p.)

Keywords: Numerical control, frame bending

Paper No. 9:

Title: SHIPDS - SHIPLO: A Two-Phase Programming System for the Design of Surfaces in Shipbuilding. Pp. 151-172.

Author: Andreas Weichbrodt, University of Utah.

Abstract: This paper describes a first approach to a programming system that combines triangular and rectangular interpolation methods and applies them to a typical design problem in shipbuilding, the representation of a ship hull. The system is designed such that it requires only those data which are available from a common shiplines graph and produces the output in the most general form. This output is then used in a post-processor fashion by a graphical or production device. (22 p.)

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Keywords: Computer-aided design, hull design

Paper No. 10:

Title: AUTOKON's New Structural Design Capabilities: Moving into the Drawing Office. Pp. 173-200.

Author: Paul F. Sorensen, Shipping Research Services.

Abstract: This paper describes new modules added to the batch AUTOKON which make it attractive for use in the drawing office. By means of powerful and easy-to-use features, a computer-based structural model of surfaces, stiffeners, etc., may be established at an early stage. The model may be queried to produce a variety of drawings for design and production purposes. (28 p.)

Keywords: AUTOKON

Paper No. 11:

Title: HULSTRX - A CASDAC Computer Aid for Hull Structural Contract Design. Pp. 201-215.

Author: Stephen H. Klomparens, Hydronautics, Inc.

Abstract: This paper is a status report on the development of a computer-aided design tool for representing and displaying ship structure. Program Hull Structure (HULSTRX) was being developed for the Navy's (NAVSEA) Surface Ship Structures Branch as a part of the Navy's Computer-Aided Design and Construction (CASDAC) project. (15 p.)

Keywords: Computer-aided design, hull design

Paper No. 12:

Title: Network Scheduling of Shipyard Production, Engineering, and Material Procurement. Pp. 217-228.

Author: Marc Boucher, SPAR Associates, Inc.

Abstract: PERT-PAC is a production and control planning tool useful to shipyards in their scheduling, production, planning, and material procurement activities. It uses performance evaluation review techniques and special networking features that allow multiple access points and automatic re-scheduling capabilities. System features and benefits are illustrated. (12 p.)

Keywords: Production control, planning and production control

Paper No. 13:

Title: Planning and Ship Outfitting Production Control at Newport News. Pp. 229-248.

Author: Jerry Bollinger, Newport News Shipbuilding.

Abstract: This report provides a general overview of the techniques used in developing the Product Plan at Newport News and covers in more detail the implementation and control of the plan, with emphasis on ship outfitting. The intent is to inform interested parties about the Outfit Planning and Control Methods used. (20 p.)

Keywords: Planning and production control

Paper No. 14:

Title: An Integrated Interactive Plate Nesting and Manufacturing Planning System. Pp. 249-262.

Author: John M. Wallent and Paul M. Cofoni, General Dynamics.

Abstract: General Dynamics introduced a scheduling, planning, and production system designed to meet three requirements: (1) reduce the staging inventory to some specified working time span; (2) provide a method to plan and produce scheduling and trade work instructions automatically; and (3) improve the plate and equipment utilization to a more acceptable level. This paper describes the system and illustrates its functions. (14 p.)

Keywords: Production control, nesting

Paper No. 15:

Title: Cost-Effective N/C Processing in a Small Shipyard. Pp. 263-273.

Author: William Shipley, Martinette Marine, and Filippo Cali, Cali and Associates.

Abstract: As a result of schedule and cost problems, a decision was made to develop greater control over the schedules and costs of generating N/C programs at Martinette Marine. It was decided to convert to PNC and to add partial programming capability in-house. The technical development and hardware configurations employed are outlined in this report. (11 p.)

Keywords: Numerical control, cost reduction

Paper No. 16:

Title: AUTOKON-76/79 - An Affordable Implementation on Prime Minicomputers. Pp. 275-279.

Author: Jon Gude, Shipping Research Services.

Abstract: Cost reductions in computer hardware, making possible their use by all shipbuilders, are illustrated in this paper on a typical application. A configuration is outlined, costs for each item listed, and benefits detailed. (5 p.)

Keywords: Minicomputers, AUTOKON

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Paper No. 17:

Title: Minicomputer Applications for Long Range Planning. Pp. 281-290.

Author: Lawrence D. Eddy, National Steel and Shipbuilding Company.

Abstract: This paper describes the development and use of programs for long-range planning by NASSCO's Planning and Scheduling department. A Tektronix 4051 minicomputer was employed, along with programs written in BASIC, to generate estimates for schedules of ship deliveries, resource allocation, and manpower requirements for both firm and potential new businesses. (10 p.)

Keywords: Long-range planning, minicomputers

Paper No. 18:

Title: Shipbuilding Evaluation and Analysis System. Pp. 291-356.

Author: Joan Forman and John M. Hotaling, Maritime Administration.

Abstract: The elements of the computer model Shipbuilding Evaluation and Analysis System (SEAS) are discussed. SEAS is a group of modules designed to provide evaluations and analyses pertinent to all phases of shipbuilding. The following are typical SEAS applications: workload analyses of shipyards; assessment of building position availability and facility utilization; five-year shipbuilding forecast; and carriage capacity for specified ship construction programs. (66 p.)

Keywords: Economic models, SEAS

Paper No. 19:

Title: AUTOPART, AUTONEST, AUTODRAW - Systems for Interactive Generation of Production Information. Pp. 357-384.

Author: Paul F. Sorensen, Shipping Research Services.

Abstract: This paper describes AUTOPART, AUTONEST, and AUTODRAW, a suite of AUTOKON programs for parts definition, nesting, verification and general drafting. They are implemented in interactive graphics technology using a minicomputer and a Tektronix 4014 storage tube for communication. AUTOPART and AUTONEST may be used as a stand alone system providing N/C cutting information, partly replacing similar functions of the AUTOKON batch system. However, for shipbuilding, the 3 modules should be seen as an integral part of the whole AUTOKON system, offering higher efficiency and increased flexibility in the production and of the process. (28 p.)

Keywords: Interactive graphics, minicomputers, computer-aided design

Paper No. 20:

Title: Application of the GIFTS-5 Mini-Based Graphics System for Ship Design and Analysis. Pp. 385-408.

Author: Hussein A. Kamel, University of Arizona.

Abstract: The GIFTS finite element structural analysis system was developed with support from the office of Naval Research, the U.S. Coast Guard, and members of the GIFTS User Group. It is a general purpose, interactive, graphics-oriented collection of programs that have applications in ship structure analysis, both static and dynamic, as well as in preliminary ship design. (24 p.)

Keywords: Ship design, structural analysis, minicomputers

Paper No. 21:

Title: Data Processing Trends at Italcantieri: Present Software Products and Future Plans. Pp. 409-449.

Author: Piergiacomo Banda and Renzo Di Luca, Italcantieri.

Abstract: An overview of Italcantieri's development is given. Particular attention is paid to data processing development at the different yards in the system. A general description of the principal characteristics of the data processing environment is followed with descriptions of each of the principal software products employed in the production process. Finally, future software products are listed with a delivery plan for the first modules. (41 p.) Computer aided design (CAD)/Computer aided manufacturing (CAM)

Paper No. 22:

Title: Increased Shipbuilding Productivity through Production Engineering. Pp. 451-462.

Author: Frank H. Rack, Shipbuilding Consultants, Inc.

Abstract: The present state of American shipbuilding is reviewed. Major productivity improvement potential is suggested in the following shipyard areas: (1) Organization (People and Structure); (2) Engineering; (3) Planning and Production Control; (4) Material Handling and Control; and (5) Production Engineering. (12 p.)

Keywords: Production control, productivity, production engineering

Paper No. 23:

Title: Design for Production. Pp. 463-484.

Author: Ian S. MacDougall and David Carss, A and P Appledore Limited.

Abstract: The concept of Design for Production requires that the ship designer, in satisfying the Statement of Requirements for a given vessel, also pay close attention to ease-of-production. This paper defines the elements of a design-for-production approach to shipbuilding and illustrates the methodology required. (22 p.)

Keywords: Design/production integration, design processes

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Paper No. 24:

Title: Group Technology and Automated Process Planning: A Change in Management Strategy. Pp. 485-493.

Author: Alexander Houtzeel, Organization for Industrial Research, Inc.

Abstract: Trends toward increased customization increase problems associated with batch manufacturing, both in design and manufacturing itself. Group technology, an approach to finding common solutions for the same or similar problems, helps to solve these problems. The benefits in such applications as design retrieval, design standardization, standardization of machine tool routings, automated process planning, and machine tool investment can result in substantial savings. (13 p.)

Keywords: Group technology

Paper No. 25:

Title: Integrating Shipyard Design and Manufacturing Functions into an Existing CAD/CAM System. Pp. 495-504.

Author: Patrick J. Hanratty, Manufacturing and Consulting Services, Inc.

Abstract: This paper lists the functions and associated function control key designations for an existing CAD/CAM software system. (10 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM)

Paper No. 26:

Title: Current Status of the Low Cost Parts Definition Project. Pp. 505-508.

Author: Richard C. Moore, Newport News Shipbuilding.

Abstract: This paper reports on the status of the Interactive Graphics Part Definition (IPD) Project at Newport News. Included are the main requirements of the system, the functional areas addressed by IPD, the IPD hardware configuration, and an implementation schedule for the project. (4 p.)

Keywords: Interactive graphics, parts definition

Paper No. 27:

Title: Shipbuilding Steel - United States Vs. Japanese Philosophies. Pp. 509-522.

Author: E. Eugene Mayer, Levingston Shipbuilding Company.

Abstract: The author compares U.S. steel industry production to that of Japan, with particular reference to the industry's relationship to shipbuilder's needs. The lack of

production in the U.S. of the proper steel shapes for shipbuilding is a major concern. Charts and graphs detail the comparisons. (13 p.)

Keywords: Steel industry production

Paper No. 28:

Title: ICCAS '79 Highlights. Pp. 523-528.

Author: Richard C. Moore, Newport News Shipbuilding.

Abstract: The topics at the International Conference on Computer Applications in the Automation of Shipyard Operation and Ship Design, held June 18-21, 1979, in Glasgow, Scotland, are listed. Included is a list of the papers of interest in a title-author list. (6 p.)

Keywords: Automation

Paper No. 29:

Title: Exploiting DBMS in Shipbuilding. Pp. 529-532.

Author: O. J. Wolanyk, National Steel and Shipbuilding Company.

Abstract: This paper argues for DBMS use as a means of controlling corporate data. Information is defined as a corporate resource that should be managed. Reasons for doing so are: to improve the accuracy and timeliness of information; to be able to retrieve up-to-date information in a timely fashion; to reduce data redundancy; and to maintain data integrity and independence. (4 p.)

Keywords: Database management

Paper No. 30:

Title: Planning and Production Control for Small and Medium Size Yards. Pp. 533-534.

Author: James S. Sligar, Jeffboat Inc.

Abstract: The Special Interest Group meeting on Planning and Production Control for Small and Medium Size Yards is reported in this abstract. Areas of common interest were: Work measurement standards; Work packages for labor, material control, and scheduling purposes; Numerical control; and Computer applications other than business and accounting. (2 p.)

Keywords: Planning and production control

Paper No. 31:

Title: Common Shipyard Information System and Data Processing Problems. Pp. 535-537.

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Author: Donald A. Spanninga, National Steel and Shipbuilding Company.

Abstract: This paper is a report on the Special Interest Group meeting on Common Shipyard Information System and Data Processing Problems. (3 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), database management

NSRP 0007

UMTRI 70063

TITLE: REAPS 7th Annual Technical Symposium. Proceedings. Twenty-six papers. (621 p.)

AUTHOR: IITRI.

DATE: 1980

Paper No. 1:

Title: Ship Production Committee Panel Overviews. Pp. 7-74.

Author: Ship Production Committee Panel Chairmen.

Abstract: Interim reports for the NSRP Ship Production Committee Panels are given. Reports are included for SP-1, Shipyard Facilities and Environmental Effects; SP-2, Outfitting and Production Aids; SP-3, Surface Preparation and Coatings; SP-6, National Shipbuilding Standards Program; SP-8, Industrial Engineering; and progress reports on the REAPS Program and the Ship Producibility Research Program. (68 p.)

Keywords: Ship production committee panels

Paper No. 2:

Title: An Information Service for the Maritime Industry. Pp. 75-78.

Author: Davis G. Mellor, Maritime Research Information Service.

Abstract: The paper reviews the services and publications available to the maritime industry through the Maritime Research Information Service (MRIS). This is a computer based service sponsored by the Maritime Administration and operated by the Transportation Research Board of the National Research Council. Information distribution to the maritime industry is provided through monthly and semi-annual publications to subscribers, special bibliographies, computerized retrievals on request, and on-line retrieval directly through the Lockheed DIALOG System. (3 p.)

Keywords: Maritime Research Information Service (MRIS)

Paper No. 3:

Title: A Report on the IPAD National Symposium. Pp. 79-125.

Author: Douglas J. Martin, IIT Research Institute.

Abstract: The Integrated Programs for Aerospace-Vehicle Design (IPAD) Symposium, held 17-19 September, 1980, in Denver, was sponsored by NASA and the IPAD Industry Technical Advisory Board. The official IPAD Executive Summary is reproduced here. A description of IPAD, its capabilities, perspectives by the engineering executive, manager, user, and application programmer, and the IPAD development plan are presented. (47 p.)

Keywords: Integrated Programs for Aerospace Design (IPAD)

Paper No. 4:

Title: Fitness for Purpose: A New Look at Weld Defect Acceptance Criteria. Pp. 127-147.

Author: Leslie W. Sandor, Sun Ship, Inc.

Abstract: This presentation highlights the results of the "Weld Defect Tolerance Study" published under the Ship Producibility Program in June 1980. It is shown that the repair of innocuous defects currently adds .5 million dollars to 1 million dollars per ship in unnecessary cost, and that the end result in many cases may be even more deleterious to the completed structure. An update is provided on action being taken in the industry to improve/develop more rational acceptance standards for certain defects. (21 p.)

Keywords: Weld defect tolerance, weld repair

Paper No. 5:

Title: Hull Construction Tolerance Standards. Pp. 149-161.

Author: Thomas P. Krehnbrink, Sun Ship, Inc.

Abstract: A project to develop a trial set of representative hull construction tolerance standards was undertaken at Sun Ship. The trial standards served to test for possible industry consensus in this sensitive area. The standards include representative forming, distortion, alignment, fitup, plate fairness, and weld profile tolerances. Source material for these standards includes foreign commercial shipbuilding industry standards, U.S. Navy and Maritime Administration standards, and standards from individual U.S. and foreign shipyards. (13 p.)

Keywords: Shipbuilding standards program, hull construction

Paper No. 6:

Title: The IPD System for Interactive Part Coding and Nesting. Pp. 163-183.

Author: Richard C. Moore, Newport News Shipbuilding.

Abstract: The Interactive Graphics Part Definition project (IPD) at Newport News is described. The main requirements of the system are: real time definition of applications

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with graphic output; portability; expandability; and interface capability with AUTOKON/ SPADES/ STEER-BEAR systems. (21 p.)

Keywords: Interactive graphics

Paper No. 7:

Title: Shipyard Planning and the Computer: Fact or Fantasy? Pp. 185-194.

Author: Stephen M. Knapp, SPAR Associates, Inc.

Abstract: The planning environment in American shipyards has undergone a change of technique and attitude with the upswing in use of computers. Traditional planning mechanisms have given way to PERT networks and sophisticated data collection and reporting computer systems. Data processing has moved from the basic accounting arena into operations research and massive production-oriented systems which has diluted the planning effort. This is caused by planners which have not evolved from production, a planning attitude that the computer can solve all problems, and management's inability to recognize the shortcomings of computer software. Technology is available to assist the shipyard with total planning and complete ship's plans and schedules. These topics are addressed: (1) An analysis of traditional planning techniques; (2) An evaluation of data processing in the planning environment; (3) A critique of the computerized planner; (4) Recommendations for management planning, and data processing to improve the problem areas of computers in planning. (10 p.)

Keywords: Management, computer technologies

Paper No. 8:

Title: The Outfit Planning Program. Pp. 195-207.

Author: Leon F. McGinnis, Georgia Institute of Technology, and Robert J. Graves, University of Massachusetts.

Abstract: This paper presents a brief discussion of the shipbuilding process and focuses on one major component which is referred to as outfitting. The outfit planning problem is described in detail and then formally modeled as a generalization of the resource constrained project scheduling problem. The value of the approach as well as barriers to its adoption are also discussed. (13 p.)

Keywords: Outfitting, outfit planning

Paper No. 9:

Title: Drawing Office to Part Cutting with a Mini-Based On-Line System. Pp. 209-220.

Author: William A. Clark, Port Weller Dry Docks.

Abstract: Port Weller Dry Docks, a small, progressive Canadian shipyard installed AUTOKON-79, AUTOPART, AUTONEST and developed several pipe fabrication and

installation programs on an in-house PRIME 550 minicomputer. In addition, the company purchased several graphic peripherals and a Union Carbide Plasma burning machine with DNC capabilities that are used in conjunction with the software. This paper summarizes the reasons for making these moves, the justifications, and the problems encountered. (12 p.)

Keywords: AUTOKON, minicomputers

Paper No. 10:

Title: STEERBEAR 3 with Interactive Graphics. Pp. 221-244.

Author: Kai Holmgren, Kokums Computer Systems AB.

Abstract: The development of the next generation of STEERBEAR (SB3) is described. New features are: interactive graphics; improved facilities for handling 3-D curves and surfaces; parametric design modules; distribution of the workload between mainframes, minicomputers, and microcomputers. (24 p.)

Keywords: STEERBEAR, interactive graphics

Paper No. 11:

Title: Economics of Computers in Shipyard Production Control. Pp. 245-267.

Author: Donald E. Lincoln, Portsmouth Naval Shipyard, James A. Burbank and James R. McReynolds, Corporate-Tech Planning, Inc.

Abstract: Like private shipyards, naval shipyards are focusing on improved production planning, scheduling, labor/progress data collection, and industrial engineering as the main thrust of their productivity improvement programs. The naval shipyards are drawing heavily on the use of computers to support these functions. One project, the subject of this paper, is of particular interest since a computer is used to integrate planning, scheduling, work-in-process tracking and labor standards to provide a closed-loop production control system for a key production shop at the Portsmouth Naval Shipyard. This system achieved operational status during the spring of 1980. A complete economic history of its initial economic justification, development and operating costs and preliminary indications of payback are now available. Since the design of this system makes it quite appropriate for private shipyard use, the data included within this paper should be of interest to those concerned with the economics of computers in private shipyard production control functions. (23 p.)

Keywords: Computer technologies, production control

Paper No. 12:

Title: Application of Modular Software to Establish a "Closed Loop" System for Shipyard Production Control. Pp. 269-287.

Author: Henry S. Burgess, Arthur Andersen and Company.

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Abstract: This paper addresses the key functions of a closed-loop production and planning control system generally applicable to the ship-building industry. A key feature of the shipbuilding closed-loop system is the application of made-to-order concepts not generally used in production and inventory planning, and control systems for other industries. The use of modular packaged software to make the system operational on a timely step-by-step basis is explored. Special considerations for tailoring the software to satisfy general shipbuilding requirements are reviewed. A summary of the potential benefits of a closed-loop system (i.e., "what if" planning) is also included. (19 p.)

Keywords: Production control, production planning

Paper No. 13:

Title: Photogrammetric Three-Dimensional Digitizing of Piping Arrangement Scale Models for Computer Input. Pp. 289-336.

Author: John F. Kenefick, Photogrammetric Consultants, Inc.

Abstract: In July 1976 MarAd, in cooperation with Todd Shipyards Corporation, Seattle Division, published a National Shipbuilding Research Program report entitled "Photogrammetry in Shipbuilding". Efforts put forth in the conduct of that project represented the U.S. shipbuilding industry's first exposure to photogrammetry, the science of obtaining two- and three-dimensional measurements from photographs. Included within that report were detailed descriptions of four surveys conducted under real shipyard conditions. In the project described here, photogrammetric procedures and basic computer programs were developed which would allow piping geometry and events to be expressed in terms of coordinates in a ship's coordinate system; i.e., in precisely the same form that input to computerized pipe detailing systems must be presented. The fact that piping geometry can be "lifted" photogrammetrically from a design model is not so striking until one considers the alternative methods. Only then does the practicality of photogrammetry become clear. Without extreme measures, pipe lengths and in-line locations of pipe events can be determined with a typical accuracy of plus or minus one half an inch or better, onboard from photographs of a 1:15 design model. (47 p.)

Keywords: Photogrammetry, piping design

Paper No. 14:

Title: Generating New Ship Lines from a Parent Hull Using Section Area Curve Variation. Pp. 337-369.

Author: Robert McNaul, Maritime Administration.

Abstract: Section area curve variation may be used to obtain a new set of fair ship lines from a parent hull by varying any of all of the following parameters: prismatic coefficient, longitudinal center of buoyancy, extent of parallel midbed, or slopes at entrance and run. A standard series may be obtained by varying any one of these parameters independently while holding the other parameters constant. Deriving a new set of ship lines using this approach has an advantage over other methods since a known parent hull with good stability, resistance, seakeeping, etc., qualities may be selected as the starting point for the new design. In this paper a linear system of 10 simultaneous equations is presented which allows the independent variation of three of the parameters: prismatic coefficient,

longitudinal center of buoyancy, and extent of parallel midbody on a parent section curve. Another linear system of 12 simultaneous equations is presented which allows the independent variation of the above three parameters and the slopes at the entrance and run of a parent section area curve. A new set of ship lines can be obtained directly from the new section area curve. Matrix methods are used to solve the systems of equations. Several examples with numeric and graphic results from a computer program developed at the Maritime Administration are presented (33 p.)

Keywords: Computer-aided design, hull design

Paper No. 15:

Title: A New Approach to Fabrication Drawings. Pp. 371-391.

Author: Donald P. Ross, Cali and Associates, Inc.

Abstract: In this paper a problem is discussed that has existed in the shipbuilding industry for many years; that is, how to present to production workers fabrication drawings that are more accurate, less cumbersome, and easily understood. An approach to solving this problem through use of N/C lofting software is presented and discussed. (21 p.)

Keywords: Fabrication drawings

Paper No. 16:

Title: Evaluation of Alternative Generic Coatings in Different Ship Areas. Pp. 393-401.

Author: Benjamin S. Fultz, Offshore Power Systems.

Abstract: The information contained within this presentation was obtained from a research project performed under the National Shipbuilding Research Program. The following results were achieved to improve the paint system selection process: establishment of a computer program of paint service histories which demonstrates that valid conclusions can be reached as to which generic paint type is best for a specified area of this ship; support by laboratory testing of performance trends of the computer program analysis; demonstration by laboratory testing that careful evaluation of paint suppliers is necessary; indications that careful selection of laboratory test methods and evaluation parameters to duplicate service conditions can serve as a screening method for candidate paint(s); and identification of craft interference and premature area release for painting prior to compartment completion. That is, poor paint planning and scheduling is the major cause of inordinately high ship painting costs. (15 p.)

Keywords: Painting, coating materials

Paper No. 17:

Title: QC Circles for Improving Quality and Productivity. Pp. 403-408.

Author: C. Philip Alexander, Ann Arbor Consulting Associates, Inc.

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Abstract: In 1962 the first Quality Control Circle was launched in Japan under the auspices of the Japanese Union of Scientists and Engineers (JUSE). The heart of the QC Circle program is a highly trained workforce engaged in identifying and implementing opportunities for improving their own immediate working situation, the product they make, or the service which they provide. This comes about in small groups or Circles of workers which have volunteered to be trained in QC Circle techniques. These Circles select and work on problems or opportunities for improvement, and then with management approval implement them. These small groups of 5 to 10 workers are normal work groups and usually include the supervisor or foreman. (6 p.)

Keywords: Quality assurance, quality control, Quality (control) Circles

Paper No. 18:

Title: New Applications of Industrial Robots to Shipbuilding. Pp. 409-430.

Author: John W. Hill, SRI International.

Abstract: Based on shipyard visits and a review of current ship construction, several new applications of industrial robots to shipbuilding are proposed. Preliminary estimates indicate that the time required to perform certain shipyard tasks could be decreased by 50 percent to 80 percent by the addition of various robot workstation concepts. Though control of robot workstations may eventually be integrated into CAD/CAM systems, manual techniques can currently be adopted, permitting a worker to program a robot station. Applications include, but are not limited to: (1) use of robots for welding in both fixed shop installations and movable field installations; (2) use of robots for flame or plasma arc cutting of irregularly shaped pieces such as profiles; (3) use of robots for grinding; and (4) use of robots for blasting and painting operations, particularly in the shop environment where booths surrounding the equipment can be used to shield other workers and to keep the shop clean. (22 p.)

Keywords: Robots, welding, cutting, blasting and painting

Paper No. 19:

Title: The Avondale Pipe Shop: Preparing for Production. Pp. 431-441.

Author: Harris F. Arnold, Avondale Shipyards, Inc.

Abstract: The Pipe Shop Management System was designed to meet the following objectives: 1) to provide a Manufacturing System that would be tightly coupled with the CADAM System; 2) to provide a total system that would assist in the smooth operation of the Pipe Shop; and 3) to provide a system that would increase productivity in the Pipe Shop and the Avondale functions supporting the production of pipe spools. To meet the above overall objectives, it was decided, after an evaluation of the functions, that the IBM COPICS software packages would be used. COPICS is an interactive data base manufacturing software system using terminals. (11 p.)

Keywords: Pipe fabrication, production planning

Paper No. 20:

Title: Automated Handling for Flame Cutting. Pp. 443-454.

Author: John A. Seelinger, Anderson Engineers, Inc.

Abstract: Steel plate handling, in support of flame cutting machines, is usually the major factor limiting the machine's productivity. This is particularly true with the new, faster CNC controlled machines equipped with plasma-arc cutting equipment used in conjunction with water tables. This paper provides the essential principles and stages of plate handling for a shipyard cutting operation. Typical solutions for both the existing shipyard and the new facility are covered, focusing on the importance of automated equipment to attain maximum production levels and peripheral benefits from today's fast, dependable, and accurate cutting machines. Efficient use of the proper equipment produces cost saving benefits by minimizing labor-intensive stations and providing accurate cut parts to maximize the employment of fixture and robot welding. (12 p.)

Keywords: Numerical control, cutting, plasma cutting

Paper No. 21:

Title: Development of Effective Computer Capabilities by the J. J. Henry Company. Pp. 455-471.

Author: W. Barkley Fritz, J. J. Henry Company.

Abstract: On April 2, 1980, the J. J. Henry Company, Inc. signed an agreement with Cali and Associates to use the SPADES system of computer programs to enhance its preliminary contract and detail design service for its clients. As a design agent for the shipbuilding industry, J. J. Henry had been making use of computers for many years; however, this latest step involved a major extension of its production services to computer-aided design. The paper briefly discusses the new SPADES service, the facilities installed, the training required, and the problems in getting the new service into full production on a very tight schedule. Also included is a listing of the application programs available via its terminal facilities using a variety of off-site computer network services. (17 p.)

Keywords: Computer-aided design, SPADES

Paper No. 22:

Title: Use of AUTOKON Design Facilities - A Designer's Presentation of an Actual Case. Pp. 473-506.

Author: Hans Oigarden, Shipping Research Services A/S.

Abstract: Use of AUTOKON design modules is demonstrated in case studies for a chemical carrier, for a passenger cargo vessel, and for box structures, superstructures, and hatch covers. (24 p.)

Keywords: AUTOKON, ship design, computer-aided design

Paper No. 23:

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Title: Japanese Technology That Could Improve U.S. Shipbuilding Productivity. Pp. 507-536.

Author: James R. Vander Schaaf, IIT Research Institute.

Abstract: This presentation highlights various aspects of Japanese Shipbuilding practices with emphasis on those of Ishikawajima-Harima Industries (IHI). Topics discussed include zone planning and outfitting, design and material definition and shipbuilding standards and modules. (30 p.)

Keywords: Zone planning, zone outfitting, IHI

Paper No. 24:

Title: Implementing IHI Technology at Avondale. Pp. 537-554.

Author: Charles J. Starckenburg, Avondale Shipyards, Inc.

Abstract: This is a presentation of basic advantages, successes, and problems experienced with the introduction of IHI technology into an American shipyard. Fundamental and historical patterns that must change in order for this technology to be completely successful are discussed. (18 p.)

Keywords: Technology transfer, IHI

Paper No. 25:

Title: Improving Shipbuilding Productivity Through Industrial Engineering. Pp. 555-566.

Author: Raymond P. Lutz, University of Texas.

Abstract: The introduction of Industrial Engineering to shipbuilding contributes to the elevation of the level of technology in the industry. This paper discusses the advantages of studying work methods and establishing engineered job standards. Examples are given from various industries and suggestions for applications in shipbuilding are made. (12 p.)

Keywords: Industrial engineering, labor standards

Paper No. 26:

Title: An Overview of the Manual and Computer "MOST" Work Measurement Systems. Pp. 567-590.

Author: William M. Yates, Jr., H. B. Maynard and Company.

Abstract: Maynard Operation Sequence Technique (MOST) is a system for the establishment and maintenance of engineered labor time standards. The procedure involves documentation of work conditions; work measurement techniques (MOST); sub-operation data development; a filing system for sub-operation data; and calculation formats

for final time standards. This report gives a summary of the manual and automated versions of the system with analysis examples and outlines of procedures. (24 p.)

Keywords: Maynard Operation Sequence Technique (MOST), MOST

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TITLE: REAPS 8th Annual Technical Symposium. Proceedings. Twenty-eight papers. (634 p.)

AUTHOR: IITRI.

DATE: 1981

Paper No. 1:

Title: Ship Production Committee Panel Overviews. Pp. 5-93.

Author: Ship Production Committee Panel Chairmen.

Abstract: Summaries of NSRP Ship Production Committee Panel activities and projects are provided for the following panels: SP-2, Outfitting and Production Aids; SP-1/3, Shipyard Facilities and Environmental Effects; the IREAPS Program; SP-4, Design/Production Integration; SP-6, National Shipbuilding Standards Program; SP-7, Welding; SP-8, Industrial Engineering; SP-023-1, Surface Preparation and Coatings; and SP-9, Education and Training. (89 p.)

Keywords: Ship production committee panels

Paper No. 2:

Title: The AUTOFIT CAD/CAM System for Piping Engineering: Operational Experience and Development Status. Pp. 95-105.

Author: Frank Dahle, Shipping Research Services A/S.

Abstract: AUTOFIT is built up around a main database that includes all information necessary for piping design and detail engineering. The system is also prepared to interface other tasks and functions as: analyses planning, shop automation and including other engineering disciplines (steel structuring, material control, purchasing, quality control). AUTOFIT meets the need for communication through a flexible command processor. The user can choose his own user interface such as language, screen configuration, several ways of giving input, or degree of interaction. (11 p.)

Keywords: AUTOFIT, pipe design, Computer aided design (CAD)/Computer aided manufacturing (CAM)

Paper No. 3:

NSRP BIBLIOGRAPHY

Title: AUTODRAW: AUTOKON's Interactive Graphics System for Viewing and Manipulating Structural Model Data into Complete Drawing Documentation. Pp. 107-123.

Author: Frans van Cuilenborg, Shipping Research Services A/S.

Abstract: AUTOKON is an integrated system for the shipbuilding industry. The system consists of a "BATCH" and an "INTERACTIVE" part. The batch oriented programs are: BOF/LANSKI/SHELL/TRALOS/TRADET/DRAW/PARTO/ALKON. The interactive oriented programs are: DFREC/AUTO-NEST/AUTO-LINK/AUTO-INIT/AUTO-PART/AUTO-DRAW/KINGDRAW/TRAPAR. AUTODRAW is a program to verify the contents of a DATA-BASE and to make complete drawings with that data. (17 p.)

Keywords: AUTODRAW, interactive graphics

Paper No. 4:

Title: Using AUTOKON from Early Design: Recent Experience from Actual Ship Designs. Pp. 125-143.

Author: Hans Oigarden, Shipping Research Services A/S.

Abstract: This paper includes a short outline of design modules; results of a 12,500 TDW chemical carrier; economical comparison between the first project (an 11,000 TDW) and the last project (a 12,550 TDW chemical carrier) done in SRS utilizing design modules; and the results from a 128,000 TDW oil tanker, from an early design stage, to use of AUTODRAW. (19 p.)

Keywords: Design processes, computer-aided design

Paper No. 5:

Title: Japanese Shipbuilding Techniques: Surface Preparation and Coating - Materials and Methodology. Pp. 145-152.

Author: Gerald C. Soltz, GCS Corrosion Consultants, Inc.

Abstract: In this paper the Japanese and United States Shipbuilding Industries' coating systems and surface preparation and application methods are compared. The surface preparation and paint planning process as it relates to zone construction will be discussed in detail. (8 p.)

Keywords: Coating methods, coating systems

Paper No. 6:

Title: The Implementation of Production Engineering Techniques at Norfolk Shipbuilding and Drydock Corporation. Pp. 153-174.

Author: Malcolm Bell, A and P Appledore Limited, and Les Flora, Norshipco.

Abstract: Norfolk Shipbuilding and Drydock Corporation was about to start production of a floating dock to their own account. Design drawings were obtained from a naval architectural consultant. Norshipco was aware that the information on the design drawings had to be transferred to working drawings and, where possible, the producibility of the structure improved. The paper describes how this task was carried out, the drawing formats used, and the structural and outfit changes made. (22 p.)

Keywords: Design/production integration, design engineering

Paper No. 7:

Title: A Management Simulator for Shop Stores in The U.S. Naval Shipyards. Pp. 175-184.

Author: Hugh E. Warren, California State University, Los Angeles.

Abstract: For several years shop stores have been served by a package of computer programs with many sophisticated options. Among these options are management control parameters for changing reorder points and order quantities on a global basis. The parameters had not been widely used until a pair of simulator programs gave inventory managers a means to link values of the control parameters with measures of performance. The first simulator looks at individual shop stores items and allows them to be classified. Some items may not be appropriate for forecasting techniques, some may benefit from hand set reorder points and order quantities and others may best be given totally to computerized rules. The second simulator considers the totally computerized items and enables management to make the chosen tradeoffs in performance for these items as a group. (12 p.)

Keywords: Management information systems, material control

Paper No. 8:

Title: U.S. Navy CAD/CAM Program Hull Structure (HULSTRX). Pp. 185-232.

Author: David Helgerson and Eric Byler, Advanced Marine Enterprises, Inc.

Abstract: This paper is a status report on the development of HULSTRX and its integration into the Navy CAD/CAM Program. It presents the implementation of the system outlined by S. Klomprens at the 1979 meeting of REAPS. The HULSTRX Program effort is aimed at the development of a ship data base containing the locations and scantlings of all hull structural members based upon an established description of the internal and external hull geometry. The data base to be generated will be used for three purposes: (a) development of structural contract design guidance drawings; (b) dissemination of pertinent structural information to other areas of ship design such as arrangement developments, weight estimation and distributive systems backgrounds and composites; and (c) as an aid for the development of structural details, fabrication drawings, and generation of N/C data. (48 p.)

Keywords: HULSTRX, Computer aided design (CAD)/Computer aided manufacturing (CAM), hull design

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Paper No. 9:

Title: BRITSHIPS – Shipbuilding CAD/CAM in Productive Application. Pp. 233-262.

Author: D. R. Patterson, British Ship Research Association.

Abstract: BRITSHIPS is the generic title for a computer system built from related ship design/production software created by the British Ship Research Association (BSRA). The integrated system has been the subject of continuous development since it first went into use in the late 1960s, and won a Queen's Award to Industry for technological innovation in 1974. BSRA is the central research and development agency for the British shipbuilding industry. BRITSHIPS has been developed in close consultation with the industry and is a reflection of the practical needs of the shipbuilders. The system is constantly updated in line with advances in design and production technology, advances in computing methods, and the developing requirements of the shipbuilding community. This paper describes the structure and organization of the system, and the facilities it offers. (30 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), BRITSHIPS, production planning

Paper No. 10:

Title: A National Coalition for the Shipbuilding Technology Program. Pp. 263-286.

Author: F. William Helming III, Softech, Inc.

Abstract: An investigation of an approach to a U.S. Navy sponsored shipbuilding technology program is discussed. An approach is recommended, and a detailed project plan for a shipbuilding technology program is proposed. (24 p.)

Keywords: Computer technologies, shipbuilding technology

Paper No. 11:

Title: Economic Benefits and Technology of Cu/Ni Ship Hull Sheathing. Pp. 287-310.

Author: Leslie W. Sandor, The Franklin Research Center, and L. McDonald Schetky, International Copper Research Association, Inc.

Abstract: Fuel consumption of ships is related to hull roughness. The increasing high cost of fuel is the driving force behind the efforts that are expended in looking for methods which would reduce hull roughness and would maintain a smooth hull surface profile during the designed life of a ship. One such desirable method involves the use of copper-nickel. This study examined a number of methodologies for applying Cu/Ni in sheet form. The welding of Cu/Ni clad steel was also evaluated in a shipyard environment. The cost differential between Cu/Ni sheathed and conventional painted hulls was determined for a large container ship. The economic analysis was based on 1980 cost figures and a specific application method of Cu/Ni hull sheathing. The results were 33.5 percent for the effective

discounted cash rate of return and 4.2 years for the zero-interest breakeven point, against an initial incremental investment of 3.4 million dollars using 45 percent tax rate. (24 p.)

Keywords: Hull sheathing, copper-nickel sheathing, cost reduction

Paper No. 12:

Title: A CNC Sheetmetal Fabrication System for Production of Ships Ventilation Components and Flatwork. Pp. 311-320.

Author: Thomas R. Galie, Naval Ship Systems Engineering Station, and David R. Blais, Bath Iron Works Corporation.

Abstract: Shipyard methods for fabricating ventilation and flatwork are key cost drives in ship production. They consist of a multitude of repetitious operations, resulting in excessive manhours and material costs. By utilizing computer graphics technology and Computer Numeric Control (CNC) machine tools, it is possible to reduce the manhours required for fabrication of ventilation and flatwork by as much as 40 percent. Benefits resulting from increased efficiency in materials use, in-process storage, and production planning may also be realized by users. In addition, the U.S. Navy can benefit through a reduction in ship production costs, increased production capacity, and spread of a new technology adaptable to many shipyards. This paper discusses a joint effort by the Naval Ship Systems Engineering Station (NAVSSSES) and the Bath Iron Works Corporation (BIW) to develop and implement a Computer-Aided Manufacturing (CAM) system for cutting the cost of fabricating ventilation and flatwork in BIW sheetmetal operation. It is a cost-shared project, funded by the Navy under its Manufacturing Technology (MAN TECH) program. (10 p.)

Keywords: Numerical control, ventilation equipment, sheetmetal fabrication

Paper No. 13:

Title: Ship Structural Cost Program. Pp. 321-324.

Author: Anthony Furio, David Taylor Naval Shipyard.

Abstract: A ship-cost computer tool has been developed to estimate U.S. Naval Surface Ship construction for both shop and field Engineered Uniform Method and Standards and current Naval shipbuilding practices. This procedure has been incorporated into the Ship Structural Cost Program (SSCP) to provide a means of rapidly estimating structural cost for ship structures. In this form SSCP provides a three-phase analysis where the shop erection and field installation procedures are included in Phase 2 and 3 and the panel/grillage shop assembly procedures are included in Phase 1. The overall aim of the cost program is to develop a cost/weight tradeoff tool that has the capability of performing weight/cost optimization tradeoff studies. This information will become useful for Navy research and design communities in assessing high cost areas in the new ship construction, identification of optimum plate-beam combinations with respect to cost and/or weight, and the identification of materials and design details which tend to reduce cost. (5 p.)

Keywords: Cost accounting, Ship structural cost program

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Paper No. 14:

Title: Human Performance Engineering: On Reversing the Productivity Slowdown.
Pp. 335-358.

Author: D. Chris Anderson, University of Notre Dame.

Abstract: In this paper a human performance engineering approach to increased work productivity is outlined. Three applications are summarized by way of illustrating its major advantages and features, one in manufacturing, one in a service, and one in a sales setting. The ingredients of this approach start with a precise statement of desired company objectives in terms of behavior changes that may be required of individual workers. An accurate and reliable behavior counting system is needed next to learn exactly what workers are doing so that graduated steps in the form of individual, public charting is then to be introduced. Following a suitable period, a potent and relevant positive consequence consistently should be given for behavior increases or for maintenance of an acceptable performance. Various safeguards, test for effectiveness, and implications are discussed. (24 p.)

Keywords: Management-labor relations, manpower planning

Paper No. 15:

Title: Productivity Navy Style. Pp. 359-367.

Author: James W. Tweeddale, Office of the Assistant Secretary of the Navy.

Abstract: Productivity improvement is a most difficult concept to come to grips with in the operations of a central, national government. The term "productivity improvement" is most generally considered to mean the beneficial results of acts of innovation or change which are undertaken for the purpose of producing a greater output from a given input of resources. This paper describes a productivity program which is being implemented within the Navy industrial base. Three years of successful experience have shed considerable light on the management of change in large military organizations with a rigid institutional structure. The paper draws attention to major dimensions of the Navy's program and to the process of managing for productivity improvement. (13 p.)

Keywords: Productivity, management, management techniques

Paper No. 16:

Title: Quality Circles... Doing Business Better at Philadelphia Naval Shipyard.
Pp. 369-376.

Author: Richard Bradley, Philadelphia Naval Shipyard.

Abstract: An overview of quality circle philosophy and a status report on the quality circles at the Philadelphia Naval Shipyard are given. A management presentation covers problem identification and techniques, along with accomplishments and recommendations concerning the problem "loft time at tool room window". Other accomplishments and other problems under consideration are also discussed. A general overview of the Naval Sea Systems Command facilities involved in quality circles is presented, and in conclusion,

keys to a successful quality circle program, and proper procedures for implementation are defined. (8 p.)

Keywords: Quality (control) Circles, management

Paper No. 17:

Title: 'SPADES' System: On Interactive Graphics. Pp. 377-397.

Author: Lonnie W. Lowery, Cali and Associates, Inc.

Abstract: The unique requirements of shipbuilding do not afford easy application of graphics systems from other industries. What happens if a drawing revision affects the part? If the instructions that produced the original were not saved, the entire part would have to be redone, instead of just introducing the changes. The 'SPADES' System is designed to work either in batch or in an Interactive Graphic mode. All 'SPADES' Modules - in addition to using the same input handling routine and postprocessor - make extensive use of common general routines. No incompatibility exists between the various modules. One of the major advantages is interchangeability between the graphic and batch mode of the system so that rework could be processed easily, whether the original work had been done through the 'CRT' or in batch. (21 p.)

Keywords: SPADES, interactive graphics

Paper No. 18:

Title: MOST Computer Systems: Shipyard Applications. Pp. 399-424.

Author: Louis M. Kuh, H. B. Maynard and Company, Inc.

Abstract: An overview of the Most Computer System is presented, as it may best be applied in the shipyard, including the structure of time data for shipyard use. The simplicity and ease of preparing methods improvements with the computer aided materials are outlined, and examples from shipyard applications are reviewed. (26 p.)

Keywords: MOST, labor standards

Paper No. 19:

Title: Interactive Parts Definition Project. Pp. 425-441.

Author: Richard C. Moore and Arthur F. Kaun, Newport News Shipbuilding.

Abstract: This project permits IREAPS shipyards to introduce interactive graphics economically into their production environment. The uses and benefits of the deliverables are examined. The project accomplished some key interfaces and shipbuilding refinements. (17 p.)

Keywords: Interactive parts definition, parts definition

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Paper No. 20:

Title: An Approach to Successful Shipyard Planning and Scheduling. Pp. 443-457.

Author: Stephen M. Knapp, Spar Associates, Inc.

Abstract: Critical paths, "I-J" nodes, and activity duration are all words of the network designer. All are usually foreign to the shipyard planner, and in general, shipyard planning personnel tend to shy away from the networking plan, and subsequently schedule, the production work orders required to complete the construction of any vessel, regardless of its complexity. The fundamental approach to successful shop production planning and scheduling using networking techniques that have reduced planning time dramatically are described. Two basic criteria for the planning and scheduling network are "simplicity" and "accuracy". Simplicity is concerned with the creation, development, and maintenance of a production plan. Accuracy defines the manner in which the plan reflects the actual construction of the vessel in question. (15 p.)

Keywords: Planning and scheduling, networking

Paper No. 21:

Title: Planning and Scheduling Ship Construction Subject to Limited Resources. Pp. 459-476.

Author: Laurent C. Deschamps, Spar Associates, Inc.

Abstract: The over-riding concern in shipbuilding today is how to increase productivity. However, attention instead should be focused upon improving management policy. Quality of goods and services produced and the improvement of production operations from a controlled learning experience should be management's primary goals. By concentrating on these, increased productivity will be a by-product. This discussion addresses the vital need to consider and accommodate the impact of limited resources (manpower, floor space, crane capacity, etc.) to the planning problem. Often ignored by planning, resources, if not available in sufficient quantities, or not applied properly, will most definitely lead to higher costs and longer production schedules. (18 p.)

Keywords: Planning and scheduling, production planning, scheduling

Paper No. 22:

Title: Implementation of a Practical Planning and Production Control System in Small and Medium Sized Shipyards. Pp. 477-495.

Author: J. Niel Spillane, Shipbuilding Consultants.

Abstract: Small and medium sized shipyards (200 to 1000 employees) find that they have the management control problems of the major shipbuilders but are without the staff and administrative resources to easily cope with them. Although the depth of detail required in a small shipyard planning and production control system will vary with product complexity, personnel strengths, and contract construction period, the basic elements of a sound system are markedly similar and cannot be ignored without incurring loss of performance, deterioration of productivity and schedule delay. (19 p.)

Keywords: Planning and production control, production planning

Paper No. 23:

Title: A Practical Approach to Using Standard Software Packages in Small Shipyards. Pp. 497-504.

Author: George H. Hoffman, St. Louis Ship.

Abstract: In the growth of a shipbuilding concern, a time arrives when manual efforts to control cost and report status become undesirable. However, when an attempt is made to apply readily available software, many obstacles are presented. One approach to avoid many of these obstacles is addressed. By describing vessel construction through a network of dated work orders, and the treating of this network as a structured bill of material, standard software packages can be used to manipulate the data necessary to provide material requirements planning and job cost accounting. Critical issues impacting the selection and successful implementation of computerized systems are also discussed. (8 p.)

Keywords: Computer software, material control, cost accounting

Paper No. 24:

Title: A Case Study Using Models in the Shipbuilding Industry. Pp. 505-526.

Author: John W. Rohrer, Universal Services Association, Inc., and Gilbert L. Kraine, Sun Ship, Inc.

Abstract: Engineering models can be a better way to accomplish project objectives and open new doors for improvements in operational and management techniques. Thinking must be changed from studying and designing on paper to designing on a model. Initial modeling efforts may be difficult but some of the problems can be reduced by the lessons learned. When an appreciation of the value of models and the ease by which they can be constructed is gained, the model will become part of the standard design procedure. (17 p.)

Keywords: Physical models

Paper No. 25:

Title: Producibility from Conceptual Design to Ship Construction. Pp. 523-544.

Author: Ian S. MacDougall, A and P Appledore Limited.

Abstract: Producibility concepts may be applied in a variety of ways. Three main classifications are identified: (1) at the conceptual design stage; (2) at the design development stage; and, (3) as a method of reducing operational costs by removing work content, shortening the construction time and rationalizing material requirements of existing designs. This paper reviews the effectiveness and likely benefits to be gained from these three approaches and examines design engineering, production engineering, facilities engineering and personnel engineering as applied at these three levels. (23 p.)

Keywords: Design engineering, facilities engineering, production engineering, producibility

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Paper No. 26:

Title: Computer Assisted Process Planning: A First Step Toward Integration. Pp. 543-549.

Author: Alexander Houtzeel, Organization for Industrial Research, Inc.

Abstract: Computer assisted process planning can be a first step toward the integrated use of computers in the design and manufacturing process to improve productivity in batch manufacturing. The key to the process of integration is a part-feature recognition method to analyze and retrieve manufacturing processes and arrive at least-cost designs consistently linked to "best" manufacturing processes. Major problems are incompatible computers, software, and people. (7 p.)

Keywords: Process planning, computer-aided manufacturing

Paper No. 27:

Title: Productivity: Management's Bonus (!) or Failure (???). Pp. 551-574.

Author: Frank H. Rack, Shipbuilding Consultants, Inc.

Abstract: Productivity starts with planning and ends with timely deliveries. Its objectives are satisfied customers and the achievement of profit goals. Thus productivity in its broad sense, means more than just meeting engineered time standards of output throughout the manufacturing cycle. Some reasons given as managerial weaknesses underlying the productivity problem are: (1) failure to develop adequate planning in advance for the production cycle; (2) inability to accurately and fairly measure productivity throughout the cycle; (3) failure to control the production cycle even where measurement techniques have been implemented; and (4) inattentiveness to legitimate complaints, or recommendations, advanced by employees. (24 p.)

Keywords: Productivity, management, production planning

Paper No. 28:

Title: U.S. Shipbuilding Standards Program: Long-Range Plan. Pp. 575-597.

Author: Yoshinonu Ichinose, IHI Marine Technology, Inc.

Abstract: Ishikawajima-Harima Heavy Industries/IHI-Marine Technology is developing a long-range plan for the U.S. shipbuilding standards program. Primary emphasis of the long-range plan is directed at near term (2 to 3 year) priorities to achieve maximum benefits at both industry and individual shipyard levels. Secondary emphasis is aimed at developing midterm (5 to 7 year) and long-term (10 to 20 year) goals to serve as planning guidelines for ongoing efforts. The basic goals and objectives of the U.S. shipbuilding standards program long-range plan are summarized. Included are such examples as the need to reduce design and engineering cycle time costs, the need to shorten manufacturing lead times for critical materials, and the desirability of implementing outfit unit construction and accuracy control concepts. The recommended organizational infrastructure for standards development is addressed, and appropriate divisions of responsibility among ASTM Committee F-25 on standards, SNAME Panel SP-6 on

standards and specifications, the government, shipbuilders, regulatory agencies, supporting industries and other concerned parties are discussed. (24 p.)

Keywords: Shipbuilding standards program, standards

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TITLE: IREAPS 9th Annual Technical Symposium. Proceedings. 2 Vols. Thirty-three papers. (Vol. I, 611 p.; Vol. II, 260 p.)

AUTHOR: IITRI.

DATE: 1982

Papers from NSRP 0009, Volume I.

Paper No. 1:

Title: Keynote Address: Considerations Regarding Improved Productivity Based Upon Experience of Series Production of Merchant Ships. Pp. 1-21.

Author: Cato F. Sverdrup, Burmeister and Wain Shipyard.

Abstract: In 1960 B and W Shipyard commissioned new yard facilities, introducing new building methods with large blocks (modules, sections) assembled in the building dock by gantry cranes. To ensure effective operation of such facilities, computer based sophisticated planning and control systems were developed. The anticipated improvement in production efficiency of the new system remained, for the first decade of operation, as it was with traditional shipbuilding. Upon thorough analysis of the situation the yard management was forced to acknowledge that the excessive complexity of systems applied had made the understanding of fundamental parameters for successful planning and control of new systems ambiguous. The yard started to simplify all phases of the shipbuilding processes. Discarding complicated systems, efforts were centered on series production of ships to improve productivity. Over a two-year period the yard more than doubled the throughput while at the same time reducing man-hours per ship by close to 50 percent. Specializing in Panamax bulk carriers at peak efficiency, the yard launched one vessel from its building dock every 28 working days. Some basic considerations are covered as to how productivity can be achieved by relying more on common sense than on complicated computer systems. (21 p.)

Keywords: Productivity, production planning

Paper No. 2:

Title: PARTGEN: An Advanced Interactive Method for Highly Automated Parts Generation Based on the Design Model Data. Pp. 23-42.

Author: Frans van Cuilenborg, Shipping Research Services.

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Abstract: This is a brief introduction to the present status of the AUTOMODL development effort (AUTOKON) and an indepth description of the first module of an AUTOMODL named PARTGEN. PARTGEN works on a topological model of the ship and is stored in the database. PARTGEN uses extensively interactive graphics and will virtually eliminate 90 percent of what today is called partcoding in the production phase. In addition to performing part generation, PARTGEN also has other valuable functions. It can do fairing of lines, interactively, to establish a preliminary hull form for building up the design model in the database. It has a report generator whereby the user can make extensive reports from the database and make user formulated layouts on the reports. PARTGEN also includes extensive automatic updating procedures due to changes. This is a benefit of having parts for production stored as topological data instead of as geometry. (20 p.)

Keywords: PARTGEN, interactive graphics

Paper No. 3:

Title: CASA: A System for Computer Aided Ship Accommodation. Pp. 43-75.

Author: Piergiacomo Banda and Giustiniano Di Filippo, Italcantieri.

Abstract: The Computer Aided Ship Accommodation (CASA) system has been planned for the production of drawings of high graphic quality, the relevant bill of material, and the preparation of the workshop documentation. The system uses interactive graphic techniques to facilitate both the man-machine communication and to increase the throughput and flexibility of the program. CASA has three main modules: (1) Description of standards; (2) Description of ship design data; and (3) Interactive automatic design. From description of construction data and standards with the aid of interactive functions of CASA, "automatic" and "interactive" design are developed. (23 p.)

Keywords: CASA (Computer Aided Ship Accommodation system), computer-aided design

Paper No. 4:

Title: An Integration Approach to Computer Aided Design Systems for Ship Design. Pp. 77-110.

Author: John R. Knobel, SofTech, Inc.

Abstract: The use of Computer Aided Design (CAD) tools has become increasingly common in the ship design and manufacturing industries over the last decade. These tools have often evolved from small individual efforts developed by one or two engineers into major programs on which large portions of the ship design effort depend. In many cases the management of the computer system has not kept pace with the evolution of the software. This paper describes an approach taken to the development of computer systems to minimize some of the resulting problems. The underlying premise is that the objective of the system is to increase the overall productivity of the organization instead of the productivity of any single technical discipline. The conclusions reached were that more consideration should be given to the data storage, management, and communication capabilities of current computers by the ship design organizations in addition to the effort of developing design or analysis programs. The conceptual system design that resulted

from applying this approach to a particular organization is presented along with a description of the first software item implementing this concept. (34 p.)

Keywords: Computer aided design (CAD)/Computer aided manufacturing (CAM), computer-aided design

Paper No. 5:

Title: Small Shipyard Productivity Increases Through Integrated Manpower, Schedule and Material Control. Pp. 111-140.

Author: Laurent C. Deschamps, SPAR Associates, Inc.

Abstract: This paper describes the need for fully integrating all aspects of shipbuilding so that current resources can be utilized in the most effective and cost-efficient way. The integration of manpower, scheduling, and material control using mini-computer planning, and cost/schedule control systems have proved to be extremely beneficial to small and medium sized shipyards. These systems have given management an added insight into areas that have been troublesome. By integrating all efforts of the shipyard plan, relative merits of new production techniques can be measured and evaluated. This extension of management visibility and control permits the shipyard to implement new technologies with far more confidence than possible before. (30 p.)

Keywords: Management techniques, productivity

Paper No. 6:

Title: The Conception and Construction of a High Productivity Barge Building Shipyard. Pp. 141-150.

Author: Frank H. Rack, Shipbuilding Consultants, Inc.

Abstract: Shipbuilding Consultants, Inc. (SCI) of Dickinson, Texas, acting as consultant to Bergeron Industries, Inc. (BII) of St. Bernard, Louisiana, and with the assistance of the Carlson Corporation (CC) as architect/engineers, conceived, designed, and constructed a new high productivity shipyard on an 88 acre site near Demopolis, Alabama, for rapid multiple construction of barges up to 300 foot length size range. One barge is to be delivered every other day. Five major modules per barge are fabricated and assembled by an indoor semi-automated production line feeding sequential outdoor erection positions. Barges are launched via a winch controlled launch system from the elevated site which is 80 feet above the Tombigbee River. This paper describes the facility layout and production features. Further, the actual construction from ground breaking (9/28/81) to first barge christening, and facility dedication (4/21/82) to first barge launch (6/29/82) in nine months is discussed. (10 p.)

Keywords: Facilities planning, facility layout

Paper No. 7:

Title: So You Want to Use Engineering Models. Pp. 151-160.

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Author: John W. Rohrer, USA Models.

Abstract: Concerns and requirements for making use of models within a company are presented. Alternatives are weighed, suggested approaches are provided, and some of the people requirements, and other resources necessary to have a successful program are discussed. A new model program must be planned into the design program. It must be sold to management and the various design personnel, and integrated into the present way of doing things. (10 p.)

Keywords: Physical models, engineering models, design models

Paper No. 8:

Title: Modern Ship Repair Technology Applied to Naval Vessels. Pp. 161-176.

Author: James H. Shoemaker, Norfolk Naval Shipyard.

Abstract: During the past several years the Maritime Administration has sponsored the National Shipbuilding Research Program (NSRP). The primary thrust of this program has been to identify those techniques which have enabled the Japanese to become world leaders in shipbuilding. To date, the NSRP has been directed primarily toward new construction. However, in the Fall of 1981, Norfolk Naval Shipyard embarked on a program to adapt these techniques to the repair of naval ships. This effort is based on the Outfit Planning and Product Work Breakdown Structure methodology presented in the NSRP publications. (See NSRP 0164) Further, a mini-computer system has been installed at Norfolk which allows schedules to be produced in a real-time manner. This system allows the shipyard to take full advantage of the NSRP techniques. (16 p.)

Keywords: Outfit planning, product work breakdown structure

Paper No. 9:

Title: HULSTRX: A U.S. Navy Structural Design Model. Pp. 177-195.

Author: Jon Gude and Stephen H. Klomparens, Designers and Planners, Inc.

Abstract: The concepts and status of the HULSTRX development, along with a discussion of its utility in the rapidly changing U.S. Navy ship design environment, are presented. HULSTRX provides for definition of ship structure at preliminary and contract design levels in terms of absolute geometric data and relational component data. Relational structural component definitions allow for quick design changes, and absolute geometric description of the hull surface can be independently defined. Application routines will enable designers to efficiently produce design drawings, various structural and geometric analyses, and interface with design or product models of other systems. (19 p.)

Keywords: HULSTRX, structural design, hull design

Paper No. 10:

Title: Interactive Computer Support for the Improvement of Planning and Production Control in the Shipyard Environment. Pp. 197-215.

Author: Richard A. Bihl, Planning Research Corporation.

Abstract: Planning Research Corporation has been working with the U.S. Navy in providing a unique production management system for Navy Intermediate Maintenance Activities (IMAs). This system, successfully adapted from commercially proven techniques and underpinned by engineered labor performance standards, is in use at the Shore Intermediate Maintenance Activities (SIMA) Norfolk, Virginia and Mayport, Florida. The engineered labor performance standards, developed as Engineered Time Values (E.T.V.), provide a means to accurately plan, schedule and progress work, to exercise production control on a real-time basis and to analyze factors affecting productivity in order to effect remedial action. A key feature of the Engineered Time Values (ETV) System is the Productivity Management Information Component (PMIC) which supports these functions through the use of interactive computer equipment. (19 p.)

Keywords: Engineered labor standards, labor standards, planning and production control

Paper No. 11:

Title: Rapid Development of Production Schedules with Standard Planning Modules. Pp. 217-234.

Author: Stephen M. Knapp, SPAR Associates, Inc.

Abstract: Standard Planning Modules represent production work package arrangements which are predefined to simplify the creation of planning networks at the central planning level. The approach centers around the notion that a vast majority of production activities can be established without the aid of available, detailed engineering. The creation of work packages under this approach is dependent solely upon historical production performance, adaptation of work from previous vessels of the same class, specific details provided by the vessel's specification, and general arrangement engineering drawings. Final production schedules become a derivative of the planning schedule as detailed information becomes available from engineering, material procurement, and other sources. (18 p.)

Keywords: Production planning, production scheduling

Paper No. 12:

Title: Standards for Production Planning and Control in Shipyard Shops. Pp. 235-245.

Author: Robert J. Graves, University of Massachusetts, Leon F. McGinnis, Georgia Institute of Technology, and Rodney A. Robinson, Corporate-Tech Planning, Inc.

Abstract: This paper addresses the problem of establishing meaningful work order labor budgets for use in a shipyard pipe fabrication shop. Two methods are described for developing planning or scheduling standards. The first builds upon an existing base of detailed fabrication labor standards, which may be engineered standards or measured standards. The second uses sampling and statistical analysis to develop the planning or scheduling standards in situations where there are no existing labor standards. The first approach was applied in a seven month pilot project sponsored by the Maritime Administration through the Ship Producibility Research Program. The procedures and

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results of this pilot project are described. The primary result was a fifty percent increase in the perceived capacity of the shop, with no additional investment in equipment or labor. (11 p.)

Keywords: Time studies, labor standards, engineered labor standards, planning and scheduling

Paper No. 13:

Title: Worker Participation and Organizational Change in Shipbuilding: An International Review. Pp. 247-268.

Author: Michael E. Gaffney, National Academy of Sciences.

Abstract: Significant innovations of a human resource nature have been introduced to international shipbuilders since the mid-60's. In the past few years, a number of U.S. yards have experimented with some of these practices (quality circles, semi-autonomous work groups, multi-skilled workers). This paper draws together information from several sources in an attempt to identify those underlying principles which have taken various forms in many shipyards in a number of countries. (22 p.)

Keywords: Labor-management relations, management techniques, management

Paper No. 14:

Title: Computer Integrated Shipbuilding: A Framework for Technology Modernization. Pp. 269-299.

Author: A. Wayne Snodgrass, D. Appleton Company, Inc.

Abstract: Computer Integrated Shipbuilding (CIS) systems is based upon a completely integrated CAD/CAM system that provides computer control or assistance to all shipbuilding functions. The shipbuilding aspects embraced by CIS include business planning and support, engineering design and ship production planning, control, and automation. All business functions of marketing, ship delivery, and logistics support can be linked into such a CIS system. The objective of this paper is to provide a framework for shipbuilding technology modernization which incorporates a road map for the integration of shipbuilding functions via systematic planning and the simultaneous systematic application of computer technology. This CIS approach is unique in that it is data driven and is based upon a three-architecture concept. This concept concentrates planning methodologies on building three formal integrated architectures: (1) the "application and database architecture", defining what applications and databases must be implemented to support the using community; (2) the "computer systems architecture" on which those applications and databases will be implemented; and (3) the "control architecture" which defines specific project and software management techniques to be used to implement and maintain the applications within the computer systems architecture. Each of the architectures is ultimately represented in the form of standards and procedures. (41 p.)

Keywords: CAD/CAM, integrated manufacturing

Paper No. 15:

Title: Shipbuilding Project Management. Pp. 301-324.

Author: Ernest G. Frankel, Massachusetts Institute of Technology.

Abstract: Uncertainties in material and component delivery as well as fabrication, assembly, and erection process times make it difficult to effectively use traditional CPM, PERT, and similar methods for shipbuilding project management. A conditional probabilistic project management and control method is proposed which allows incorporation and updating of times and their uncertainties by the use of feedback, to improve real time decision making, project control, and adaptive planning. (24 p.)

Keywords: Management information systems, project management, planning and scheduling

Paper No. 16:

Title: Computervision Interface to Batch Electric Boat Piping Programs. Pp. 325-341.

Author: Laurence J. McKee, and Robert Sciullo, General Dynamics/Electric Boat Division.

Abstract: The design and implementation of the computervision interface to the batch electric boat piping design analysis and assembly programs is described. This interface allows three-dimensional piping models produced on computervision to be processed by the Electric Boat Piping programs on the UNIVAC. The end results of this processing are assembly details which are delivered to the pipe shop for assembly. (17 p.)

Keywords: Pipe fabrication, piping design

Paper No. 17:

Title: Navy Computer-Aided Ship Design. Pp. 343-352.

Author: Craig M. Carlson, Naval Sea Systems Command.

Abstract: The Navy efforts in computer-aided ship design and construction have undergone a number of changes in the past two years. The history of these changes is presented, current efforts are defined, and future thrusts are outlined. This discussion includes the Computer Aided Ship Design and Construction (CASDAC) program, the Computer Supported Design program, the Manufacturing Technology program, and the Shipbuilding Technology Program. The primary emphasis in describing current efforts and future thrusts is on NAVSEA's computer-aided ship design and the two-way interface of the Navy contract design package with the shipbuilder. (10 p.)

Keywords: CASDAC, CAD/CAM

Paper No. 18:

Title: Productivity Improvement in Shipyard Steel Fabrication through Integrated Material Handling Technology. Pp. 353-364.

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Author: Steiner Draegbo and Frank E. McConnell, Total Transportation Systems, Inc.

Abstract: A significant portion of shipyard steelwork can be mechanized through introduction of modern production line technology. The productivity improvements on such lines arise principally from more efficient material handling and a corresponding reduction of time lost between operations. Panel lines are undergoing exciting developments and are being installed even in very small shipyards. Efficient and affordable web line and beam line technology is now available but not yet adopted by shipyards in the United States. (12 p.)

Keywords: Productivity, material handling, process lanes

Paper No. 19:

Title: Improving Shipyard Productivity by Subcontracting Material and Labor within Shipyards. Pp. 365-377.

Author: I. David Gessow, Maritime Administration.

Abstract: An organization which specializes in one area produces at lesser cost than an organization which, in one plant, produces and assembles in substantially different areas. Shipyards which manufacture and assemble many different products recognize the advantages of specialization; they try to purchase materials and equipment in as finished form as available for further assembly and installation. In some areas shipyards go further and subcontract the installation of material directly into ships. The thesis proposed here is that the productivity of U.S. shipyards would be increased and ships would cost less if a deliberate policy of extensive subcontracting of material and its installation labor within shipyards were adopted. In time, shipyard staff would become primarily specialized efficient organizations which coordinate the work of specialized, independent contractors. The organizations would be the same in principle as those which have developed for most large, land-based construction. The discussion explores the promise of this change from present practice. How would it apply to traditional and newer preoutfitted modular construction and its effect on the labor force of shipyards? Some of the discussion is based on the author's many years of experience working for a company which was a subcontractor for material and labor within large and small shipyards in the United States. (12 p.)

Keywords: Productivity, labor specialization, subcontracting

Paper No. 20:

Title: The Utility of Quality Circles and Productivity Teams in U.S. Shipbuilding. Pp. 379-391.

Author: Stephen E. Harper, Business Innovations, Inc.

Abstract: Quality circles have been found to improve productivity an average of 12 percent in 3 to 6 months in a controlled research pilot study performed by Business Innovations, Inc. for the U.S. Department of the Navy. Human relations and job satisfaction were also found to improve within a few months of starting quality circles at four companies. Quality circles (QC's) have been adopted widely by U.S. and Japanese

industry and are increasingly finding acceptance in U.S. industry, including shipbuilding. The average return on investment for quality circles is 6 to 1. QC's are a simple, but effective, technique for problem solving which involves employees and increases motivation, communication, and productivity. They are a phenomenon of group dynamics, not quality control techniques. Implementation of quality circles needs to be carefully planned and should involve all levels of management and employees. An alternative to quality circles at foremen and management levels is "productivity teams." These involve more sophisticated training and the use of industrial engineering techniques. Productivity Panels and quality circles are low cost, high return investment for shipyards to cut costs and turn around companies with lagging sales due to decreased international competitiveness. (13 p.)

Keywords: Quality (control) Circles, productivity, management techniques, industrial engineering

Paper No. 21:

Title: Shipbuilding Applications for the Engineering Model. Pp. 393-400.

Author: Clyde A. Baumgardner, Design Models, Inc.

Abstract: This paper is based mainly on the Model Builder's experience at the National Steel and Shipbuilding San Diego Yard while working on the Navy's T-ARC7 program. It will present varied uses for Engineering Models in the Shipbuilding Industry and will discuss improved planning and design, lower design and construction cost advantages and improved problem-solving techniques. (8 p.)

Keywords: Physical models, engineering models

Paper No. 22:

Title: MOST Computer Systems: Inter-Shipyard Data Transferability. Pp. 401-421.

Author: Louis M. Kuh, J. B. Maynard and Company, Inc.

Abstract: Over the past year and a half, five participating shipyards have been preparing labor time standards using MOST Computer Systems on a time sharing basis. The result has been the development of separate databases covering the following operating areas: blast and paint - platen and dock areas; electrical - shop and outfitting; main assembly; fabrication shop; and staging erection and teardown - platen, dock and ways. The ability to transfer data from one yard to another is discussed, as well as the methodology for such transfer. (22 p.)

Keywords: MOST, engineered labor standards

Paper No. 23:

Title: Productivity Issues in Naval Shipbuilding. Pp. 423-435.

Author: Joseph C. Lucie, Naval Sea Systems Command.

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Abstract: This paper will look at the changing nature of productivity as it relates to job design, participative management, and the increasing use of incentives, feedback, and goal setting. Likewise, a brief discussion of organizational design and recent developments toward work motivation will show that the real key for productivity improvements lies with management. Hinderances to achieving productivity improvements are: (1) poor organizational structures which preclude inclusion of productivity considerations early in the design phase; (2) improper attention and training provided to the first level supervisors at the waterfront and the failure to recognize the valuable contribution these people could provide; and, (3) the crucial requirement for having qualified and experienced ship production personnel on Navy management teams. (13 p.)

Keywords: Productivity, labor-management relations, management-labor relations

Paper No. 24:

Title: MAPLIS: An On-Line Materials Resource Planning System Tailored to the Shipbuilding and Offshore Industry. Pp. 437-455.

Author: Henrik Bucher, Shipping Research Services.

Abstract: MAPLIS is an on line computer system for material management in yards building ships and offshore constructions. It consists of five modules or subprograms which may be installed separately or together as one integrated system. Material planning and control in MAPLIS starts in the design office with drawing files, material specification, and purchase requests, continues with purchase orders, expediting, receiving, storage status, and cost control, and ends in work preparation with work orders, drawings, and bill of materials. The system handles outfit and steel materials, both direct and stock items. (19 p.)

Keywords: MAPLIS, material control, management information systems

Paper No. 25:

Title: Classification and Coding: A Tool to Organize Information. Pp. 457-477.

Author: Alexander Houtzeel, Organization for Industrial Research, Inc.

Abstract: The uses of classification and coding as a tool to integrate computer-aided design and manufacturing are described. The information revolution has created an enormity of data which is increasingly difficult to access. In recent years, companies have turned to classification and coding systems as a means of organizing raw data and retrieving useful relevant information. Essentially, classification is a means of separating raw information into classes of similar information; coding is a means of retrieving the information so that it can be analyzed and applied to accomplish specific objectives. The MULTICLASS system enables the user to employ multiple coding systems that can be used for various information retrieval and analysis purposes i.e., retrieval and standardization of manufacturing information, assembly information, tool retrieval, electronics, material selection and use. (23 p.)

Keywords: Classification systems, management information systems

Paper No. 26:

Title: Weld Acceptance Standards. Pp. 481-498.

Author: Bruno L. Alia and Irving L. Stern, American Bureau of Shipping.

Abstract: The presentation covers the objectives and summarizes the progress of MARAD SP-7 Panel programs on (a) development of reference standards for visual inspection welds, and (b) evaluation of the quality of existing ship welds by ultrasonics. The relationship of the visual acceptance standards, quality control procedures, quality of production welds and the significance of representing acceptance standards with model reference standards is discussed. Ultrasonic evaluation of the quality of existing ship welds is related to the existing radiographic and ultrasonic examination conducted outside areas required by the governing code or rules. This may occur in new construction or after various periods of service. Unnecessary repairs can be costly and at times can degrade rather than improve structural reliability. Internal discontinuities that represent a significant degradation of structure should be repaired. (18 p.)

Keywords: Welding, welding tests, weld defect tolerance, ultrasonic tests, radiographic tests

Paper No. 27:

Title: Application of SHIPOPT to Preliminary Design of Commercial Ships. Pp. 499-512.

Author: Colin S. Moore and Allan T. Maris, Giannotti and Associates, Inc.

Abstract: The theory and results of applying computer-aided ship structure optimization procedures to design of a new ferry for southwestern Alaska routes is called SHIPOPT. Ship optimization is a rationally based, interactive procedure which recognizes prescribed design constraints and optimizes within those constraints ship structural scantlings and geometry for strength, weight, and cost. The structural constraints typically considered are allowable shear and bending stresses, buckling loads, fatigue life, weight, and ship arrangements, based on commercial or regulatory body requirements. (14 p.)

Keywords: Ship design, computer-aided design, SHIPOPT (Ship Optimization)

Paper No. 28:

Title: Standardization and Integration of Shipyard Processes and Procedures. Pp. 513-530.

Author: James Ronald Fisher, Naval Sea Systems Command.

Abstract: NAVSEA's ongoing effort to improve, standardize, and integrate shipyard process instruction are outlined. This plan will combine the best features of various DOD, Navy, and Private programs, including: (1) the navy technical information presentation programs, (2) DOD computer aided time standards, (3) Navshipyd/Ordnance Station EMandS automated support (NEAS), (4) the Carnegie Mellon/USS CARL VINSON CUN 70 ZOG program, (5) shipboard nontactical ADP system (SNAP), (6) NAVSHIPYD Norfolk - work planning and control systems - PROMPT, and (7) technical repair

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standards (TRS) program. Specific aspects of these programs will be discussed, including computer aided authoring, group technology, common vocabularies, a status report of these efforts, as well as future plans. (17 p.)

Keywords: Process analysis, production engineering

Paper No. 29:

Title: The Functional Approach to Problem Solving in the Shipyard Environment. Pp. 531-554.

Author: Owen Scott and Johan Collasius, General Dynamics, Inc.

Abstract: This paper covers a structured problem solving methodology as used in the Operations Department at the Electric Boat Division of General Dynamics. A brief overview describes several successful applications of the problem solving methodology. To provide an understanding of the concepts, a brief description of the technique used is given. (24 p.)

Keywords: Problem-solving, BISAD (Business Information Systems Analysis and Design)

Paper No. 30:

Title: Human Performance Engineering: a Technology for Developing the Human Resource. Pp. 555-585.

Author: D. Chris Anderson, University of Notre Dame.

Abstract: Human performance engineering is a behavioral technology that rests on the proposition that increases or decreases in productivity always are the byproduct of human action. The key to increased productivity thus begins with location of those actions that must be changed. This is followed by the introduction of variables known to be effective in bringing about alterations in human behavior. By this approach, managers are envisioned as major sources of such variables. Increasing productivity thus is tantamount to engaging managers in an appropriate application of these causal agents. Following a careful enumeration of the procedures and results of this approach in a manufacturing setting, a detailed proposal outlining application to the shipbuilding setting is presented. (31 p.)

Keywords: Productivity, human behavior, human resources, human performance engineering

Paper No. 31:

Title: The Five-Year National Shipbuilding Productivity Improvement Plan. Pp. 587-605.

Author: Edmund R. Bangs, IIT Research Institute.

Abstract: The presentation highlights the efforts of 43 management representatives from 15 of the country's major shipyards who have applied themselves in an organized team

effort to develop a national shipbuilding productivity improvement plan. The plan identifies the systems and technology required to improve shipyard productivity. Organizations involved included SPC, IREAPS, NAVY, MARAD, MTRB, and the Shipbuilding Council of America. (19 p.)

Keywords: Productivity, long-range planning

Papers from NSRP 0009, Volume II

Paper No. 1:

Title: Ship Production Committee Panel Overviews. Pp. 3-140.

Author: Ship Production Committee Panel Chairmen.

Abstract: Summaries of Ship Production Committees' activities are described in individual reports. Panels included are: SP-1/SP-3, Facilities and Environmental Effects (Richard A. Price); SP-2, Outfitting and Production Aides (Louis D. Chirillo); SP-4, Design Production Integration (F. Baxter Barham); Ship Producibility Program (Joseph R. Fortin); SP-6, National Shipbuilding Standards and Specifications (James E. DeMartini); SP-7, Welding (Ben C. Howser); SP-8, Industrial Engineering (Joseph R. Phillips); SP-023-1, Surface Preparation and Coatings (John W. Peart); SP-9, Education (Howard M. Bunch); and an Update on the IREAPS Program (Edmund R. Bangs). (137 p.)

Keywords: Ship Production Committee Panels

Paper No. 2:

Title: Computer Aided Design and Computer Aided Manufacturing in a Naval Repair Yard. Pp. 141-220.

Author: Jack Renard and Frank Nigro, Long Beach Naval Shipyard.

Abstract: A record of achievement and growth of an integrated program in the field of CAD/CAM technology is listed. Activities, analyses, and operational results dealing with the Long Beach Naval Shipyard (LBNS) Joint Planning/Production Computer Applications Program for Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). The CAD effort on behalf of the Planning Department and the CAM operations on behalf of the Production Department are part of the overall Naval Ship Design/Construction Program formulated to bring unification into the total manufacturing sequence beginning with the design stages and going through the parts-production phases performed by processed plan (numerically controlled (N/C) machine tools). (80 p.)

Keywords: CAD/CAM, numerical control

NSRP 0010

UMTRI 70065-66

TITLE: IREAPS 10th Annual Technical Symposium. Proceedings. 2 Vols. Forty-four papers. (Vol. I, 505 p.; Vol. II, 479 p.)

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AUTHOR: IITRI.

DATE: 1983

Papers from NSRP 0010, Volume I.

Paper No. 1:

Title: Keynote Address: The Human Side of Technology. Pp. 1-14.

Author: Admiral Hyman George Rickover, U.S. Navy.

Abstract: The use of technology profoundly affects the shape of our society. Technology makes obsolete our traditional concepts of ethics and morals, we are pressured by technology to alter our lives without attempting to control it. Much harm has been done to man and nature because technologies have been used with no thought for the possible consequences of their interaction with nature. Science, being pure thought, harms no one; therefore it need not be humanistic. But technology is action – often potentially dangerous action, based on knowledge. To make technology safe, we must have protective laws and a more responsible thinking among those who manage technologies. Every citizen is duty bound to make an effort to understand how technology operates and what its possibilities and limitations are. All this is necessary if we are to achieve a humanistic attitude toward technology – an attitude that looks upon technology as an instrument created for no other purpose than to serve man. (15 p.)

Keywords: Human resources, technology impact

Paper No. 2:

Title: Productivity Rediscovered. Pp. 15-48.

Author: J. W. Brasher, Ingalls Shipbuilding Division.

Abstract: In world class competition, productivity or lack thereof can mean the difference between 5 percent unemployment and 15 percent or more unemployment. Contrary to popular opinion the higher unemployment will result from lack of such productivity improvement innovations as automation. Productivity improvement, properly prioritized, is easy yet difficult. This talk covers both sides of the issue and offers program suggestions applicable to any endeavor. (34 p.)

Keywords: Productivity, automation

Paper No. 3:

Title: Cost Concepts and Productivity. Pp. 49-70.

Author: I. David Gessow, Maritime Administration.

Abstract: Productivity and costs are apparently simple and separate concepts. Actually, both are not simple and both need explanations and qualifications to define clearly their

intended meanings. They are also related because improvements in productivity must appear finally as reductions in cost. Improving productivity in shipbuilding requires, in part, measuring and analyzing the application of labor to materials. It also requires analyzing the allocation of other resources to the shipbuilding process. In both instances the unit of measurement is eventually expressed as dollars or other currency. This paper briefly describes some cost and cost related concepts which are useful in measuring and understanding productivity. (32 p.)

Keywords: Productivity, cost reduction

Paper No. 4:

Title: Enhancing Production Management Control through Performance Measurement. Pp. 71-88.

Author: Joseph C. Lucie, Naval Sea Systems Command, and Thomas D. O'Connor, Advanced Technology, Inc.

Abstract: One of the key issues today in all business environments is the enhancement of productivity. Production Management Control is the cornerstone of the attainment of optimal productivity. This paper identifies ways that the manager can monitor the progress and performance of the shipbuilding effort throughout the construction cycle. The main thrust centers around the analysis that can be performed on the information generated from the cost/schedule control systems criteria system and integrated with the more traditional networking and quantitative construction data. (18 p.)

Keywords: Productivity, production control, performance measurement

Paper No. 5:

Title: Build Strategy Development. Pp. 89-119.

Author: John D. F. Craggs, A and P Appledore Limited.

Abstract: This paper looks at factors that impact productivity and concludes that the key is the ability to organize work such that facility utilization and labor utilization are optimized. The reasons for the success of the traditional method of ship production and the reasons for the development of, and the concepts of, the modern approach to ship production are outlined. The objectives and elements of a company shipbuilding strategy are described. Finally, the need to formally develop a build strategy for each vessel and the typical contents of build strategy documentation are described. (31 p.)

Keywords: Production methods, shipbuilding strategy

Paper No. 6:

Title: A Conceptual (Data Base Design) Information Model for Outfit Planning. Pp. 120-150.

Author: Richard L. Diesslin, IIT Research Institute.

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Abstract: This paper provides a summary of the conceptual data base design developed in the NSRP report entitled "A Conceptual (Data Base Design) Information Model for Outfitting Planning." This study was performed using conceptual function and information modeling techniques in order to provide an in-depth understanding of the outfit planning systems specifications. This analysis will be useful to shipbuilders considering developing/buying a manufacturing information system in terms of how to diagnose systems specifications and how well a system will integrate with other existing systems as well as specifically illustrating the elements necessary in an outfit planning based manufacturing approach. (31 p.)

Keywords: Outfit planning, database design, management information systems

Paper No. 7:

Title: Rationalization of Shipyard Information Flows for Improved Shipbuilding Productivity. Pp. 151-159.

Author: M. E. Steller, Temple, Barker and Sloane, Inc.

Abstract: This paper provides a practical approach to rationalization of shipyard information produced by and received by shipyard employees. An improvement in the yard's productivity is gained through better quality and timeliness of management information, elimination of redundant or unnecessary reports, streamlining of reports, and reduced distribution of the information. The process to achieve these goals is based on a microcomputer-assisted analysis of existing information flows and inventory of reports and management information. An inventory of reports and management information is developed to include distribution, frequency, computerized vs. manual production, size, and use of the information. Based on the analysis, recommended rationalization can result in productivity gains and in cost reductions. (9 p.)

Keywords: Management information systems, information management

Paper No. 8:

Title: Cost Reduction in Deck Machinery Installation. Pp. 160-168.

Author: D. G. Pettit, Naval Sea Systems Command.

Abstract: To be competitive, shipbuilders can no longer afford the time consuming luxury of locating deck machinery, hull, and rigging fittings by trial and error during ship construction. Standardized formats for the exchange of installation information between shipbuilder and vendor are proposed. Equipment vendors can assist the shipbuilder and ensure more satisfactory installations by using techniques of modular ship construction. Design features which minimize shipbuilder time and cost are discussed. Use of preinstallation testing of packaged equipment is emphasized. A new approach to bed plate and foundation design is presented. (9 p.)

Keywords: Cost reduction, modular ship construction

Paper No. 9:

Title: Post-Processors for the Ship Hull Characteristics Program for Calculating Metacentric Height. Pp. 169-192.

Author: Robert McNaul, Maritime Administration.

Abstract: Intact and damaged stability analyses require significant calculation effort beyond determining a righting arm curve for one operating or damaged condition. A required metacentric height (GM) curve for all operating conditions is usually the desired final result. A set of post-processing subroutines have been developed by the Engineering Computer Group at the Maritime Administration to permit direct calculations of the required metacentric height in an intact operating condition or in a damaged condition. These subroutines allow evaluation of intact and damaged stability of a vessel using the U.S. Coast Guard's, the Maritime Administration's or the International Maritime Organization's stability criteria. (24 p.)

Keywords: Damaged stability, intact stability, metacentric height

Paper No. 10:

Title: Production Risk Management. Pp. 193-211.

Author: Joseph C. Lucie, Naval Sea Systems Command and D. L. McMichael, McMichael and Associates.

Abstract: Experience and observations show beyond a reasonable doubt that very little has been done in the practical application of advanced tools and techniques to manage risk in a production environment. While initiatives have been generated to develop organizational capabilities to conduct independent program analyses in terms of schedule, cost, and technical risk, few of those initiatives have resulted in useful methodologies for improved program management. This paper addresses schedule risk management and its purpose is to invite the production manager to consider advancement in the state-of-the-practice for the quantitative management of schedule risk. It traces the evolution of the scheduling process which historically has been deterministic in nature. With the advent of computer-based systems, tools and techniques have been developed that place in the hands of the production manager a means to control the process while accounting for uncertainty and risk. The underlying theory and application by the manager are discussed. (19 p.)

Keywords: Risk management, production risk management, schedule risk

Paper No. 11:

Title: State-Of-The-Art CAD/CAM Applications in the Shipbuilding Industry. Pp. 212-239.

Author: Richard L. Diesslin, IIT Research Institute.

Abstract: This paper discusses the National Shipbuilding Research Program's comprehensive study of CAD/CAM applications in the shipbuilding industry. The project is funded by the Maritime Administration and is being performed by IIT Research Institute in cooperation with the Institute for Research and Engineering for Automation and Productivity in Shipbuilding (IREAPS) and the Ship Production Committee's SP-4 Panel on Design/Production Integration. The project has as its goals: (1) to identify and compile

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present uses of CAD/CAM in the design, manufacturing and production of ships in the United States; (2) to identify gaps in U.S. shipbuilding CAD/CAM technology applications with respect to a shipyard functional breakdown; and (3) to locate and recommend advanced CAD/CAM resources for application to deficient areas in U.S. shipbuilding. (28 p.)

Keywords: CAD/CAM

Paper No. 12:

Title: Increase of Productivity by Automated Prefabrication of Pipe Spools. Pp. 240-275.

Author: Gunter Wilkens, Oxytechnik.

Abstract: This report describes systems for modern pipe processing which have proven to be highly economical. The increase of productivity is based on turning manual work to machine work, thus achieving increase of throughput, reduction of costs, reduction of skillful craftsmen, and better qualities of production. (36 p.)

Keywords: Pipe fabrication, pipe handling

Paper No. 13:

Title: CAD/CAM in a Naval Repair Yard – Update. Pp. 276-303.

Author: Jack Renard and Frank Nigro, Long Beach Naval Shipyard.

Abstract: A record of achievement and growth of an integrated program in the field of CAD/CAM technology is presented. Dealing with the Long Beach Naval Shipyard (LBNS) Joint Planning/Production Computer Applications Program for Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) activities, analyses and operational results related within recent calendar years are covered. The CAD effort on behalf of the Planning Department and the CAM operations on behalf of the Production Department are part of the overall Naval Ship Design/Construction Program formulated to bring unification into the total manufacturing sequence, beginning with the design stages and going through the parts-production phases performed by processed planning (numerically controlled (N/C) machine tools). The enhancement of the computer system in the CAD/CAM operations led to improved schedules, reduced job cost, smoother and swifter communications, diminished lead times, and drawing/model changes as compared with the prior system. (28 p.)

Keywords: CAD/CAM

Paper No. 14:

Title: Behavior Modification or Worker Participation? Productivity and the Shipbuilding Workforce. Pp. 304-319.

Author: Michael E. Gaffney, National Academy of Sciences.

Abstract: This report discusses the topic of maximizing human resource contributions to shipbuilding productivity. Two schools of thought are presented: Behavior Modification and Worker Participation. This paper will review the two approaches, specifying their respective strengths and weaknesses. (16 p.)

Keywords: Human resources, human behavior, productivity, management-labor relations

Paper No. 15:

Title: Human Factors and Models. Pp. 320-348.

Author: Donald M. Hall, Raytheon Service Company, and John W. Rohrer, USA Models.

Abstract: This paper speculates on an industrial plant or ship constructed to conform to the requirements of a system designed to maximize human potential. The concept of this system embodies the basic assumption that man should be considered one of the major components of the system rather than merely an operator of the system once it is developed. Some way must be found for thinking about the functions of the man within the framework of the man-machine-software environment. Design Work Study Technology and physical models are tools which enable the system engineer and designer to study all aspects of the operation and design by making use of the models to study man-machine-software interface. (29 p.)

Keywords: Human factors engineering

Paper No. 16:

Title: BRITSHIPS 2 - A Computer Aided Design and Production System Using Computer Graphics. Pp. 349-413.

Author: D. R. Patterson, British Ship Research Association.

Abstract: BRITSHIPS is the generic title for a computer system built from related ship design/production software created by the British Ship Research Association (BSRA). The integrated system has been the subject of continuous development since it first went into use in the late 1960's. BSRA is the central research and development agency for the British shipbuilding industry. The latest version, known as BRITSHIPS 2 and sponsored by British Shipbuilders, supports the shipbuilding process from the design of the full form through design analysis, steelwork design, production definition of the hull form, lofting, piping, to assembly drawings and sketches, and production and materials requisition information. This paper describes the structure and organization of the system, and the facilities it offers. (65 p.)

Keywords: Computer-aided design, CAD/CAM

Paper No. 17:

Title: Applications of Computer-Aided Engineering to Ship Systems and Structures. Pp. 414-429.

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Author: James M. Reed, Kenneth F. Cooper, and Thomas C. Esselman, Westinghouse Electric Corporation.

Abstract: The Westinghouse Electric Corporation computer-based capabilities in geometric modeling and piping/support design and analysis were developed for the design and construction of nuclear power plants. Since the requirements for the design and analyses of piping systems and compartments for naval vessels are similar to those for nuclear power plants, these capabilities have many potential applications to ship systems and structures. Westinghouse computer-aided engineering systems can be used at naval shipyards through fully equipped Structural Analysis Mobile Units, electronically linked to mainframe computers in Pittsburgh, Pennsylvania. To illustrate the potential application of Westinghouse computer-aided engineering (CAE) capabilities, an example of an auxiliary machinery compartment on board the USS Nimitz (CVN 68) was modeled and selectively analyzed. (16 p.)

Keywords: CAD/CAM

Paper No. 18:

Title: "SPADES" Integrated Approach to Structural Drawings and Lofting. Pp. 430-441.

Author: Filippo Cali and Floyd Charrier, Jr., Cali and Associates.

Abstract: The 'SPADES' Integrated Approach allows the user to extract engineering structural drawings, N/C lofting, and production control reports from one common database. The common database management concept insures that once the data has been correctly loaded, all information generated will reflect the common database information and provide continuity throughout the different phases of shipbuilding. Some advantages of this common database management are: greater management control; overall visibility of required information; greater revision control; overall improvement in production schedules; and substantial man-hour savings. (12 p.)

Keywords: SPADES, database management

Paper No. 19:

Title: The Engineered Time Values System - A Better Approach to Productivity Management in Maintenance. Pp. 442-490.

Author: Richard A. Bihl, PRC Systems Services.

Abstract: The Engineered Time Values System is an adaptation of commercially proven maintenance management procedure, underpinned by engineered labor performance standards for the measurement of performance, productivity, and work progress. The system provides the visibility to management of what is happening in the production process so that dynamic control can be executed to maximize productive efficiency. The system is oriented to the internal management functions of workload planning/control and associated resources management. The key change from the current production management system which uses input labor hours as the measurement tool, is the shift to earned hours. Engineered performance standards are used to develop a standard measure of work content for each job undertaken. This work content value is adjusted to a planned

man-hour figure by the addition of travel, job preparation and other allowances. The planned man-hours are then converted into earned hours incrementally as the work is accomplished. This paper examines the applicability of ETV System concepts to shipyard functional requirements in the areas of: engineered standards development; engineered standards employment in Planning and Estimating; materials identification, acquisition and staging; and job tracking and work progressing. (49 p.)

Keywords: Engineered labor standards, productivity

Paper No. 20:

Title: Material Requirements Planning – A New Automatic System at the Long Beach Naval Shipyard. Pp. 491-500.

Author: Douglas W. Cunningham, Arthur Andersen and Co.

Abstract: A minicomputer-based Material Requirements Planning (MRP) system is helping the Long Beach Naval Shipyard (LBNSY) plan and control material in the Marine Machine Shop. The system features proven, state-of-the-art management techniques transferred from highly successful American and Japanese manufacturing companies and fitted to the repair and overhaul environment at LBNSY. The large, measured benefits include fewer material shortages, less surplus, reduced turnaround time to overhaul a component, and improved control over previously unrecorded material. The system helps both planning and production personnel by: (1) effectively anticipating material requirements in advance of need; (2) predicting part usage based on historical usage of parts per overhaul; (3) developing time-phased net material requirements based on scheduled overhauls and expected usage, on-hand and on-order position, safety stock levels and lead times; (4) assisting in analyzing the impact of changes in the overhaul schedule; and (5) providing easy-to-use, on-line, integrated access to information. (10 p.)

Keywords: Material management, management information systems

Papers from NSRP 0010, Volume II.

Paper No. 1:

Title: A Floor Space Simulator for Shipyard Steel. Pp. 501-520.

Author: Stephen M. Knapp, SPAR Associates, Inc.

Abstract: A software package intended to aid planners in the evaluation, planning, and scheduling of steel unit placement within the confines of the yard is described. The Floor Space Simulator/Allocator system, or FSS/A, will allow the planner to structure the steel requirements from the unit level to six levels of subassemblies and components, and will simulate the time oriented placement of those units within a defined spacial area. Suitable provisions will be available for the planner to study pre-outfit requirements and alternative construction approaches, all within the realm of a real-time simulation. This paper will present a discussion of the space scheduling problem, an overview of the FSS/A system, an assessment of simulation versus the actual yard, an evaluation of the benefits to be derived by the yard, and a general description of the planner's use of the system to solve the space ordering of steel units. (20 p.)

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Keywords: Space allocation, material handling

Paper No. 2:

Title: Computer Applications in a Building and Repair Yard: Two Years of Lessons. Pp. 521-543.

Author: Rick Lovdahl and Paul B. Cromer, Todd Pacific Shipyards.

Abstract: This paper describes the evolution of, and experience with, a medium-size data-processing system over a two-year period in a West Coast shipyard. The introduction provides a brief sketch of previous data processing experience at the yard. Major requirements summarizes the five major areas of computer applicability: Engineering, Database Management, Graphics, Planning and Procurement. A third section describes the early goals, present achievements, and future tasks of the data processing system. System description discusses the system hardware (computers, terminals, etc.) and software (programs). System selection, site preparation, training and interaction of software are discussed in the Other Considerations section. The paper closes with a Summary and Conclusions. (23 p.)

Keywords: Computer-aided engineering, database management

Paper No. 3:

Title: Product Modelling in Interactive AUTOKON. Pp. 544-569.

Author: Jorn Oian, Sentralinstitutt For Industriell Forskning, Oslo, Norway.

Abstract: AUTOKON has for years been the most widely used CAD/CAM shipbuilding software in the world. Behind AUTOKON stands a cooperation between the Central Institute of Industrial Research (SI, formerly CIIR), The Aker Yard Group (AG), and Shipping Research Services. The introduction of new Interactive AUTOKON modules has established AUTOKON as a tool for the designer as well as a tool to be used for production preparation. It is no longer only a shipbuilding system. Interactive AUTOKON has been designed to efficiently handle the complex plate and profile structures found in offshore products. This paper describes the Interactive AUTOKON System which presently replaces a major portion of the batch AUTOKON modules. Main emphasis is placed on the philosophy behind the system development and examples of use. (26 p.)

Keywords: CAD/CAM, AUTOKON, interactive AUTOKON

Paper No. 4:

Title: Bi-Directional Interactive Graphic Interface Between the Structural Synthesis Design Program and the Hull Structural Data-Base Program. Pp. 570-588.

Author: Robert Frasca, Advanced Marine Enterprises, Inc., P. Glennie, Naval Sea Systems Command, and Eric Byler, Advanced Marine Enterprises, Inc.

Abstract: An interactive, bi-directional interface program has been developed to integrate data exchange between the two Navy Computer Supported Design (CSD) programs HULSTRX and SSDP. HULSTRX develops a structural design geometry library and structural scantling file which can be used by other analysis programs in subsequent stages of a ship design. SSDP is a structural synthesis design program which can develop structural scantlings from given requirements or analyze given scantlings to determine whether they conform to current U.S. Navy design practices. The Structural Interface Program, which is run on a Tektronix CRT, provides automatic exchange of complex geometric information between the programs by prompting the user with questions, statements, and displays of different portions of ship geometry. (19 p.)

Keywords: Interactive graphics, computer-aided design

Paper No. 5:

Title: Keeping Unit Output Low While Increasing Productivity. Pp. 589-600.

Author: W. Z. Hayman III, Missouri Valley Shipyard.

Abstract: Missouri Valley Shipyard has survived through the years despite the limited, eight month repair/navigation season on the Missouri and an obsolete, World War II-era new construction facility. Owner-initiated modernization had to contend with the winter river closing, limited new vessel winter storage space, and equally limited working capital. Other constraints included an eight foot grade separation and an ongoing new construction program. Of the three schemes developed, use of a modular-extrusion method was selected as it allowed concentration of effort, enclosed hull erection, minimum interference with current production, and intermixing of product lines. (12 p.)

Keywords: Productivity

Paper No. 6:

Title: Does the Future of U.S. Shipbuilding Lie Inland? Pp. 601-626.

Author: J. W. Boylston and Johnathan M. Ross, Giannotti and Associates, Inc.

Abstract: An efficient inland marine building community remains competitive in the international market. This paper theorizes that since it is impossible to upgrade work rules and difficult to upgrade equipment, perhaps offshore shipbuilding should turn inland and start anew. Launching facilities, water depths, and crane facilities will all be reasons for difficulty in building inland. This paper shows one concept for building a 30,000 DWT coastal tanker inland. (26 p.)

Keywords: Inland shipbuilders

Paper No. 7:

Title: Getting the Job Done at the Smaller Shipyard. Pp. 627-631.

Author: Clyde A. Baumgardner, Design Models, Inc.

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Abstract: When Bender Shipbuilding of Mobile, Alabama, had to design and construct a 133 foot Freezer Trawler in record time, they turned to the Design Model program to simplify, expedite, and coordinate the design process and to improve the quality and accuracy of communication in all phases of the program. This effort is compared with the successful T-ARC 7 model at National Steel and Shipbuilding. (5 p.)

Keywords: Design modeling, physical models

Paper No. 8:

Title: Implementation and Impact of Work Stationization in Ship Construction Outfitting. Pp. 632-640.

Author: Michael R. Yriondo, Designers and Planners, Inc.

Abstract: This paper is intended to demonstrate that the implementation of innovative management systems and techniques which properly use the human resource can provide productivity improvements far exceeding those currently being contemplated or achieved through emphasizing high technology equipment and materials. The thrust of this paper is to demonstrate that investment in managers and management systems can provide substantial economic improvements not directly coupled to the acquisition of high technology equipment and materials. (9 p.)

Keywords: Human resources, management techniques, productivity

Paper No. 9:

Title: Impact of Technological Change on Shipbuilding Productivity. Pp. 641-679.

Author: Ernest G. Frankel, Massachusetts Institute of Technology.

Abstract: Technological change has resulted in major productivity gains in some shipbuilding countries, while others such as the U.S. have lagged behind, although a large proportion of these technological changes originated in the U.S. This paper evaluates the gains from the factors which play a role in assuring significant productivity gains from technological changes in shipbuilding production processes, and evaluates the effect of industry participation in research and development of process and product technology, and the timing of application of new process technology, and the influence of worker incentives and training on the attainment of significant productivity gains through technological change. (39 p.)

Keywords: Productivity, process technology, technological change

Paper No. 10:

Title: On Getting People to Do What They Should and Could Be Doing. Pp. 680-719.

Author: D. Chris Anderson, University of Notre Dame.

Abstract: Evidence is presented that the manager is the pivotal ingredient in achieving marked and lasting improvements in human work performances. Nine generic manager-controllable systems are outlined that, when properly implemented, will result in across-the-board changes of from 15 percent - 100 percent or more in work efficiencies. Respectively, these systems are (1) targeting behaviors that must be changed to increase work output; (2) measurement of said behaviors; (3) informing workers of the latter; (4) a feedback procedure; (5) coaching workers on how to improve these behaviors; (6) establishing behavioral goals for change; (7) occasional meetings; (8) social reinforcement for behavior improvements; and (9) a compensation system that rewards these behavior changes. Proper installation of these systems demonstrably produces work improvements considerably in excess of those attempted through alternative approaches. Applications of these nine systems in settings similar to shipyards will be covered. (40 p.)

Keywords: Management techniques, management-labor relations, human behavior

Paper No. 11:

Title: Can We Expect the Shipbuilder/Design Agent Relationship to Produce Inexpensive High Productivity Ships? Pp. 720-766.

Author: J. Niel Spillane, Shipbuilding Consultants, Inc.

Abstract: Almost by definition, inexpensive high-productivity shipbuilding hinges on the adequacy of the relationship between the shipbuilder and the design agent and the proficiency of their actions early in new ship construction to optimize the design, the selection of materials, the production processes, and the acquisition of facilities. In a competitive marketplace the keystone of the design contract with the shipbuilder is likely to be least-cost engineering, particularly when prior ship owner/design agent agreements limit the scope of the agent's services. Under these typical conditions, it is unlikely that the design agent will offer, or that the builder will demand, identification and implementation of all the minimum tasks needed to insure inexpensive ship construction. This paper attempts to define the business incentives of the principals, the minimum features of a comprehensive design agent/builder arrangement, and some recommendations for offsetting the shortfall between them. (47 p.)

Keywords: Design agent-shipbuilder relationship, productivity

Paper No. 12:

Title: Accuracy Control for U.S. Shipyards. Pp. 767-800.

Author: Richard Storch and John R. Gribskov, University of Washington.

Abstract: Research conducted by the University of Washington personnel at Tacoma Boatbuilding Company (TBC) has provided a basis for any U.S. shipyard to initiate and operate an accuracy control system. This paper discusses the steps necessary for initiation of such a system and then outlines, in case study format, the practical aspects of accuracy control planning, execution (measuring), and evaluation (analysis). Examples of vital point selection, planning sheets, check sheets, normal distributions of variation determination, and control chart development are presented. A discussion of the long term value of an accuracy control system is also included. The results presented are based on

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actual on-site research at TBC, involving the construction of the stern section of hulls one and two of the U.S. Navy T-AGOS vessels. (34 p.)

Keywords: Accuracy control, quality control

Paper No. 13:

Title: SNAME's Ship Design Committee Overview: The First Year. Pp. 801-807.

Author: Robert S. Johnson, Westinghouse Defense and Electronics.

Abstract: Established in February, 1982, the Ship Design Committee was created with the charter to encompass requirements development through the completion of Contract Design. This presentation provides a recap to date of the committee's background, membership composition, and meeting activities. A discussion of their relationship with the Ship Production Committee is also included. (7 p.)

Keywords: Ship design, Ship Design Committee

Paper No. 14:

Title: The 5-Year National Shipbuilding Productivity Improvement Plan. Pp. 808-827.

Author: Edwin J. Peterson, Todd Pacific Shipyards Corporation.

Abstract: The Ship Production Committee (SPC) of SNAME has managed the National Shipbuilding Research Program through a relatively informal cooperative effort with private shipyards, design firms, educational institutions, government agencies and other technical societies, and maritime organizations. Through a truly national effort, a comprehensive Five Year National Shipbuilding Productivity Improvement Plan has been drafted and has received widespread favorable endorsement by the U.S. shipbuilding industry. The plan is needed to take advantage of progress already made and to provide a more formalized framework for developing and implementing technical and management tools which can substantially reduce the cost and time needed to build and repair ships. The sole purpose of the Five Year Plan is to make it possible for the Panels to do their work more effectively for the benefit of the maritime community. (20 p.)

Keywords: Productivity, long-range planning

Paper No. 15:

Title: SP-2: Outfitting and Production Aids. Pp. 828-834.

Author: L. D. Chirillo, L. D. Chirillo and Associates.

Abstract: Initiatives by Panel SP-2 for the National Shipbuilding Research Program brought to industry's attention the highly organized nature of Japan's shipyards. Modern industrial sciences are practiced, such as statistical control of manufacturing which provides a built-in method for constant improvement in the shipbuilding system. These

methods, coupled with college graduates managing shops, account for Japan's superior productivity in shipbuilding and elsewhere. (7 p.)

Keywords: Outfitting, production methods, production aids

Paper No. 16:

Title: SP-1 and 3: Facilities and Environmental Effects. Pp. 835-844.

Author: Richard A. Price, Avondale Shipyards, Inc.

Abstract: The objective of this program is to assist U.S. shipyards in reducing cost and construction time through the development and implementation of efficient equipment and facilities and improved work flow arrangements. The program addresses all phases of ship construction, including fabrication, assembly erection, outfitting, and required shipyard services. The program also includes Environmental Effects (Panel SP-3), considerations involved in facility expansion, and modifications, operations, and ship production from a regulatory point of view. (12 p.)

Keywords: Facilities engineering, facilities planning, environmental effects

Paper No. 17:

Title: SP-4: Design/Production Integration. Pp. 845-866.

Author: F. Baxter Barham, Jr., Newport News Shipbuilding.

Abstract: This presentation provides an overview of the Design/Production Integration Panel, beginning with a look at the panel's background and its basic concept that design is the first step in overall interactive production processes. The panel's method of operation is outlined and its integrated program of related projects presented. The current status of panel work is included. (22 p.)

Keywords: Design/production integration

Paper No. 18:

Title: SP-7: Welding. Pp. 867-886.

Author: Benjamin C. Howser, Newport News Shipbuilding.

Abstract: The SNAME/SPC Welding Panel is committed to the implementation of existing technology as it pertains to shipbuilding welding. Toward these objectives, two projects have recently been completed which are believed to be of considerable interest to the shipbuilding community. Problems involved in the integration of a robot arc welder into shipyard production welding are discussed, as well as a report on the findings of a group of panel members who visited Japan to study their shipbuilding welding methods. (20 p.)

Keywords: Welding, Japanese shipbuilding technology

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Paper No. 19:

Title: Introduction: Ship Producibility Research Program. Pp. 887-891.

Author: J. E. DeMartini, Bath Iron Works.

Abstract: Since 1973, Bath Iron Works Corporation has managed the Ship Producibility Research Program (SPRP), an integral part of the Maritime Administration's National Shipbuilding Research Program. In recent years, program efforts have been concentrated in two principal areas: (1) Shipbuilding Standards; and (2) Shipbuilding Industrial Engineering. Significant progress has been experienced in both areas. This introduction highlights the recent history, accomplishments, and achievements of the SPRP. (5 p.)

Keywords: Ship Producibility Research Program

Paper No. 20:

Title: SP-6: Advances in Shipbuilding Standards and Specifications. Pp. 892-907.

Author: Thomas M. O'Toole, Bath Iron Works.

Abstract: Since 1978, SNAME Panel Sp-6 and ASTM Committee F-25 on Shipbuilding Standards have actively been working to develop national industry standards for shipbuilding. Together, they constitute the National Shipbuilding Standards Program. This paper addresses the recent advances of the National Shipbuilding Standards Program and the continuing use of standards in the shipbuilding industry. The specific projects of SNAME Panel SP-6 are reviewed with emphasis on new and future standards that will assist in achieving significant cost savings. The developing program to convert Navy Documents that appear to have commercial parallels into commercial standards and the Navy's continuing adoption of commercial ASTM shipbuilding standards are also discussed. (16 p.)

Keywords: Shipbuilding standards, shipbuilding standards program

Paper No. 21:

Title: SP-8: The Shipbuilding Industrial Engineering Program. Pp. 908-917.

Author: Joseph R. Phillips, Bath Iron Works.

Abstract: The successful use of industrial engineering techniques is increasing in the more aggressive U.S. shipyards, both large and small. Activities sponsored by SNAME Panel SP-8 on Industrial Engineering are reaching an expanding audience as repair and overhaul yards, as well as new construction yards, seek to cut costs through the more efficient use of our most expensive resource, manpower. Recent panel efforts have concentrated in four areas: application studies demonstrating the many uses of engineered labor standard data; informational efforts including a five-city workshop series and a primer for small and medium shipyards; increased coordination with Naval Shipyard/NAVSEA industrial engineering effort; and development of a comprehensive plan for future educational and developmental programs to further advance the use of industrial engineering to reduce the cost of building and maintaining vessels in U.S. shipyards. (10 p.)

Keywords: Industrial engineering

Paper No. 22:

Title: SP-9: Education and Training. Pp. 918-925.

Author: Howard M. Bunch, University of Michigan.

Abstract: The purpose of this panel is to coordinate the development and emplacement of programs for education in the range of technical skills required to improve shipyard productivity. This includes technical training, management refresher training, and pre-entry professional training. The panel was established in May, 1981; contract funding was initiated in the summer of 1982 with a budget of 300,000 dollars. Six projects are underway, and in varying states of completion. The budget for FY1983 is 410,000 dollars. The funds are to cover seven high-priority project areas, carried out in eight contract assignments. (8 p.)

Keywords: Training, training programs, education

Paper No. 23:

Title: SP-10: Flexible Automation. Pp. 926-940.

Author: James B. Acton, Todd Pacific Shipyard.

Abstract: Flexible Automation may be defined as the combination of reprogrammable single and multi-functional manipulators and fixed function machines integrated with conventional fabrication and assembly techniques for optimizing the performance of the manufacturing process. Achieving this in the shipbuilding industry came a step closer by the activation of the SP-10 panel at its first meeting on June 14, 1983. With initial projects reviewed and reports on various related projects in progress made by shipyard and Navy members, potential new projects were defined. Current and future projects and unique nature of this panel are discussed in the presentation. (15 p.)

Keywords: Flexible automation, robots

Paper No. 24:

Title: SP-0-23-1: Surface Preparation and Coatings. Pp. 941-949.

Author: John W. Peart, Avondale Shipyards, Inc.

Abstract: This paper gives a brief review of the National Shipbuilding Research Program's effort in the area of surface preparation and coatings. Its efforts to determine the necessary radius required on sharp edges to provide coating life equivalent to flat areas is discussed. The survey of abrasive sources and the quality of the abrasive materials available and the necessary requirements is reviewed. The progress report on the development of a means to deposit calcite coatings in ship ballast tanks as a method in controlling corrosion is presented. (9 p.)

Keywords: Surface preparation, coatings, abrasives

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UMTRI 70674

TITLE: Survey of Japanese Shipyards.

AUTHOR: Bath Iron Works Corporation.

DATE: 1979

ABSTRACT: A survey of Japanese shipyards was conducted from October 29 to November 26, 1979, in support of a MARAD sponsored project for stimulating the U.S. shipbuilding industry to improve productivity. In brief, the objective of this project was for a team of six individuals having broad shipbuilding experience to visit Japanese shipyards for the purpose of identifying specific areas where Japanese Shipbuilding Technology can be transferred to the U.S. shipbuilding industry. The emphasis of this project is in the area of Systems and Procedures, Management and Organization Techniques, and Computer Software as opposed to Hardware Systems requiring large capital investment. (42 p.)

KEYWORDS: Japanese shipyards, technology transfer, Japanese shipbuilding technology

NSRP 0100

UMTRI 70605

TITLE: Project Report - Stimulating the U.S. Shipbuilding Industry to Improve Productivity.

AUTHOR: IITRI.

DATE: January 1980

ABSTRACT: During the period from October 29 through November 16, 1979, a U.S. team of six individuals with broad shipbuilding experience visited six Japanese shipyards. The intent of this visit was to identify and examine low investment, high return Japanese shipbuilding technology. The objective of this project is to stimulate U.S. shipbuilders to adapt and adopt these advanced techniques in their yards to improve productivity. (102 p.)

KEYWORDS: Japanese shipyards, Japanese shipbuilding technology

NSRP 0109

UMTRI 70614

TITLE: Japanese Technology That Could Improve U.S. Shipbuilding Productivity.

AUTHOR: IITRI.

DATE: June 1980

ABSTRACT: During the period from October 29 through November 16, 1979 a U.S. team of six individuals with broad shipbuilding experience visited six Japanese shipyards. The intent of this visit was to identify and examine low investment, high return Japanese shipbuilding technology. The objective of this report is to encourage U.S. shipbuilders to adopt the observed advanced techniques for the purpose of improving productivity. (35 p.)

KEYWORDS: Japanese shipbuilding technology

NSRP 0137

UMTRI 70678

TITLE: Manufacturing Technology for Shipbuilding: Planning and Scheduling, Volume I.

AUTHOR: Avondale Shipyards, Inc.

DATE: 1982

ABSTRACT: This report, which is one of four different reports, focuses on hull and outfitting production planning and scheduling at Avondale Shipyards, Inc. The subject of the report is the planning and scheduling functions being performed at Avondale as a result of implementing and applying those principles learned and assimilated from IHI. These methods are introduced by the National Shipbuilding Research Program of the Maritime Administration through the Shipbuilding Production Committee of SNAME. (350 p. approx.)

KEYWORDS: Manufacturing technology, production planning, outfitting, Avondale Shipyards

NSRP 0138

UMTRI 70679

TITLE: Manufacturing Technology for Shipbuilding: Design Engineering for Zone Outfitting, Volume II.

AUTHOR: Avondale Shipyards, Inc.

DATE: 1982

ABSTRACT: The apparent benefits of zone outfitting practiced by Japanese shipbuilders, and IHI in particular, are shorter production times and less cost. Avondale's approach, then, was to study the underlying concepts of the IHI zone outfitting technology and to select those concepts that could be applied or could be modified and applied to the particular environment at Avondale. (250 p. approx.)

KEYWORDS: Manufacturing technology, zone outfitting, design engineering

NSRP 0139

UMTRI 70680

TITLE: Manufacturing Technology for Shipbuilding: Moldloft, Production Control, Accuracy Control, Volume III.

AUTHOR: Avondale Shipyards, Inc.

DATE: 1982

ABSTRACT: This is the third report presented by Avondale Shipyards on the transfer of IHI technology. They address three areas of production upon which IHI technology has had a great effect, i.e., Moldloft, Production Control (Production Engineering/Material

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Control) and Accuracy Control. This report covers those activities that take place from the "Moldloft Meeting" (month nine of construction period) through delivery of the vessel. (150 p. approx.)

KEYWORDS: Manufacturing technology, moldloft, production control, accuracy control

NSRP 0140

UMTRI 70681

TITLE: Manufacturing Technology for Shipbuilding: Process Lanes and Design Engineering for Zone Outfitting, Volume IV.

AUTHOR: Avondale Shipyards, Inc.

DATE: 1984

ABSTRACT: This report focuses specifically on the sequential development of the process lanes concept at Avondale. The concept and the subsequent application of the process lanes principles, specifically, within the Avondale environment is discussed. This represents the task of assimilating the IHI technology principles and adapting them to our own shipbuilding environment. (130 p. approx.)

KEYWORDS: Manufacturing technology, process lanes, Avondale Shipyards, zone outfitting, design engineering

NSRP 0185

UMTRI 70250

TITLE: A Survey of CAD/CAM Technology Applications in the U.S. Shipbuilding Industry (1983).

AUTHOR: Richard L. Diesslin.

DATE: January 1984

ABSTRACT: The objective of this project is to provide shipyard management with a comprehensive shipbuilding industry study detailing computer technologies available and their current application to shipbuilding functions including problems encountered, benefits realized, and level of success attained. (219 p.)

KEYWORDS: Computer technologies, CAD/CAM

NSRP 0226

UMTRI 73406-07

TITLE: NSRP 1985 Ship Production Symposium. Proceedings. 2 vols.

AUTHOR: The University of Michigan.

DATE: December 1985

ABSTRACT: This two volume set includes papers that were presented at the NSRP 1985 Ship Production Symposium held in Long Beach, California on September 11-13, 1985, as well as several additional papers that were accepted for publication only. The theme of the

meeting was "Moving Ahead with Implementation of Advanced Technology." Each Ship Production Committee Panel was responsible for one of the symposium sessions and selected the papers to be presented. (Vol. 1, 543 p., Vol. 2, 523 p.)

KEYWORDS: Zone outfitting, CAD/CAM, productivity, zone construction, technology impact

Papers from NSRP 0226, Volume I.

Paper No. 1:

Title: Overview of Panel SP-1/3: Facilities and Environmental Effects. Pp. 24-35.

Author: Richard A. Price, Avondale Shipyards.

Abstract: The primary objective of this program is to reduce cost, improve productivity and reduce the time required for new ship construction, conversion, and repair in the shipbuilding industry through the implementation of new technology. The program addresses all phases of ship construction, including fabrication, assembly erection, outfitting, and required shipyard services. The program also includes Environmental Effects considerations involved in facility expansions, and modifications, operations, and ship production from a regulatory point of view. (12 p.)

Keywords: Operations analysis

Paper No. 2:

Title: Group Technology/Flow Applications Research. Pp. 36-48.

Author: Lynwood Haumschilt and William S. Oakes.

Abstract: The general subjects of GT (group technology), production cells, shop flow, and CIM (Computer Integrated Manufacturing), have much to offer the shipbuilder. In this paper, the authors describe these related subjects and the opportunities that shipbuilders have, a new look at CIM and GT from a shipyard perspective, and several proposed practical projects involving a machine shop and a sheet metal shop. (13 p.)

Keywords: Group technology, computer-integrated manufacturing

Paper No. 3:

Title: Web Fabrication Line: Results of a Feasibility Study. Pp. 49-53.

Author: Michael Tomzig, Oxytechnik System Engineering.

Abstract: In 1974 Oxytechnik designed a web fabrication system comprising equipment for mechanized handling and welding stiffeners to plates and a conveying system. This first concept was the basis for a feasibility study to investigate the possibilities of highly mechanized, automatic fabrication of webs for building ships. This paper discusses this

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feasibility study: its history, requirements, results, description, special features, and conclusions. (5 p.)

Keywords: Web fabrication, feasibility studies

Paper No. 4:

Title: The Nesting and Marking of Ship Parts Cut From Steel Plate. Pp. 54-102.

Author: Harry Hooper, Consultant to Avondale Shipyards.

Abstract: See SP1, NSRP report no. 0203.

Paper No. 5:

Title: Overview of Panel SP-2: Outfitting and Production Aids. Pp. 103-104.

Author: L. D. Chirillo Associates.

Abstract: Since 1983, the following additional National Shipbuilding Research Program (NSRP) publications were widely distributed: *Design for Zone Outfitting* (NSRP 0179), *Design Modeling* (NSRP 0193), *Pre-Contract Negotiation of Technical Matters* (NSRP 0196), and *Product Oriented Material Management* (NSRP 0210). (2 p.)

Keywords: Outfitting, production aids

Paper No. 6:

Title: A New Shipbuilding Measurement Tool: Photogrammetry for Measuring Circularity of Submarine Hulls. Pp. 105-136.

Author: Lawrence R. Jacobsen and Philip N. Biondo, General Dynamics, Electric Boat Division.

Abstract: Photogrammetry is the art, science, and technology used in the interpretation of coordinate data about physical objects by the measurement and analysis of photographic images. The Electric Boat Division of General Dynamics utilizes photogrammetry primarily, in measuring the as-built circularity (out-of-roundness) of the TRIDENT Class pressure hull cylinders. Various other mechanical methods had been used in the past for measuring hull circularities; but the unique features and capabilities of photogrammetry proved itself well to meet demanding shipyard needs. The large awkward shape of submarine pressure hull cylinders, in combination with the flexibility and ease of the photogrammetric technique, makes photogrammetry a productive tool for Electric Boat's shipbuilding applications. (31 p.)

Keywords: Photogrammetry, hulls

Paper No. 7:

Title: Application of Zone Logic and Outfit Planning Concepts to Overhaul, Modernization, and Repair of U.S. Navy Ships. Pp. 137-160.

Author: Dennis Moen, Puget Sound Naval Shipyard.

Abstract: This paper presents the experience of Puget Sound Naval Shipyard in applying zone logic and outfit planning concepts to the overhaul, modernization, and repair of an aircraft carrier, three cruisers, and a submarine. Procedures were developed to involve design, production, testing, and material personnel in the overhaul process from preplanning through completion of the production phase, with the resulting synergism and open communication. The systems approach was replaced with zone by stage sequenced work packaging with as much work as possible done off the ship. Computer Aided Design (CAD) and photogrammetry were applied to enhance pre-planning and off-ship work. Puget Sound Naval Shipyard's application of zone logic is drawn from the research managed by the Maritime Administration's National Shipbuilding Research Program which has introduced the highly successful scientific shipbuilding systems developed in Japan. In brief, this concept represents a shift in logic from system to zone orientation. (44 p.)

Keywords: Zone outfitting, photogrammetry, computer-aided design

Paper No. 8:

Title: Pipe Fabrication to Support Modern Ship Construction Methodology. Pp. 161-210.

Author: David J. Saginaw II, National Steel and Shipbuilding Company.

Abstract: In October of 1983, National Steel and Shipbuilding Company, as part of a yard-wide advanced technology implementation program, initiated a project to modernize its existing pipe fabrication operation. The modernization included facility enhancements, equipment acquisitions and involved the implementation of an integrated manufacturing control philosophy beginning in design and employing principles of group technology with respect to pipe fabrication. The paper summarizes the efforts associated with the pipe fabrication modernization project by tracing the facility enhancement from the initial feasibility studies to detailed shop layout and by describing the operating procedures currently being implemented in the pipe shop to support an integrated manufacturing control philosophy. An assessment of the favorable impact on productivity of the new facility and methodology is discussed as well as several facility and technology enhancements identified as appropriate steps to further improvement in pipe fabrication productivity. (50 p.)

Keywords: Pipe fabrication, group technology

Paper No. 9:

Title: Zone Outfitting in a Canadian Great Lakes Shipyard: The First Four Years. Pp. 211-245.

Author: Alan J. Telfer, Collingwood Shipyards.

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Abstract: This paper traces the introduction of Zone Outfitting and Outfit Modules in a Canadian Great Lakes shipyard following ideas put forward at a Washington, D.C., seminar in 1981. Advances made during construction of five 736 foot bulk carriers are presented, showing the increase in outfit material incorporated in steel units before erection and the rapid increase in size of machinery modules from 3 - 4 tons to some of 40 tons. The different attitudes to these changes by senior management, production supervisors, drawing office and mechanics are briefly examined: Some of the problems encountered are discussed along with the benefits gained by different departments in the yard. The paper examines problems which have yet to be overcome, with a look at new advances planned for future ships. (35 p.)

Keywords: Zone outfitting, outfit planning

Paper No. 10:

Title: The Use of Statistical Methods in Dimensional Process Control. Pp. 246-264.

Author: Stephen Krajcsik, Bethlehem Steel Corporation.

Abstract: In shipbuilding, the stage of construction which lends itself to the most time and cost reduction is unit erection in the basin or on the ways. This requires all units to be complete and accurately assembled in order to eliminate costly rework during and after erection. To achieve this high degree of unit accuracy, a pilot dimensional control program was begun that has set the guidelines for systematically monitoring each stage of the production process prior to erection. Through the collection and analysis of data, each process can be controlled. The cumulative effects of "fine tuning" each individual work process will ultimately lead to improvement in the dimensional accuracy of completed units. This paper discusses the application of statistical methods in the collection and interpretation of dimensional data on automatic burning machines. The results obtained and the benefits derived from the pilot program have proved that statistical process control, as applied successfully in Japanese shipyards, is a viable method for improving productivity in the shipbuilding industry. (19 p.)

Keywords: Quality control, statistical process control, process control

Paper No. 11:

Title: Theodore Roosevelt (CVN 71) Construction Schedule Compression. Pp. 265-280.

Author: Irving D. Halper, Naval Sea Systems Command.

Abstract: The shipbuilding industry has made significant advances in its use of modernized ship construction techniques and facilities. This paper, in addition to discussing those topics, attempts to examine the environment in which improvements in ship construction can occur and looks at the type of planning that must be done to ensure benefits are realized. The Navy is now the major customer of the U.S. shipbuilding industry, and even with the increased emphasis on competitive procurement, contracts for a significant amount of sole source ship construction will exist due to technical or facility constraints. For these contracts, as well as many others, the shipbuilder has a limited incentive to accept the increases in risk inherent in changing his business strategy and existing

industrial processes. The Navy has recognized this problem and has successfully changed this environment for aircraft carrier construction. (16 p.)

Keywords: Scheduling, contract specifications, contract planning

Paper No. 12:

Title: Overview of Panel SP-4: Design/Production Integration 1985. Pp. 281-299.

Author: F. Baxter Barham, Jr., Newport News Shipbuilding.

Abstract: Panel SP-4 seeks ways to assist U.S. Shipbuilding to attain and maintain a worldwide competitive position in Time-Cost-Quality. The work of the panel addresses the detail design and planning efforts, integration of those efforts into the production process and the tools involved. During the past year the panel pursued its goal through the publication of a report on *Software Tools for Shipbuilding Productivity*, (NSRP 0197) completed work on *Design for Production Manual*, (NSRP 0236) and continued efforts on systems of classification and coding and computer aided process planning suitable for the shipbuilding environment. In addition, work has begun on five new projects involving a broad spectrum of shipyard disciplines. This presentation describes all of these activities. (19 p.)

Keywords: Design/production integration

Paper No. 13:

Title: Engineering Management for Zone Construction of Ships. Pp. 300-402.

Author: Thomas Lamb, Tacoma Boatbuilding Company.

Abstract: Zone construction has been proposed as the way for the U.S. shipbuilding industry to improve its productivity and survive the current hard times. Obviously as the production requirements for zone construction are different from traditional ship construction so are the engineering requirements. While production could perform zone construction from traditionally prepared engineering it would do so inefficiently and after waiting a long time for most of the engineering to be completed before they could start, thus defeating one of the goals of zone construction. The production department in a shipyard changing to zone construction will probably reorganize into major zone sections. To obtain maximum benefits from zone construction it is necessary for the engineering department to be like organized and managed. The paper therefore discusses engineering aspects that are influenced by the change to zone construction. Discussion and comments by participants at the Symposium are appended to this paper. (103 p.)

Keywords: Zone construction, zone planning, engineering management

Paper No. 14:

Title: Producibility as a Design Factor in Naval Ships. Pp. 403-442.

Author: Michael L. Bosworth and Clark Graham, U.S. Navy.

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Abstract: This paper provides examples of producibility concepts which should be addressed during the ship design process. An evaluation procedure is presented to assist in the gathering and the organizing of information required for an objective tradeoff analysis. The ship synthesis model "ASSET" is utilized as the principal design tool to determine ship impact and the cost of producibility concepts. One of the primary recommendations of the authors is that the Navy needs to increase the visibility of producibility as a design factor in naval ships by developing rigorous evaluation tools, cataloguing producibility concepts for considerations in future designs, and establishing an advocate for ship producibility within the design organization. (40 p.)

Keywords: Producibility, design-for-production, design methods

Paper No. 15:

Title: Multi-Skilled Work Teams in a Zone Construction Environment. Pp. 443-460.

Author: Dan Stravinski, National Steel and Shipbuilding Company.

Abstract: In order to address the problems inherent in a trade oriented production organization, and to develop a work force which will perform efficiently and effectively in a zone construction environment, NASSCO proposed to develop semiautonomous, multi-skilled work teams. The teams are made up of a stable membership, are well trained, have multiple skills, and have some degree of control over decisions necessary to complete work in their areas. One supervisor, rather than individual trade supervisors is responsible for completion of work within the area. Employee participation is encouraged to the greatest possible extent. Although ultimate authority for decisions within the work area remains with the supervisor, it is envisioned that the traditional role of supervision will shift in emphasis from "boss" to facilitator acting as liaison between the work team and other parts of the organization. (18 p.)

Keywords: Human resources, zone construction, work teams, Quality (control) Circles, labor-management relations

Paper No. 16:

Title: The Sparrows Point Yard/Local 33 Employee Involvement Effort. Pp. 461-471.

Author: R. David Case, Industrial Union of Marine and Shipbuilding Workers of America, AFL-CIO, and Stephen F. Sullivan Bethlehem Steel Corporation, Sparrows Point Yard.

Abstract: This paper describes the conditions which stimulated consideration of an employee involvement program, the development of groundrules for its operation, the process of orientation and training which preceeded its introduction, successes and failures in its operation, and projections for its role in the future of the Sparrows Point Yard. (11 p.)

Keywords: Human resources, labor-management relations

Paper No. 17:

Title: Overview of Panel SP-6: Marine Industry Standards. Pp. 472-497.

Author: Thomas M. O'Toole, Bath Iron Works.

Abstract: The idea of standardization is not new to the shipbuilding industry; however, the creation by industry and implementation by government agencies of marine industry consensus standards is a relatively new one. Over the past nine years, SNAME Panel SP-6 has provided the voluntary efforts of ASTM Committee F-25 on Shipbuilding Standards with over 100 draft standards through a cooperative effort known as the National Shipbuilding Standards Program. This cooperative effort is increasing awareness of the significance of shipbuilding standards that satisfy the needs of Naval and commercial construction. The U.S. Navy and U.S. Coast Guard have been major contributors to the National Shipbuilding Standards Program since its inception, and with this continued support, the Program can continue to develop quality commercial standards for virtually all types of ship building and repair. (24 p.)

Keywords: Marine industry standards, standards, shipbuilding standards

Paper No. 18:

Title: Standardization from Marine Equipment Suppliers Perspective. Pp. 498-510.

Author: Parker L. Hay, Hyde Products, Inc.

Abstract: The deep depression of the shipbuilding industry in the United States has brought into sharp focus the fact that broad and sweeping changes must be rapidly implemented if the industry is to survive. The factors leading to the decline of U.S. shipbuilding are many and complex and there are no quick and easy solutions. However, it must be recognized that many of our traditional manufacturing procedures and techniques are prominent among those factors. Although some of the industry's problems may be outside the influence of technical societies, manufacturing procedures and methods are not, and are, in fact, already being dealt with through the Society's participation in the National Shipbuilding Standards program. The task is not easy, however, since there has been considerable indifference, if not outright resistance, to standardization by marine equipment suppliers, particularly deck machinery manufacturers. (13 p.)

Keywords: Shipbuilding standards, standardization

Paper No. 19:

Title: Making the Right Connection: Piping Systems, Past, Present, and Future. Pp. 511-527.

Author: David C. Kelly, Deutch Metal Components.

Abstract: A fundamental concern of members of the shipbuilding community is the escalating cost of repairing and fabricating piping systems. These shipbuilders are searching for ways to reduce installation costs and to improve the quality and timeliness of shipyard output. The primary cost in attaching segments of a piping system is directly

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related to installation man-hours for welding or brazing, flushing, hydro-static testing, quality assurance and potential rework. The more labor intensive the piping installation, the greater the need for an alternative method. New technologies have provided more cost effective methods for permanently joining piping. This paper will discuss the history of welding and brazing, the development of mechanically applied pipe connections and the potential impact that this technology will have on the future of piping fabrication and repair. (17 p.)

Keywords: Piping systems, pipe fabrication

Paper No. 20:

Title: Marine Industry Standards of the U.S. and the World. Pp. 528-543.

Author: Robert B. Toth, R.B. Toth Associates.

Abstract: This paper provides an overview of standards developed or invoked by national and international organizations for the marine industry. Data on standards promulgated by U.S. voluntary and government organizations are presented and compared with those standards available to shipbuilders in other nations. A critical deficiency in the U.S. is the relatively small number of fully definitive voluntary standards that can be used for competitive procurement. Recommended action by the marine industry and the standardization community is presented, focusing on the need to effectively apply the limited resources that are available. (16 p.)

Keywords: Standards, marine industry standards, standardization

Papers from NSRP 0226, Volume II.

Paper No. 1:

Title: Overview of Panel SP-7: Welding. Pp. 544-556.

Author: Benjamin C. Howser, Newport News Shipbuilding.

Abstract: At the beginning of Fiscal Year (FY) 1984, the SP-7 Panel had six projects in progress and seven projects approved and funded but not underway. During the course of the year, one of the projects - Evaluation of the Unimation "Apprentice" Robot - was terminated prior to completion because preliminary studies indicated that any potential benefit this equipment may have had for shipbuilding welding had been far surpassed by existing robot welding technology. Two others of the six projects in progress were completed in FY 1984 and reports were printed and distributed. These were: *Out-of-Position Welding of 5000 Series Aluminum Alloys Using Pulse GMAW Power Sources* (NSRP 0184), and *Study of Fitting and Fairing Aids of U.S. Shipyards* (NSRP 0195). (12 p.)

Keywords: Welding

Paper No. 2:

Title: Evaluation of the Useability and Benefits of Twist Wire GMAW and FCAW Narrow Gap Welding. Pp. 557-589.

Author: Derek H. Mortvedt and Frank B. Gatto, Puget Sound Naval Shipyard.

Abstract: Puget Sound Naval Shipyard is evaluating and developing the twisted wire narrow gap joints and reduced bevel weld joints for the shipbuilding industry. Test and evaluation work is being accomplished with twisted solid wire and twisted flux cored arc weld on carbon steel, low alloy steels (ASTM-302B), and quenched and temper steels (HY-80). Weld joint design tolerances, welding parameters tracking systems, and weld joint irregularities have been evaluated with both twisted FCAW and solid welding electrodes. All test welds have been accomplished on two and three inch thick base metals. The following elements of the electrode quality were found to be critical for depositing sound metal: uniformity of the twist; tightness of the twist; smoothness of the wire; amounts of residual stress; prevention of looping; and the amount of helix. (33 p.)

Keywords: Welding, gas metal arc welding (GMAW), flux core arc welding

Paper No. 3:

Title: Evaluate the Benefit of New Higher-Strength HSLA (High Strength, Low Alloy) Steels. Pp. 590-595.

Author: John C. West, Bethlehem Steel Corporation.

Abstract: As the continuing search for offshore oil heads toward deeper water, the need for sturdier designs and stronger steels multiplies. Thus the costs to build mobile drilling units and fixed platforms rise exponentially. In Bethlehem's design improvement and cost reduction efforts, a steel capable of being welded without sustained preheat or limited heat input was found. This quenched and precipitation hardened steel is ASTM A710 Grade A Class 3. Due to its high degree of weldability, it shows great potential for sizeable savings in welding costs. (6 p.)

Keywords: Welding, high-strength steel

Paper No. 4:

Title: Higher Strength Steels Specially Processed for High Heat Input Welding. Pp. 596-646.

Author: Irving L. Stern, American Bureau of Shipping.

Abstract: See SP7, NSRP report no. 0209.

Paper No. 5:

Title: Analytical Education: A Key to Implementing Advanced Shipbuilding Technology. Pp. 648-660.

Author: Maurice W. Cunningham, Bath Iron Works Corporation.

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Abstract: Not only U.S. shipyards, but shipyards worldwide, are feeling the impact of declining new construction orders. As the shipbuilding depression continues, it is forcing all yards to become as efficient as possible if they intend to stay in business. Industry analysts agree that how well shipyards implement advanced shipbuilding technology will determine their success or failure. Industrial engineers can help maximize the benefits of these advanced techniques. The analytical skills they bring to the industry will help provide the data feedback needed for full implementation. Where industrial engineers are not available, the alternative is to train shipyard personnel in industrial engineering techniques. Such training needs to be focused to specific needs in order to fill the educational void as rapidly and economically as possible. (13 p.)

Keywords: Education, industrial engineering, training

Paper No. 6:

Title: Computerized Application of Standards. Pp. 661-717.

Author: Carol I. Edwards, Charles C. Meador, and Craig Brubaker, Newport News Shipbuilding.

Abstract: A computer program has been developed which provided for the elimination of manual applications of standards by integrating previously developed standards into existing computer-aided design systems. Standards for the pipe shop were developed between 1978 and 1979 using Manual MOST (Maynard Operation Sequence Technique). The implementation of this program into the computer-aided design system has resulted in improved accuracy and consistency of standards application. Other benefits resulting from the computerized application of standards include: increased manhour productivity, standardization of pipe detail part terms, capability to apply detailed standards, and the capability for computerized transfer to the Production Scheduling and Control System. (57 p.)

Keywords: Maynard Operation Sequence Technique (MOST), standards

Paper No. 7:

Title: Increasing Productivity Through Methods Improvement. Pp. 718-743.

Author: James R. Ruecker, National Steel and Shipbuilding Company.

Abstract: The SNAME Ship Production Committee's SP-8 Panel on Industrial Engineering's primary objective has been to increase productivity in the Shipbuilding Industry. Since the Panel's conception, it has introduced a number of Industrial Engineering techniques to improve the utilization of our two most important resources, men and machines. One can not function without the other, and only through proper management will optimum productivity be achieved. The use of Industrial Engineering Techniques provides for a good, solid evaluation of tasks to boost productivity. The SP-8 Panel has sponsored a number of Methods Engineering Workshops to acquaint shipyard personnel with the techniques that are available, and how to use them. Workshop attendees have been introduced to work sampling, operations and flow process charting, operations analysis, and relationship charting. With these, an individual can systematically perform an analysis on any size task, and produce facts about the operation

from which decisions can be made to improve productivity. Substantial productivity gains can be made through the application of Industrial Engineering Techniques. (26 p.)

Keywords: Productivity, methods engineering

Paper No. 8:

Title: The Reluctance to Implement New Technology: Industrial Engineering's Role. Pp. 744-756.

Author: Bryan D. Johnson and Marilyn S. Jones, Virginia Polytechnic Institute and State University.

Abstract: Although the U.S. has been a leader in technological development, it has fallen behind some other countries in the industrial implementation of these new methods. Recently, issues of Industrial Engineering have addressed such topics as a lack of management commitment to Computer Integrated Manufacturing Systems (CIMS), factors limiting the growth of robotics in the U.S., and the reluctance of management to implement office automation. The paper examines these issues and presents some of the published hypotheses of why industrial management in the U.S. is reluctant to accept and apply the newer management concepts and technologies. The industrial engineer's responsibility in finding areas where new technologies will result in improvements, preparing the justification, presenting the plan to management to gain their commitment, and directing the implementation is discussed. (13 p.)

Keywords: Industrial engineering, technological change

Paper No. 9:

Title: Improving Shipyard Productivity through the Combined Use of Process Engineering and Industrial Engineering Methods Analyses Techniques. Pp. 757-774.

Author: Tommy L. Cauthen, Ingalls Shipbuilding.

Abstract: Despite the obvious compromises to efficiency that must be made when producing small quantities, the shipbuilding industry sometimes rules out or fails to consider some of the efficient techniques and methodologies of mass production manufacturing. In this paper a comparison and contrast is made between the methods of mass production and small quantity manufacturing. Also revealed in this paper are the benefits from the use of a mass production process engineering technique and a methods analysis technique during the performance of the National Shipbuilding Research Program's SP-8 panel Task ES-8-21. The use of a mass production process engineering technique (using tool routings to provide a summary of all of the tools, gages, etc., required to operate and control the products being produced from mass production machining and assembly equipment) is explained as a solution to a methods problem of excessive travel for tools in shipboard equipment machining and installation by Outside Machinists. The paper concludes with a promotion of this specific application of mass production methodology in shipbuilding and a promotion of the re-evaluation of mass production techniques by shipyards as a vehicle for productivity improvement. (18 p.)

Keywords: Process engineering, industrial engineering

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Paper No. 10:

Title: Overview of Panel SP-9: Education and Training. Pp. 775-776.

Author: Howard M. Bunch, University of Michigan.

Abstract: In 1981 the Ship Production Committee established the Education and Training Panel (SP-9). The panel's purpose is to develop and maintain educational programs in: (1) skilled trades training, (2) pre-entry professional training, and (3) middle management training. The SP-9 panel was given the responsibility of organizing and administering the 1985 NSRP Ship Production Symposium. It has established the *Journal of Ship Production*, an archival journal focusing on the science of ship production; maintains the NSRP Microfiche Library of NSRP publications (including an index), and distributes microfiche free of charge to about 50 designated shipyards and libraries around the United States. Additionally, SP-9 has launched a project that will assess the communication requirements and communication skills of shipyard workers, then develop methods to improve those skills; maintains the AVMAST library and lending service of audio-visual material for shipyard training; and is preparing a lecture course on basic naval architecture. (2 p.)

Keywords: Education, training

Paper No. 11:

Title: Evaluation of Two Multi-Shipyard Cooperative Training Programs. Pp. 777-787.

Author: Alvin J. Abrams, Data Design Laboratory.

Abstract: Descriptive and evaluative information is reported on two multi-shipyard training programs: (1) Tidewater Maritime Training Institute, Norfolk, Virginia, and (2) Cooperative Apprentice Training Program, Seattle, Washington. Both programs are described relative to their: (1) program history, (2) legal basis, (3) objectives, (4) funding, (5) geographic area, (6) staff and facilities, (7) trainee input, (8) curriculum, and (9) hiring and retention of graduates. (11 p.)

Keywords: Training programs Cooperative Apprentice Training Program, apprentice training

Paper No. 12:

Title: Northern European Craft Training: A Trip Report. Pp. 788-802.

Author: Paul Vickers, University of Michigan.

Abstract: The Education and Training Panel of the Ship Production Committee is charged with conducting research on training methods and techniques and developing new training methods. As part of this effort, the panel funded a project to provide the means for on-site inspection and evaluation of craft training programs in Europe. In June of 1985, a four-person project team traveled to Northern Europe to meet with shipbuilding trainers and educators. This paper presents highlights of that trip. Discussed here are apprentice

training programs of The United Kingdom and the Federal Republic of Germany, and adult training in Scandanavia. (15 p.)

Keywords: Training programs, education, apprentice training

Paper No. 13:

Title: The Certificate in Manufacturing Engineering – Ship Production: A New Program for Shipyard Employee Self-Instruction. Pp. 803–808.

Author: William D. McLean, Society of Manufacturing Engineers.

Abstract: The Manufacturing Engineering Certification Institute (MECI) of the Society of Manufacturing Engineers (SME), offers a peer recognition program for individuals involved within the many facets of manufacturing engineering and technology related career areas. The MECI certification program was developed in 1972 to provide manufacturing personnel with the means to document specific areas of expertise, to encourage continuing education, and to foster professional development. In 1986, a new certification specialty in Ship Production was added to those currently available to an individual applying for recognition as a Certified Manufacturing Engineer. This new area, developed under the direction of Professor Howard Bunch, of the University of Michigan Transportation Research Institute, and MECI, is offered to all qualified applicants beginning with the December, 1986 examination cycle. This paper introduces the new ship production specialty within the SME/MECI certification program. (5 p.)

Keywords: Training programs, education

Paper No. 14:

Title: A Computerized Robot Selection System. Pp. 810–834.

Author: Marilyn S. Jones, Virginia Polytechnic Institute and State University.

Abstract: Attributes which should be considered when selecting a specific robot model are identified. Some of the attributes are specifications necessary to determine a set of feasible robots which are capable of performing a particular task. Other attributes pertain to the selection of a single robot model from the set of feasible robots. The robot selection model was implemented on an IBM PC using R:BASE (a relational database management system by Microrim, Inc.) coupled with a BASIC program. The database consists of forty-nine robot models representing twenty vendors. The software consists of three phases. In the first phase, a feasible set of robot models is determined. The user is presented with a list of forty-five attributes and permitted to enter specifications for any or all attributes. In the second phase, the user is presented with a list of twenty-nine attributes judged most important. The final phase of the software uses a BASIC program to interrogate the user regarding preferences and priorities with respect to the attributes being used as selection criteria. The information obtained from the interrogation is entered into the decision model and the most preferred robot model in the feasible set is determined. (25 p.)

Keywords: Robots, robot selection criteria

Paper No. 15:

NSRP BIBLIOGRAPHY

Title: Islands of Automation in Shipbuilding. Pp. 835-857.

Author: Robert J. Bellonzi, Bath Iron Works.

Abstract: A number of opportunities are available in shipbuilding for substantial productivity improvement by implementing stand-alone automation technologies (sometimes called "islands of automation"). The challenge to increase the level of automation in shipbuilding can best be met by matching proven technologies with those opportunities that justify automation. Proven automation technologies are readily available and government programs are in place to provide the shipbuilder with both financial and technical support. Effective implementation of automation technologies can be greatly enhanced by following a few basic points in project development and control. Program results at Bath Iron Works have demonstrated that implementation of "islands of automation" can result in substantial productivity improvement. (23 p.)

Keywords: Automation, stand-alone systems

Paper No. 16:

Title: Computer Optimizing of Bevel Angles for Welded Pipe Joints. Pp. 858-876.,

Author: H. W. Mergler, Case Institute of Technology.

Abstract: The most common method for preparing the bevel-angle for welded pipe construction is to keep it at a constant value (e.g., 37 degrees) around the entire periphery of the branch pipe. This paper explores the "optimized bevel-angle" as a function of pipe radii, wall thicknesses, centerline offset, and intersecting angle to keep the resulting weld cross section constant and thus minimize the weld volume while insuring clearance for total weld penetration. The advantages of using the "optimized bevel angle" are demonstrated by computer simulation for pipe diameters from 4-1/2 inches to 24 inches for wall thicknesses over the range of 0.237" to 1.312". The ratio of the fixed bevel weld volume to the optimized bevel weld volume are shown to range from 1.5 to 5 which implies phenomenal reductions in the attendant welding time. (19 p.)

Keywords: Welding, computer optimization, bevel angles, pipe joints

Paper No. 17:

Title: Application of Flexible Automation to Ship Construction. Pp. 877-889.

Author: John M. Sizemore, Ingalls Shipbuilding Division.

Abstract: Computer-aided design and flexible automated manufacturing technologies presently available and currently under active development can provide the keys to improved productivity in shipbuilding. The specific applications of these technologies, implemented or proposed for other more structured and product-form stationary industries, are not generally applicable to shipbuilding. The problem addressed by this paper is the research and analysis of the potential mating of advanced productivity improvement technologies to shipbuilding. Formal criteria are proposed for the selection of ship construction operations and the establishment of their priority as candidates for further study of automation potential. (13 p.)

Keywords: Flexible automation, computer-aided design

Paper No. 18:

Title: Overcoating of Inorganic Zinc Primers for Underwater Service. Pp. 891-915.

Author: G. A. Gehring, Jr. and J. A. Ellor, Ocean City Research Corporation.

Abstract: A study sponsored by MARAD under the National Shipbuilding Research Program was undertaken to determine whether overcoating of inorganic zinc primers for underwater service will result in accelerated blistering or disbondment of the topcoat. The study included 5 inorganic zinc primers - 2 U.S.-manufactured preconstruction type, 1 Japanese preconstruction type, and 2 full-coat type. Two different weathering periods were tested - 7 days and 60 days. Three different topcoats were evaluated, including the Navy MIL-P-24441 system and two commercial epoxy coating systems. Coated test panels were subjected to three different tests to rank susceptibility to blistering: (1) quiescent seawater immersion at 25 psi, 150 degrees F, and (3) continuous seawater flow at 18 knots. Interim test results suggest that, for underwater service, overcoating of certain inorganic zinc primers may result in premature blistering or disbondment of the topcoat. (25 p.)

Keywords: Zinc primers, coatings tests, overcoating

Paper No. 19:

Title: Evaluation of Wet Blasting for Ship Application. Pp. 916-922.

Author: Bernard R. Appleman, Steel Structures Painting Council.

Abstract: This paper presents the results of a field investigation of equipment and technology for wet abrasive blasting as a technique for preparation of structural steel for painting. Ten different commercially available wet blasting units were selected for field evaluation. The units selected included the following generic types: air abrasive wet blasting (addition of water at the nozzle to conventional dry blasting equipment); air/water/abrasive slurry blasting (mixing of water with the abrasive at a control unit upstream of the nozzle); pressurized water abrasive blasting (abrasive added to high or low pressure water jetting stream); and ultra high pressure water jetting (20,000 psi or greater). These evaluations were conducted on steel surfaces, typically encountered in shipyards and industrial environments, including rusted and pitted steel, milscale steel, and painted steel. The investigation considered factors such as the cleaning rates, abrasive and water consumption, operator thrust, portability, safety procedures required, use of inhibitors, and overall practicability and reliability. The paper discusses each of these factors and provides a tabulation of advantages and disadvantages for each unit observed. (7 p.)

Keywords: Blasting and painting, blast and paint equipment, abrasive blasting

Paper No. 20:

Title: Flame-Sprayed Copper Alloy Coating for Underwater Service: Corrosion Considerations. Pp. 923-940.

NSRP BIBLIOGRAPHY

Author: Louis M. Riccio, Copperlok, Inc.

Abstract: The Copperlock Coating is a new method of applying copper and copper/nickel to a hull's surface for anti-fouling purposes. The process involves the thermal spraying of a copper nickel alloy onto a specially modified epoxy resin base coat. The alloy in wire form is melted by an oxyacetylene flame, atomized by compressed air, and the molten particles are propelled to the surface where they form a strong mechanical bond. The coating can be built up to practical thicknesses of 10 to 12 mils which data show should last 15 to 20 years on ships where hull speed is in the range of 8 to 12 knots. Other applications such as off shore structures, power plants and heat transfer surfaces are presented, and the process and economic factors are discussed. (18 p.)

Keywords: "Copperlok", copper-nickel sheathing, anti-fouling, corrosion

Paper No. 21:

Title: The Naval Ship Design/Production Interface. Pp. 942-988.

Author: B. F. Tibbitts, U.S. Navy, and P. A. Gale, Naval Sea Systems Command.

Abstract: The paper discusses, from a ship designer's perspective, some of the current topics and issues relating to the interface between naval ship design and production. The current environment within which naval ship design activity is taking place is described. Notable current views on Navy ship design and how it might be improved are summarized. Navy design topics pertinent to improving ship producibility, operability, maintainability, and survivability are discussed and examples from recent ship designs are presented. Issues which result from apparent conflicts in current design initiatives and critiques of the Navy ship design process are highlighted and discussed. (47 p.)

Keywords: Ship design, design/production integration, producibility

Paper No. 22:

Title: Expanded Planning Yard Concept and Configuration Accounting or Improving Navy Ship Engineering. Pp. 989-1020.

Author: A. R. Karn and E. Runnerstrom, Naval Sea Systems Command.

Abstract: For several years the Navy has been methodically improving its organization and procedures for ship engineering. These improvements have resulted in an expanded role for the planning yard. The planning yard's two primary functions are ship alteration engineering and configuration identification. Responsibilities have been clearly defined and more discipline has been incorporated into the process for both of these functions. These improvements are in the early stages of implementation and detailed procedures will continue to evolve. Requirements for ship acquisition programs have been refined to reflect these improvements. We have learned that there is a need for clearly assigned responsibility in engineering, that configuration identification must be an integral part of engineering, and that logistics support must also be an integral part of engineering. (32 p.)

Keywords: Planning yards, configuration accounting, ship alteration engineering

Paper No. 23:

Title: CAD/CAM Directions for the U.S. Navy. Pp. 1021-1048.

Author: John F. Leahy and J. Christopher Ryan, Naval Sea Systems Command.

Abstract: In the past two decades, the U.S. Navy has undertaken significant projects in the computer aided design, manufacturing, and service life support areas. Among these are: CASDAC (Computer Aided Ship Design and Construction); ISDS (Integrated Ship Design System); CAEDOS (Computer Aided Engineering and Documentation System); CSD (Computer Supported Design); and NICADMM (Navy Integrated Computer Aided Design Manufacturing and Maintenance system). (28 p.)

Keywords: Computer aided design, computer aided manufacturing, computer aided construction, computer aided engineering

NSRP 0273**UMTRI 73863-85**

TITLE: NSRP 1986 Ship Production Symposium Proceedings.

AUTHOR: Symposium Participants.

DATE: August 1986

ABSTRACT: This NSRP report contains papers presented at the NSRP 1986 Ship Production Symposium on August 27-29, 1986 in Williamsburg, Virginia. The theme of the meeting was "Design and Production Concepts to Reduce Shipbuilding Schedules and Costs." These proceedings were not published as a volume. They are available as individual papers.

KEYWORDS: Process planning, line heating, fillet welds, zone construction

Paper No. 1:

Title: The Annual Report of the National Shipbuilding Research Program.

Author: J. W. Brasher, W. L. Christensen, V. W. Rinehart.

Abstract: This 3-part report discusses the history and beginnings of the National Shipbuilding Research Program, its accomplishments, the work of the Ship Production Committee and panel projects. Program benefits to the shipbuilding industry, and specifically to the Navy and the shipbuilding and ship repair mobilization base are detailed. Each of the three separate reports considers the outlook for the future. (25 p.)

Keywords: NSRP

Paper No. 2:

Title: Soviet Shipbuilding: Productivity Improvement Efforts.

Author: Boris S. Butman

NSRP BIBLIOGRAPHY

Abstract: Constant demand for new naval and commercial vessels has created special conditions for the Government owned Soviet shipbuilding industry which practically has not been affected by the world shipbuilding crisis. On the other hand, such chronic diseases of the centralized economy as lack of incentive, material shortage and poor workmanship cause specific problems for ship construction. Being technically and financially unable to rapidly improve the overall technical level and performance of the entire industry, the Soviets concentrate their efforts on certain important areas and have achieved significant results, especially in welding and cutting titanium and aluminum alloys, modular production methods, standardization, etc. All productivity improvement efforts are supported by an army of highly educated engineers and scientists at shipyards in multiple scientific, research and design institutions. (16 p.)

Keywords: Soviet shipbuilding, productivity

Paper No. 3:

Title: An Integrated Procedure for Hull Design and Production.

Author: Renzo Di Luca.

Abstract: The effective integrated procedure for hull design and production procedures is achieved by applying a comprehensive modeling technique that recognizes both the stages in the design process and also the structural component generation requirements. This paper describes an operational CAD/CAM system that is fully integrated from preliminary design through production. Some features discussed are ship-oriented model representations, common descriptive techniques, multi-user model access, and general graphic technology. (10 p.)

Keywords: CAD/CAM, hull design

Paper No. 4:

Title: Decentralization – The Management Key to Effective Accuracy Control.

Author: Tamara S. Upham, W. Mark Crawford.

Abstract: This paper presents the organizational structure, methods, and results of National Steel and Shipbuilding Company's efforts to decentralize the responsibility of statistical accuracy control from a central Accuracy Control Department to the hourly production workforce. It includes an accounting of the problems and successes encountered during implementation. The results are both quantitative and qualitative in form, including methods for measuring reductions in rework. During this study, workteams were established in the Hull Fabrication Shop. A three-phase methodology was used to introduce the workteams to statistical methods for improving the dimensional accuracy of their products. (16 p.)

Keywords: Work teams, statistical control

Paper No. 5:

Title: Technical Collaboration Between Mitsubishi Heavy Industries and Todd Shipyards.

Author: Lennart M. Thorell, Toshio Watanabe.

Abstract: In June 1986, Todd Shipyards Corporation, U.S.A. (Todd) and Mitsubishi Heavy Industries Ltd., Japan (MHI) concluded an agreement to transfer merchant ship construction and conversion technology between the two corporations. To date the program has been unique. MHI opened its Kobe shipyard to Todd's personnel for first-hand observation of its modernized facilities and equipment, its production methodology and its state-of-the-art shipbuilding technology. This paper: (1) explains how this collaborative agreement was reached, from the initial proposal by MHI through acceptance by Todd, (2) describes the agreement between both parties, and (3) summarizes the productivity improvements implemented and projected for future implementation by Todd's Los Angeles Division. (24 p.)

Keywords: Productivity, technology transfer

Paper No. 6:

Title: Comparison of the Construction Planning and Manpower Schedule for Building the PD214 General Mobilization Ship in a U.S. Shipyard and in a Japanese Shipyard.

Author: Howard McRaven Bunch.

Abstract: This study compares the construction planning and manpower schedules for production of five PD214 general mobilization ships at Avondale Shipyards, New Orleans, and Kawasaki Shipyards, Kobe, Japan. As background for the comparison, an examination was also made of the facilities and equipment in place at each yard. The overall conclusion of the study is that the differences in productivity found in comparing the two yards are primarily traceable to the organization of work. Fixed facilities have little impact on the differences that exist. (16 p.)

Keywords: Manpower planning, Japanese shipyards

Paper No. 7:

Title: The Streamlining of Navy Procurement Specifications.

Author: Charles J. Piersall, Jr., Charles J. Sinche

Abstract: The Department of Defense has instigated a number of initiatives to reduce the time, risk, and costs associated with developing, producing and maintaining weapon systems. These initiatives are not stand-alone policies, but have definite interrelationships that need to be addressed and developed into a cohesive policy. This paper provides a brief discussion of some of these initiatives and how they have been implemented in various shipbuilding programs. (8 p.)

Keywords: Weapon systems, streamlining

NSRP BIBLIOGRAPHY

Paper No. 8:

Title: Laser Line Heating.

Author: Kevin Scully.

Abstract: Many shipyards now employ line-heating processes to form metal by controlled heating and cooling. The benefits of line-heat forming include improved accuracy and productivity. The current line-heating method utilizes an oxyacetylene torch as the heat input. A new forming technique that uses a high-power laser as the heat source is being researched. The feasibility of forming mild- and high-strength steels with a laser heat input is reviewed. The primary incentives for using a laser are: the capability to accurately control the forming process, the capability to form high-strength steels, and the increased compatibility with other advanced manufacturing systems. By manipulating the laser power, laser beam diameter, and plate travel speed, one may form metal plates to a predetermined shape in a repeatable manner. (12 p.)

Keywords: Line heating, high-strength steel, lasers

Paper No. 9:

Title: Planning for Shipyard Surface Preparation and Coating.

Author: J. A. Cantor, R. F. Endert.

Abstract: The surface preparation and coating (SP and C) functions occur late in the ship completion cycle and can be impacted by all previous schedule derangements. Therefore, acknowledging the complexities involved, the work content of the SP and C activities was analyzed to plan, organize, and schedule work for effective production. This paper presents the results achieved and describes the self-contained instructional material available for use by SP and C planners and supervisors. (12 p.)

Keywords: Surface preparation, zone painting, planning and scheduling

Paper No. 10:

Title: An Analysis of Shipyard Painting Cost.

Author: Daryl L. George.

Abstract: An analysis of the manhours required to build auxiliary naval vessels showed that the Paint Department was fourth highest following Hull, Piping, and Electrical. This paper presents the results of an NSRP project to identify the direct and indirect costs associated with painting. Both initial application and touch-up operations are analyzed in detail, and the impact of construction sequence, and other considerations on painting costs are reviewed. techniques for the estimating of painting costs are presented. (18 p.)

Keywords: Painting, cost accounting

Paper No. 11:

Title: Adaption of Japanese Prefabrication Priming Procedure to U.S. Shipbuilding Methodology.

Author: K. A. Trimber, W. D. Corbett.

Abstract: Current U.S. shipbuilding practices require that the preconstruction primer be "Near-White Blast Cleaned", followed by the application of a new zinc primer, and the remainder of the coating system. In Japan, the original primer is minimally cleaned (Power Tool) with the primer not removed. Instead, it becomes a component of the final protective coating. This paper describes a comprehensive test program conducted to evaluate the two practices and presents the results obtained.

Keywords: Primers, coating tests

Paper No. 12:

Title: The Benefits of a Modified-Chemistry, High-Strength, Low-Alloy Steel.

Author: John C. West.

Abstract: Steels with 50 ksi and up yield points usually acquire their strength from some form of heat treatment. Most of these steels, 1-1/2 in. thick and up, must be welded using sustained preheat and controlled welding heat input of approximately 50 to 60 kilo joules per inch. These two items can add as much as 50 percent to the cost of submerged-arc welding and increases of up to 30 percent are common for manual welding when compared with lower strength steels previously used. Bethlehem Steel, in its pursuit of reduced costs, found that a quenched and precipitation hardened steel, ASTM A710 Grade A Class 3, had a high degree of weldability and could be welded without sustained preheat and almost unlimited heat. Although this steel costs more, cost reductions of 40 to 75 percent in welding labor costs are probable. (6 p.)

Keywords: High-strength steel, cost reduction

Paper No. 13:

Title: Reduced Fillet Weld Sizes for Navy Ships.

Author: Ed Gaines.

Abstract: Recently, Ingalls Shipbuilding Division of Litton updated its fillet weld design for naval ship construction. This task was part of a continuing effort to improve accuracy control by decreasing weld caused distortion. Recent material properties and a more rigorous engineering analysis were used to reduce the required fillet sizes by about 25 percent for steel and about 50 percent for aluminum. The analysis method was developed for the Navy at Newport News Shipbuilding during the 1970s. Intermittent weld tables were developed and, where utilized, proved to be a very cost effective distortion control measure. Reducing the amount of weld reduces distortion and economically improves accuracy control. Fabrication costs were significantly reduced. This paper reviews the methods and properties used to develop and implement the new weld tables. The benefits to distortion control and construction costs are also discussed. (10 p.)

Keywords: Fillet welds, accuracy control

NSRP BIBLIOGRAPHY

Paper No. 14:

Title: Investigation of Tubular Electrodes Designed for Submerged Arc Welding Applications.

Author: R. A. Whannell and B. H. Halverson.

Abstract: The Submerged Arc Welding Process has long been an important tool for joining thick steel plate in all areas of steel fabrication. Recent electrode manufacturing techniques introduced flux cored electrodes designed for Submerged Arc Welding Applications. This paper deals with the results of an investigation designed to study the relative operating characteristics of flux core submerged arc welding electrodes and to compare these results against solid submerged arc welding performance. Base metals selected for this investigation were those used in shipbuilding for hull envelopes or corrosion resistant tankage applications. Weld test data was recorded using the solid electrode results as 100 percent of normal Submerged Arc Welding performance. Using the same welding parameters as those used for solid electrodes, weld tests were conducted using the flux core electrodes. The conclusion was that the flux cored electrodes offered several economic improvements as well as improved mechanical properties on some types of steel. (14 p.)

Keywords: Submerged arc welding, tubular electrodes, flux core arc welding

Paper No. 15:

Title: Engineering for Ship Production.

Author: Thomas Lamb.

Abstract: Engineering For Ship Production is the use of production-oriented techniques to transmit and communicate design and engineering data to various users in a shipyard. The changeover from a traditional craft-organized shipyard to one of advanced technology has obviously had a tremendous effect on all shipyard departments. It should have had its second greatest impact on the engineering department. However, many engineering departments did not rise to this challenge, and therefore lost what might have been a lead position for directing and controlling change. Production performance depends largely on the quality, quantity, and suitability of technical information supplied by engineering. By organizing for integrated engineering and preparing design and engineering for zone construction, engineering can step forward and take its proper place and play an essential role in the renaissance of U.S. shipbuilding. Using examples, this paper describes how this can be done. (28 p.)

Keywords: Production engineering, zone construction, design-for-production

Paper No. 16:

Title: Unit Work Guide for Zone Outfitting in Repair and Overhaul.

Author: Shel Kjerulf.

Abstract: This paper describes Puget Sound Naval Shipyard's progress in substituting zone for system logic for alteration, overhaul, and repair of U.S. Navy ships. More

specifically, progress is tracked through development of a different way of grouping information to facilitate zone by stage implementation of work. Unit Work Guide (UWG) is the term applied by Puget Sound for the new way of grouping all required information for a discrete amount of work to be accomplished in a particular zone during a series of stages. Instruction, graphics, material lists, special tool requirements, work locations, material landing dates, and specific amounts of time to complete stages are all included. The system for utilization of UWG's is referred to as Zone Outfitting in Repair and Overhaul (ZORO). Success is manifested in the gradual sophistication of UWG's and their extension to more complicated work situations. (22 p.)

Keywords: Zone outfitting

Paper No. 17:

Title: Automatic Submerged Arc Welding With Metal Powder Additions to Increase Productivity and Maintain Quality.

Author: Phillip D. Thomas.

Abstract: This paper presents the results of a SNAME SP-7 Welding Panel research and development project recently completed by Newport News Shipbuilding. It was directed toward the evaluation, testing, and qualification of automatic submerged arc welding (SAW-AU) with metal powder additions for shipyard use. It is concluded that using controlled metal powder additions with SAW-AU is indeed a production concept that can reduce shipbuilding costs. This is possible through increased deposition rates and (possible) reduced consumables costs while, at the same time, maintaining or improving quality.

Keywords: Submerged arc welding, welding automation

Paper No. 18:

Title: Generative Process Planning by Expert Systems.

Author: F. A. Logan.

Abstract: This paper examines the attributes of expert systems and their application to the process planning function in the manufacturing industry. It traces the evolutionary stages from low level interactive computer aided process planning through to complex rule based Automated Process Planning (APP) driven by a Part Recognition Code (PRC) derived from a Computer Aided Drafting (CAD) system. It outlines the requirements for the knowledge transfer by the existing human experts into their own expert knowledge base. It also reviews the progress to Logic Generators and the extension of APP to embrace Generative Design. It concludes that Computer Aided Manufacturing (CIM) will only become a reality as manufacturing engineers commit their manufacturing knowledge to an expert system. (16 p.)

Keywords: Process planning, expert systems

Paper No. 19:

Title: The Establishment of Shipbuilding Construction Tolerances.

NSRP BIBLIOGRAPHY

Author: J. D. Butler and T. R. Warren.

Abstract: Predictable and economically achievable construction tolerances are a prerequisite for the establishment of effective shipbuilding procedures, as unproductive rework and on-the-job fitups are the alternative. This paper reviews the factors to be considered in the development of tolerances and suggests the use of variation merging equations and variation simulation as techniques that can be used to formulate a practical system of tolerances. (13 p.)

Keywords: Modular ship construction, variation simulation, design tolerances

Paper No. 20:

Title: Thermal Spraying in the United States Navy.

Author: Stephen Vittori.

Abstract: Thermal spraying emerged as a recognized repair process in the Navy in the mid-1970s. Much of the Navy's early production work was done at Puget Sound Naval Shipyard (PSNS). The three biggest test and evaluation programs to date are: 1.) Wire flame spraying aluminum onto about 600 shipyard valves and related components in 1977. 2.) Thermal sprayed metal and ceramic coatings on 25-30 shipboard machinery components in 1980. 3.) Thermal sprayed coatings on main feed pump and turbine shafts and a forced draft blower turbine shaft at a land-based naval training facility in 1984. Coated areas include journals, labyrinth seals, packing sleeves and babbitt bearings. The need for thermal spray repair is evident during ship overhauls, when critical time and cost schedules must be met. The applications listed are under evaluation in the test programs to establish confidence in thermal spraying. With detailed written standards now in place at the NAVSEA level to ensure production reliability and quality control, increasing use of thermal spray in the Navy is expected. This paper discusses the test and evaluation programs. (9 p.)

Keywords: Thermal spraying, testing

Paper No. 21:

Title: The Development of an Initial Graphics Exchange Specification (IGES) Capability.

Author: D. J. Wooley and M. L. Manix.

Abstract: Industry has long recognized the importance of computerized data exchange. The concept of a neutral exchange format is the key to an efficient and maintainable data exchange capability due to the number of dissimilar CAD/CAM systems in use today. The capability to exchange computerized design data provides the opportunity to eliminate many redundant activities such as recreating computer data from computer-generated paper drawings. The resulting improved communication of design data between contractors, subcontractors, customers, and operation and maintenance activities can reduce costs and upgrade fleet operations. This paper focusses on the need for, and the methods used, to develop a workable computerized data exchange capability. Topics of discussion include the merits of electronic data exchange, the limitations of direct translators, and the benefits of a neutral data format. (9 p.)

Keywords: IGES, graphics systems, computer-aided design

Paper No. 22:

Title: The Automatic Cutting, Marking, and Processing of Structural Sections.

Author: Gunter C. Wilkins and John M. Kalogerakis.

Abstract: Structural sections used in the offshore and shipbuilding industries require a wide range of cut-outs, end-cut configurations and edge preparations. Such shapes are currently sketched, layed-off and cut with manual and or semi-automatic methods. This paper describes the development of a high-throughput automated (C.N.C.) shape cutting line that incorporates all of the activities from the planning stage through to the finished workpiece. For the more complex shapes, a flexible automation (robotic) cutting system is described that includes an off-line programming capability. Two practical application examples are also detailed. It is concluded that section preparation is now an area that can be automated with robotics being a feasible and flexible solution. (10 p.)

Keywords: Robotics, structural sections

Paper No. 23:

Title: The Reproduction of the Godspeed.

Author: Duncan Stewart and William Boze.

Abstract: The authors, and designers, of the reproduction of the 17th century GODSPEED present the criteria used to design, build, launch, and sea trial the 1984 reproduction. Foul weather notwithstanding, the reproduced GODSPEED reenacted the Atlantic Crossing in 1985 and is now home-based at Jamestown, Virginia. (21 p.)

Keywords: GODSPEED

NSRP 0281

UMTRI 77480

TITLE: NSRP 1987 Ship Production Symposium Proceedings.

AUTHOR: Symposium Participants.

DATE: August 1987

ABSTRACT: This NSRP report contains papers presented at the NSRP 1987 Ship Production Symposium on August 26–28, 1987 in New Orleans, Louisiana. The theme of the meeting was “Modernization of American Shipbuilding: An Ongoing Endeavor”. These proceedings are not available as a bound volume—only as individual papers.

Keywords: CAD/CAM, zone outfitting, just-in-time manufacturing, design-for-production

Paper No. 2:

NSRP BIBLIOGRAPHY

Title: IHI's Experience of Technical Transfer and Some Considerations on Further Productivity Improvement in U.S. Shipyards.

Author: Hiroshi Sasaki.

Abstract: Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI), a leading shipbuilder in Japan, has uniquely exported shipbuilding technology throughout the world for three decades. The North American efforts, starting in the mid seventies were stimulated by the U.S. Government/Industry National Shipbuilding Research Program (NSRP). The technology transfer, for which the U.S. Maritime Administration (MarAd) deserves much credit, has significantly modernized and improved U.S. shipbuilding systems with carryover into naval shipyard operations for overhaul of all types of warships. But, productivity levels achieved thus far in the U.S., while impressive, are not nearly as great as those in Japan. This paper is based on analyses of the underlying differences of shipbuilding systems, technology, and practices between those in Japan and in the U.S. Hopefully, descriptions of the state-of-the-art IHI technology will serve as guidance for further productivity improvements in the U.S. (15 p.)

Keywords: IHI, productivity

Paper No. 3:

Title: Increased Duty Cycle for Plasma Arc Cutting Machines Through a Separated Automatic Plate Marking Station.

Author: J. M. Sizemore.

Abstract: Plate marking as currently practiced limits plasma arc machine duty cycle. This in turn constrains plate fabrication process lane throughput. A separate automatic plate marking station which will significantly increase plasma arc cutting capacities is defined. A 60 to 100 percent increase in plate fabrication process lane throughput is anticipated while simultaneously reducing unit direct labor. The design is supported by technical feasibility demonstrations. (33 p.)

Keywords: Process lanes, plasma cutting

Paper No. 4:

Title: The Use of Computer Simulation of Merged Variation to Predict Rework Levels on Ship's Hull Blocks.

AUTHOR: Richard Storch.

Abstract: In the modular construction of ships, significant productivity losses can occur during the erection stage, when the modules, or hull blocks, are joined together. Frequently, adjacent blocks do not fit together properly, and rework of one or both of the mating block interfaces is necessary to correct the problem. The specific cause of rework is the variation of plate edges at the block interface, which is itself a cumulative product of numerous manufacturing variations inherent in hull block construction. Variation in manufacturing is unavoidable, but not uncontrollable. The application of accuracy control techniques in shipbuilding has proven that a statistical analysis of variation makes possible an accurate prediction of its effects. This report presents an examination of block

interface variation, and the subsequent development of a computer simulation method of predicting rework levels on those blocks. (17 p.)

Keywords: Modular ship construction, accuracy control, computer simulation

Paper No. 5:

Title: Performance Teams: A Participative Approach to Productivity Improvement.

Author: Kimberly M. Thomadsen.

ABSTRACT: The Performance Team program's purpose is to increase the productivity of the organization. The program's concepts are based on participative management, top-down involvement, objective setting, and analytical problem solving. The Performance Team program has the potential to: 1) increase the involvement of production personnel in the labor management process; 2) improve the supervisor's analytical problem solving skills; 3) identify and improve work methods and productivity; 4) develop an improved rate structure; and 5) improve communication between functional departments. This paper explores the development and implementation of the Performance Team program at National Steel and Shipbuilding Company. The application of the Performance Team concepts should be of interest to all production management interested in productivity improvement. (5 p.))*KEYWORDS:* Productivity, participative management, problem-solving

Paper No. 6:

Title: Increasing Efficiency Through Outfit Planning.

Author: Catherine M. Murphy.

Abstract: Outfit Planning provides a means to increase productivity and schedule enhancements through zone outfitting, group technology, and prefabrication. In an attempt to increase efficiency, Puget Sound Naval Shipyard is using outfit planning methods to overhaul, alter, and repair U.S. Naval Ships. One project targeted for outfit planning is the forward end electronic package on submarines. This paper will describe Puget Sound Naval Shipyard's efforts to use outfit planning concepts in developing work packages for the forward end ship alterations (shipalts). (10 p.)

Keywords: Outfit planning

Paper No. 7:

Title: The Application of Intelligent Robotic Systems and Lasers for Manufacturing.

Author: Henry E. Watson.

Abstract: The R programs in Manufacturing technology at The Pennsylvania State University have a major emphasis on automation of materials processing and inspection. Two on-going research projects in these areas, that are based on the application of laser

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technology are: 1) the Laser Articulated Robotic System (LARS), and 2) the Intelligent Robot Inspection System (IRIS). Both of these projects are supported by the U.S. Navy Manufacturing Technology Program. The paper presents the background, current status, research results, and future plans for the LARS and IRIS. (8 p.)

Keywords: Robotics, lasers

Paper No. 8:

Title: Submarine Tank Repair Using Outfit Planning.

Author: Charles P. Dunford and Keith D. Blackler

Abstract: Outfit Planning and Zone Logic methods have been implemented in the shipbuilding industry in response to the need for increased efficiency in the construction of new ship. Efforts have been underway at Puget Sound Naval Shipyard to use Outfit Planning principles to plan and execute ship alterations on operational ships. The next logical step is to use these same principles to plan and execute overhaul and refurbishment work. This paper addresses efforts at Puget Sound Naval Shipyard to apply Outfit Planning principles to the repair of submarine tanks. (9 p.)

Keywords: Outfit planning, CAD

Paper No. 9:

Title: Implementation of Total Quality Management at Pearl Harbor Naval Shipyard.

Author: Gerry A. Damon.

Abstract: Pearl Harbor Naval Shipyard is one of eight public shipyards engaged in the overhaul and repair of conventional and nuclear powered surface ships and submarines of the U.S. Navy. These ships, from their power plants to their sophisticated weapons systems, are consistently on the leading edge of technology. Work performed on these ships during an overhaul, maintenance or repair cycle requires personnel in the labor force whose skills encompass a variety of vocations—engineers, machinists, accountants, welders, computer specialists, pipefitters, riggers, crane operators, and personnel specialists are but a few of the skills required. Of prime importance in ensuring success in the business is a management structure and philosophy dedicated to continuous improvement in quality, productivity and cost reduction. Recognizing that increased productivity and reduced costs are end products of quality improvement, Pearl Harbor, in April 1986, elected to adopt Dr. W. E. Deming's management fundamentals. This paper discusses the strategy and methodology being used to apply Dr. Deming's principles to the complex world of ship overhaul and repair. (12 p.)

Keywords: Deming, quality improvement

Paper No. 10:

Title: Streamlining in a Competitive Environment.

Author: Charles J. Piersall, Jr. and Charles J. Sinche.

Abstract: The push for streamlining the acquisition process has been complicated by other legislation such as the Competition in Contracting Act. Acquisition strategy decisions are often influenced by the real and perceived incompatibility between legislative actions. There are courses of action that can be taken to satisfy both sets of requirements and keep risks to a reasonable level. (6 p.)

Keywords: Streamlining, CICA

Paper No. 11:

Title: Implementing Technology—Viewing Management's Task in Today's U.S. Shipbuilding Industry.

Author: John G. Jessup.

Abstract: Competitiveness (foreign and domestic) is continuing to present formidable challenges to management in the U.S. shipbuilding industry. The implementation of advanced technologies, especially software technologies, requires a special understanding by management. Based on material from two National Shipbuilding Research Program workshops, a view of the socio-technical goals and objectives for shipyard management are presented. (10 p.)

Keywords: Technology implementation, management techniques

Paper No. 12:

Title: Why Standards Programs Fail.

Author: Clifford Sellie.

Abstract: This paper is a general review of the failings of Standards Programs, with particular reference to shipyard programs. This review is focused on the reasons why some programs fail and others succeed. Consideration is given to both the people aspects and the technical aspects. Comparison is made of theory and practice in Standards Programs, and how at times they appear to conflict. Eight basic rules are given for successful Standards Programs. They apply whether you are installing a program, maintaining a program, or trying to revitalize a deteriorated program. It is stressed that failure to follow these rules is the main reason "why Standards Programs fail. (9 p.)

KEYWORDS: Standards

Paper No. 13:

TITLE: Development of an Intelligent System for Flame Straightening Panel Structures—Devices and Algorithms to be Used With Robots.

AUTHOR: Koichi Masubuchi, Akihiko Imakita Hiroshi Miyachi, and Masayasu Miyake.

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ABSTRACT: Distortions which occur during the assembly of steel panel structures can be removed by flame straightening. This has been used for a number of years in the shipbuilding industry. Correct skill to perform this technique is acquired by many years of experience. The industry is concerned now about the decreasing number of skilled workers. What is needed to improve the situation is to develop a robot capable of not necessarily replacing a human worker but helping a human worker. This paper discusses results obtained this far in a research program of which the ultimate objective is to develop an intelligent machine capable of performing flame straightening on a deck of a ship superstructure. Discussions are given on 1) a concept of an algorithm to determine heating conditions, and 2) sensors needed for "in-process" sensing and controlling the robot movements. (12 p.)

KEYWORDS: Robotics, flame straightening

Paper No. 14:

TITLE: Computer-Aided Process Planning—A Path To Just-In-Time Manufacturing for Shipyards.

AUTHOR: Richard L. DeVries.

ABSTRACT: The use of computers to improve the productivity of U.S. shipyards has never been as successful as hoped for by the designers. Many applications were simply the conversion of an existing process to a computerized process. The manufacturing data base required for the successful application of Computer Aided Process Planning (CAPP) to the shipyard environment requires a "back to basics" approach that can lead to control of the processes occurring in the fabrication and assembly shops of a shipyard. The computer is only a tool to be used to organize the mountains of manufacturing data into useful information for today's shop manager on a "real-time" basis. (31 p.)

KEYWORDS: CAPP (Computer Aided Process Planning), Just-in-Time Manufacturing

Paper No. 15:

TITLE: Soviet Technique for Estimating Post-Welded Deflection: Case of Butt Welding.

Author: V. Birman and R. Latorre.

Abstract: The hulls of modern ships are almost entirely welded. This makes the prediction of post-welded deformations very important. The number of parameters involved in the process of welding are large so the exact mathematical theory for prediction of deformations is unavailable. Some researchers have estimated the post-welded deflections based on empirical and semi-empirical equations. The growing literature on the study of postwelded deflections of hull plates enables the estimation of these deflections based on the plate geometry and the plate material. The limited number of critical parameters covered by these experiments makes it difficult to systematically organize the data. This has delayed the introduction of a framework for estimating the influence on the plate deflection from welding speed, current, number of passes, welding rod size and material, etc. The approach adopted in the Soviet Union was to develop an integrated framework to include the critical welding parameters. This paper: 1) introduces the Russian procedure for calculation of deflection due to butt welding; 2) presents the graphical aids used in this

procedure; and 3) presents a worked example using this procedure for a butt welded plate. (8 p.)

KEYWORDS: Butt welds, post-weld deformations

Paper No. 16:

Title: A Planning Guide—New Technologies in Pipe Joint Fabrication.

Author: L. Burda and D. Kelly.

Abstract: In the past few years, methods of joining pipe together have been introduced to supplement and, in some cases replace, both the traditional welded and the brazed pipe fitting. It is necessary to examine what is available, and to justify its place and application in the marine market. This paper examines the Swage Marine Fitting (SMF) and the Heat Recoverable Coupling (HRC) and, briefly, the Compression and the bite type fittings from economic, performance and environmental standpoints. Its purpose is to evaluate them and incorporate them into an overall piping system. Additionally, the two primary guides for piping on military ships are examined to put the SMF and HRC in perspective and make recommendations for further applications. Comments are also made on the testing method and results gained. (11 p.)

Keywords: Pipe joints, piping systems

Paper No. 17:

Title: Novel Techniques and Their Applications for Measuring Out-of-Plane Distortion of Welded Structures.

Author: Koichi Masubuchi, William H. Luebke, and Hiroshi Itoh.

Abstract: Whether or not a certain amount of planar distortion is critical, a point of consistency in the ship fabrication process is the need to accurately assess an existing degree of distortion in both local and global domains. At the Massachusetts Institute of Technology, three novel measurement devices have been developed as an adjunct to ongoing research. Distortion can now be evaluated either through laser interferometry, low power laser beam triangulation, or direct surface contact. In addition to describing the operation and construction of the devices, their particular applications from a ship production/plate forming perspective are detailed. (11 p.)

Keywords: Weld distortion, fabrication processes

Paper No. 18:

Title: Ship Design for Production—Some UK Experience.

Author: George J. Bruce.

Abstract: Ship Design for Production is widely accepted in principle. Its successful establishment depends on the shipbuilder having a well-defined shipbuilding policy available to the designer, the establishment of a realistic and agreed schedule, and

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adequately trained personnel. Key production engineering techniques include spatial analysis, process analysis, and standardization. The advent of powerful and inexpensive computer software has created new opportunities for producibility to be incorporated from the earliest stages of the design process. Significant progress has been made in recent years in the development of design methods, and in their application. (10 p.)

Keywords: Design-for-production

Paper No. 19:

Title: Evaluation of Commercially Available Wet Welding Electrodes for Potential Repair of U.S. Navy Ships.

AUTHOR: Thomas C. West and Gene Mitchell

Abstract: As part of a program to determine the viability of underwater wet welding for repair of U.S. Navy surface ships, eight commercially available shielded metal arc wet welding electrodes were evaluated by a series of screening tests. Two E7014 "type" electrodes provided superior results and were used for welding procedure qualification testing on ASTM A-36 steel with a carbon equivalent of 0.35. Qualification testing included visual, liquid penetrant and radiographic inspection, as well as bend testing, reduced section tensile testing, Charpy impact testing, macroscopic examination, hardness testing, and chemical analyses. The wet welding was performed in the vertical, overhead and horizontal positions. The welding took place at seven and thirty-three feet of sea water. Nondestructive and destructive test results show that both electrodes exceed the requirements of American Welding Society specifications for underwater welding, AWS D3.6 Type B. Weld quality and strength were found to be approximately on a par with welds made in an air environment. Weldment ductility and toughness were appreciably lower than would be expected of air welds. (24 p.)

Keywords: Welding (wet),

Paper No. 20:

Title: Proven Benefits of Advanced Shipbuilding Technology—Actual Case Studies of Recent Comparative Construction Programs.

Author: A. B. Nierenberg and S. G. Caronna.

Abstract: Much has been written and discussed in the past decade concerning improved shipbuilding productivity methods in U.S. shipyards, and a substantial amount of progress has been made in the implementation of methods, facilities and shipyard dedication to achieve a reduction in U.S. shipbuilding costs. This paper presents a comparative study of two sets of comparable shipbuilding programs at Avondale Shipyards—the resultant ship construction process, methods and details. (12 p.)

Keywords: Productivity, Avondale Shipyards

Paper No. 21:

Title: High Strength Steels Produced by Advanced Metallurgical Processes.

Author: I. L. Stern, D.Y. Ku, R.F. Waite, M. Wheatcroft and W. Hanzalek.

Abstract: Increased strength of steels used for ship structural applications have traditionally been achieved with higher alloy content. Depending on the alloying elements chosen, the increased strength is achieved at a cost in weldability and toughness. Recent developments in the control of properties through precise thermomechanical processing and advanced steelmaking techniques have lead to the creation of steel with increased strength and toughness, while maintaining modest carbon equivalents to provide good weldability. The objectives of this report were to explore the potential advantages of new high strength (65 to 120 ksi yield) steels produced by advanced steelmaking and on-line processing techniques for marine applications. and to facilitate their introduction to the shipbuilding industry (26 p.)

Keywords: High-strength steel, metallurgy

Paper No. 22:

Title: User's Perspective of CAD/CAM Software.

Author: R. V. Shields, III.

Abstract: Great emphasis has been attached to the achievement of productivity and producibility benefits through the application of Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) technologies. To ensure the achievement of these benefits, it is important that the end user have appropriate software and is able to use it to his advantage. The proper procurement, customization, installation, training, and implementation of software can play a significant role in the effectiveness of CAD/CAM. Ingalls Shipbuilding has made major commitments to the use of computer software to assist design and manufacturing. This paper is a description of the achievements and problems involved in arriving at a state-of-the-art design capability. (8 p.)

Keywords: CAD/CAM

Paper No. 23:

Title: A Low-Toxicity Insulation Material for Shipboard Piping—Non-Halogenated Polyphosphazene Foam.

Author: O. J. Davis

Abstract: A flexible, fire-retardant, chlorine-free polymer foam with applications to pipe insulation has been tested for ship producibility. The new material, Non-Halogenated Phosphazene (NHP) foam, is based on Phosphorus-Nitrogen linkages (Phosphazene) with non-halogenated organic groups attached to produce selected engineering properties. The material tested is flexible, fire retardant, and produces less toxic combustion products than conventional pipe insulation material. Producibility tests have demonstrated the new material to be equivalent in handling characteristics to conventional material which uses PolyVinyl Chloride in its formulation. The use of the new pipe insulation offers a prospect of removing over 1,400 pounds of elemental Chlorine from some surface ships now in production. Removal of Chlorine is in keeping with the objective of producing ships with improved fire protection and safety. (6 p.)

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Keywords: Pipe insulation material

Paper No. 25:

Title: Overcoating Inorganic Zinc Primers for Underwater Service.

Author: G. A. Gehring and J. A. Ellor.

Abstract: During ship construction, steel hull plate is normally protected with an inorganic zinc pre-construction primer. For the underwater portion of the hull, conventional practice is to remove the primer by abrasive blasting before final coating of the hull. If the requirement for removing the preconstruction primer could be eliminated, there would be a significant cost savings. As a result, a laboratory study was undertaken to investigate the performance of selected marine coatings when applied over inorganic zinc primers in underwater service. In general, the results of the study suggest that there are inorganic zinc pre-construction primers that can be overcoated for underwater service. The results encourage further tests to investigate the parameters affecting compatibility. (14 p.)

Keywords: Overcoating, zinc primers, coating tests

Paper No. 26:

Title: Applications of Digital Transfer of Computer Aided Design Data for Production Use.

Author: M. A. Streiff and D.G. Cada.

Abstract: This paper addresses efforts to provide the capability to transfer data between Computer Aided Design (CAD) systems currently in use on the CG 47 contract. The paper will discuss experience with the use of Initial Graphic Exchange Specification (IGES) and direct translators. The pros and cons of both approaches will be addressed. The issue of transferring data between the two different hull design and lofting systems in use in shipbuilding is explored. (9 p.)

Keywords: Computer Aided Design (CAD), IGES

Paper No. 27

Title: Shop and Zone Administration and Management: The Transitions to Zone Outfitting in Repair and Overhaul at Puget Sound Naval Shipyard

Author: Anthony A. Sterns.

Abstract: This paper discusses Puget Sound Naval Shipyard's implementation of Zone Outfitting in Repair and Overhaul (ZORO). Four problems are responsible for past poor performance: funding by system, planning using key-operations which are too broad, scheduling by event, and inflating cost by inaccurate historical expenditure records. These problems are discussed and addressed. (20 p.)

Keywords: Zone outfitting, Repair and overhaul (ZORO)

Paper No. 29:

Title: Naval Shipyard Industrial Process Improvement.

Author: Kurt C. Doehnert.

Abstract: This paper describes the principles, applications, and initiatives of the management control system for industrial processes in the Naval Shipyards. It is based on the continuing efforts of the Naval Sea Systems Command Industrial Engineering and Planning Division (SEA 070), and the Naval Shipyards, to develop and implement the system, which in turn is based largely on the application and integration of principles and techniques of Industrial Engineering (IE). (10 p.)

Keywords: Industrial Engineering, Industrial processes

Paper No. 30:

Title: Study Circles Applied to Shipyards.

Author: Gregory L. Schwei.

Abstract: Study circles are a Scandinavian concept. It is estimated in these countries, every individual joins a study circle every year. Study circles are voluntary, self-facilitating groups interested in a particular subject. The range of these subjects may be from learning basic photography to referendum issues on nuclear power. Background material in the area of the subject of the study circle is provided by the government. This paper will examine a method of transplanting the study circle concept to a large, heavy industry, facility of the federal government – a shipyard – to solve problems beyond the scope of traditional quality circles. (11 p.)

Keywords: Study circles

Paper No. 31:

Title: A Study of the Construction Planning and Manpower Schedules for Building the Multi-Purpose Mobilization Ship, PD 214, in a Shipyard of the People's Republic of China.

Author: Howard M. Bunch.

Abstract: This paper presents the results of a study for building five PD-214 ships in a shipyard of The People's Republic of China. The study was performed by the author in 1987 at the Zhenjiang Shipbuilding Institute, The People's Republic of China. A comparison of shipbuilding planning and resource expenditure estimates is made for building a series of identical ships in an advanced shipyard in the United States and in The People's Republic of China. (29 p.)

Keywords: Planning and scheduling, manpower planning

Paper No. 32:

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Title: Multi-Skilled Self-Managing Work Teams in a Zone Construction Environment

Author: Daniel J. Stravinski.

Abstract: This report documents National Steel and Shipbuilding Company's (NASSCO'S) efforts to develop self-managing, multi-skilled work teams. The objective of this effort was to develop and test a new production work force organization corresponding to the technical requirements of product-oriented work breakdown structure, otherwise known as zone construction. (17 p.)

Keywords: Zone construction, work teams

NSRP 0298

UMTRI 78699

TITLE: NSRP 1988 Ship Production Symposium Proceedings.

AUTHOR: Symposium Participants.

DATE: August 1988

ABSTRACT: This NSRP report contains 24 papers presented at the NSRP 1988 Ship Production Symposium held August 24-26, 1988 in Seattle, Washington. These proceedings are not available as a bound volume—only as individual papers.

KEYWORDS: Ship production symposium

Paper No. 1:

Title: The Use of Computers in Advancing Group Technology.

Author: Eric Stewart

Abstract: When introducing product oriented work breakdown as the means of defining work within a shipyard, it is worthwhile considering the use of computers and how they may be utilized to improve the success of this task. This document addresses experiences gained and reflects on the systems in place in some of the shipyards with in the United Kingdom. (8 p.)

Keywords: Group Technology, CAD-CAM

Paper No. 2A:

Title: System Strategy Teams: A Participative Management Adaptation.

Author: Donna J. Witkowski.

Abstract: Management in the United States often falls into the trap of invoking Theory Y programs in Theory X ways. Perhaps nothing conceptualizes the plight of American businesses implementing new programs and techniques quite as succinctly as the preceding statement. Many of the buzz words of celebrated methods and techniques used

in Japan have been popularized in the U.S. Unfortunately, the implementation of these techniques is not given the careful consideration it demands. Although participative management did not achieve full potential in the U.S. with the introduction of quality circles, the foundation was laid and lessons were learned. The organization and operation of a company needs to be considered for a successful implementation. System Strategy Teams represent an adaptation of participative management developed specifically to function within Peterson Builders. (3 p.)

Keywords: Management Strategy

Paper No. 2B:

Title: An Integrated CAD/CAM Network for Work Packaging Development and Database Management.

Author: LCDR M.S. O'Hare

Abstract: The Zone Logic Technology CAD/CAM and networked Database Management System is an integrated system of commercially available, off-the-shelf computer hardware and software products. These products have been carefully selected, tailored, and integrated to specifically satisfy and support the Philadelphia Naval Shipyard Zone Technology Program in support of work packaging development, computer aided graphics and an on line, real-time, distributive database management system. (19 p.)

Keywords: CAD/CAM Network, Data base management

Paper No. 3A:

Title: Group Problem Solving-How to Matrix.

Author: Gregory Schwei.

ABSTRACT: This paper provides definition/characteristics of four problem-solving groups: task forces, quality circles, study circles, and special study teams. The latter two groups – study circles and special study teams, remedy many of the deficiencies of the former two groups task forces and quality circles. With these four groups, the shipyard manager has an expanded toolbox to tackle productivity problems. (9 p.)

KEYWORDS: Group Problem Solving.

Paper No. 3B:

Title: Zone-Oriented Drawings for Life Cycle Management.

Author: James Wilkins, Jr.

Abstract: This paper presents the results of a study which was conducted to determine whether unit-oriented construction drawings, which are being developed and used by shipbuilders who are using modern zone-oriented, or modular, construction techniques, will satisfactorily substitute for system-oriented detailed arrangement drawings in the Navy's life cycle maintenance management process. The study concluded that modular

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construction drawings will provide the necessary data in a more usable format, and thus are the preferred approach for the Navy's use. However, the study also identified several additionally needed features that are not being provided in unit-oriented drawings, but which must be included in order to meet the needs of planning and maintenance activities during the operational life of a ship. (14 p.)

Keywords: Zone-oriented drawings, life cycle management.

Paper No. 4A:

Title: Improvements in Productivity Through Staff Integration.

Author: David S. Kelly.

Abstract: This paper addresses one facet of improving a shipyard's position in an increasingly competitive environment: improvements in overall productivity resulting from integration of the functions of the shipyard staff. First, an organization is described, identifying the staff and defining its purpose within the shipyard. In a typical shipyard, the staff includes organizations for estimating, planning, engineering, purchasing, and contracting. The responsibilities of each of these groups is discussed and, in particular, the areas of interface between them are highlighted. (5 p.)

Keywords: Productivity, shipyard organization

Paper No. 4B:

Title: Infusing Producibility Into Advanced Submarine Design.

Author: LCDR B.R. Brucker.

Abstract: The SEAWOLF submarine design is promoting the employment of a variety of advanced ship design and production techniques. Major goals of the design are to fully support a zone construction program, capture the data base in a digital format, provide digital products for construction and logistics support and to simplify, as much as possible, the construction effort. Four innovations that support these goals are: producibility steering group, improved drawings, planning and sequence documents, producibility review process. (10 p.)

Keywords: Submarine design, zone construction, productivity

Paper No. 5A:

Title: Revitalization of Industrial Engineering in the Naval Shipyards.

Author: Roy M. MacGregor.

Abstract: Recent developments in the ship repair industry have focused attention on the operation of the naval shipyards. The loss of commercial ship construction work to foreign nations and the declining commercial ship repair work market have resulted in aggressive competition among private shipyards for naval ship repair work. The naval shipyards have come under increasing pressure and scrutiny to become more productive and cost

effective. This paper examines the impact of these factors on the naval shipyards, specifically with respect to the industrial engineering functions. This paper describes the initiatives taken to revitalize industrial engineering in the naval shipyards and summarizes some of the successes achieved in reducing costs. (9 p.)

Keywords: Industrial Engineering

Paper No. 5B:

Title: Zone Logic Applications for Submarine Overhauls.

Author: Ernest D. Ellsworth and H. Bruce Bongiorno.

Abstract: Japanese shipbuilding methods have typically been applied in new ship construction. As new building declines, the ship repair market has become more competitive and shipyards have started to apply some of these principles to ship repair. Public shipyards have been the most active in this technology development. This paper addresses some of the history and problems that have been encountered at Portsmouth Naval Shipyard in the application of zone outfitting methods. (6 p.)

Keywords: Zone logic applications, submarine overhauls, zone outfitting

Paper No. 6A:

Title: Technology Assessment in Ship Production.

Author: Scott C. Iverson.

Abstract: This paper describes a research approach which addresses the format of general systems theory to examine technologies and processes which have the potential for being implemented in the shipbuilding industry. It seeks to create a systematic and logical procedure in which to examine technologies and institutional policies utilized in various other industries and has the potential for creating a strategy for technology and economic impact identification and policy evaluation. (5 p.)

Keywords: Technology Assessment

Paper No. 6B:

Title: Product Work Breakdown: An Essential Approach for Ship Overhauls.

Author: L. D. Chirillo.

Abstract: This paper identifies how the same product-oriented logic successfully applied to improve construction productivity, also applies to overhauls. (14 p.)

Keywords: Product work breakdown, ship overhauls

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Paper No. 7A:

Title: Management Development for the Shipbuilding Industry.

Author: John A. McCarthy.

Abstract: This paper will address the evolution of the Management Development Program at Bath Iron Works, from the initial identification of the need for the program through the completion of the program by the first class of Management Development "interns". An analysis of the original program design and a discussion concerning the current status of the program. Based upon experience gained through the initial implementation of the program, some improvements are being made in the organization and general structure of the program. We will examine lessons learned, the future of the Management Development Program at BIW, and career development within the industry as a whole. (7 p.)

Keywords: Management development

Paper No. 7B:

Title: Initial Implementation of IHI Zone Logic Technology at Philadelphia Naval Shipyard.

Author: Koichi Baba, Takao Wada, Soichi Kondo, LCDR M.S. O'Hare and James C. Schaff.

Abstract: Group Technology or Zone Logic Technology has been successfully implemented in several U.S. shipyards for new ship construction. This technology was originally conceived in the U.S. It was greatly refined by the Japanese and recently reported to the U.S.. The technology replaces traditional system-by-system work with work organized zone-by-zone and by grouping similar work together with zones. This grouping of jobs enhances efficiency. (13 p.)

Keywords: Zone logic, group technology

Paper No. 8B:

Title: A Group Technology Approach to Master Scheduling of Shipbuilding Projects.

Author: Jon Gribskov.

Abstract: This paper describes the current Master Scheduling approach used at National Steel and Shipbuilding Company (NASSCO) in San Diego. Master schedules at NASSCO focuses on key interim products involved in ship construction: units, block, (on-board) zones, and tests. Network scheduling algorithms (i.e. Critical Path) are used. Each interim product has an associated subnet. Categorization by type is used to simplify the task of developing and maintaining activity lists, dependencies (predecessor/successor relationships) and durations for the thousands of activities. Manual level-loading of critical resources is incorporated into and supported by the overall scheduling process. This paper includes some discussion of problems encountered in the implementation of this scheduling approach. (8 p.)

Keywords: Group Technology, scheduling shipbuilding projects

Paper No. 9A:

Title: Wired for Disaster: Cableway Improvement Program.

Author: Verle Hendricks, Jim Pokrwka and Cliff Creek.

Abstract: Throughout a ship's lifecycle, as systems are installed, modified, or removed, breaches of the technical requirements for proper installation of electrical and electronic cables occur. The majority of these deviations are a result of insufficient attention to cable installation requirements during ship design or production caused by shortcuts to reduce costs or meet schedules, and overall poor workmanship. (9 p.)

Keywords: Cables, cableway improvement

Paper No. 9B:

Title: Affordable Technologies for Small Shipyards.

Author: Kenneth R. Lane, Mark W. Siburg and John W. Waterhouse

Abstract: This paper attempts to recast some large shipyard production technologies in light of the needs of small yards. The importance of small shipyards to the nation's marine economy is addressed and three methods are offered as affordable ways of increasing yard productivity. These are operations management, numerical lofting, and zone outfitting. The paper concludes with a call for increased attention to the problems of small yards. (11 p.)

Keywords: Affordable Technologies

Paper No. 10A:

Title: Thermal Reclamation of Used Blast Grit.

Author: W. A. Sandstrom.

Abstract: Naval shipyards and other domestic port facilities generate thousands of tons of used blast grit annually and dispose of it in landfills. Also, there are thousands of steel bridges in the United States that are on a repaint maintenance schedule that requires grit blasting for surface preparation; this used grit also goes to landfills. However, for environmental reasons it is becoming prohibitively expensive to landfill used blast grit containing paint residues. The Institute of Gas Technology (IGT) has conducted test work to develop a process to clean blast grit to enable its recycling for reuse. (10 p.)

Keywords: Thermal reclamation, surface preparation, sand-blasting

Paper No. 10B:

Title: Formal Manufacturing Approaches to Modern Shipbuilding.

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Author: Paul C. Powell and Charles Zigelman.

Abstract: This paper describes how a formal manufacturing environment as defined by the American Production and Inventory Control Society (APICS), compares to modern shipbuilding techniques. Formal manufacturing, through a product based build strategy, provides a framework for integrating contract scheduling, design development, material purchasing, inventory control, production capacity planning and production control. An understanding of formal manufacturing provides a foundation for understanding modern shipbuilding techniques. (13 p.)

Keywords: MRP, building strategy, inventory control

Paper No. 11A:

Title: Electroslag Surfacing: A Potential Process for Rebuilding and Restoration of Ship Components.

Author: D. W. Yu, J. H. Devletian.

Abstract: This is a review of the international literature on the most recent developments in thick section surfacing by electro-slag surfacing (ESS) using strip or wire electrodes. The advantages of this newly-developed technique from Japan are explained in comparison with the conventional surfacing processes, such as submerged arc surfacing (SAS). A number of innovations and applications in this area introduced to emphasize the substantial economical advantage of strip ESS for ship repair and manufacturing. (18 p.)

Keywords: Electroslag surfacing, rebuilding and restoration

Paper No. 11B:

Title: Applying Group Technology (GT) to Increase Productivity in a Job Shop Environment.

Author: Dennis Davison.

Abstract: Decreasing the high cost of small lost production in a job shop environment is a continual problem for shipyard shops supporting extensive repair and overhaul work. In the past, reducing cost in this area has been a desirable, but mostly unattainable goal. However, continued development of computer solutions to manufacturing problems utilizing Group Technology methods has made significant savings in this area possible. (6 p.)

Keywords: Group technology, productivity

Paper No. 12A:

Title: Designing Partial Penetration Tee Joints for Naval Ships.

Author: Edward T. Gaines.

Abstract: This paper reviews development of weld design equations which can be used to analyze beveled partial penetration tee joints. The method developed herein follow closely with the development of equations for design of square edge partial penetration tee joints

Keywords: Welding design

Paper No. 12B:

Title: Model Testing of an Oval Shaped Seal for Sealing of Large Gaps Between Mating Surfaces.

Author: Nick F. Eutizzi.

Abstract: A pressure chamber was designed and manufactured in two parts which were clamped together at their flanges using a clamping ring and an "o" ring seal was used for sealing the gap between the mating surfaces. The clamping ring held the two flanges together while the chamber was pressurized with mixed gas. The internal chamber pressure caused the gap to widen (unseat with pressure) resulting in a final gap in which the "O" ring could no longer maintain an adequate seal.

Keywords: Clamping rings, oval shaped seals

NSRP 0310

UMTRI 80455

TITLE: 1989 NSRP Ship Production Symposium Proceedings.

AUTHOR: Symposium Participants.

DATE: September 1989

ABSTRACT: This report contains 25 papers presented at the 1989 National Shipbuilding Research Program Symposium held September 13-15, 1989 in Arlington, Virginia. The proceedings are available as individual papers only.

KEYWORDS: Ship production symposium

Paper No. 1

Title: Computer Integration of SEAWOLF Class Submarine Life Cycle Functions.

Author: CDR Blaine R. Brucker and CDR K. J. Merrill.

Abstract: The SEAWOLF Program is employing computer technology to integrate the design, production and logistic support functions of the ship's life cycle. The ability to transport the electronic data from the design phase to construction, and on to logistics is the key to improving efficiency and more closely linking designer, shipbuilder and maintainer. (11 p.)

Keywords: Computer integration, SEAWOLF class submarine

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Paper No. 2:

Title: Producibility in U.S. Navy Ship Design.

Author: Hans A. Hofmann, Raymond S. Grant and Siu Fung

Abstract: This paper reviews the findings of producibility studies and attempts to indicate specific areas where an improvement in producibility and attendant cost savings for Navy ships are possible without any degradation in ship performance and survival. (17 p.)

Keywords: Producibility, navy ship design

Paper No. 3:

Title: Producibility in Ship Design.

Author: Gilbert L. Kraine and Sigurder Ingvason

Abstract: This paper addresses the problem of ship construction costs by emphasizing the improvement of production techniques, processes and management controls. There is a great deal that can be accomplished in reducing ship construction costs by improving the producibility of ship design. The design of a more producible ship requires concurrent product and process design. (14 p.)

Keywords: Producibility, ship design costs

Paper No. 4:

Title: Design for Steelwork Production During the Concept Design Phase.

Author: William Hills, I. L. Buxton and Robert G. Maddison

Abstract: Methods of improving the level of pre-contract design definition and the quality of information relating to steelwork are described. This information is combined with a comprehensive database of manufacturing process information to provide a system for estimating the work content of the main structural steel work of ships such as ro-ro vessels. Procedures are described which facilitate consistent estimates to be made while minimizing data handling requirements and increasing the flexibility of the methods at the concept design stage. (18p.)

Keywords: Steelwork production, concept design

Paper No. 6:

Title: Strategizing and Executing the Implementation and Utilization of Zone Technology at Philadelphia Naval Shipyard.

Author: LCDR Larry D. Burrill, LCDR Barry S. Munro, CF and LCDR Mark S. O'Hare.

Abstract: This paper will discuss the strategy in the development and implementation of Zone Logic Technology at Philadelphia Naval Shipyard. Frank disclosure of the valuable lessons learned and current status will also be presented. The future of Zone Logic Technology at Philadelphia Naval Shipyard will also be discussed along with candid presentation of the experiences and implementation of Zone Logic Technology in a repair environment. (12 p.)

Keywords: Zone Technology

Paper No. 7:

Title: The Evolution of Generating of Methods and Standards in U.S. Naval Shipyards.

Author: Alan J. Kaitz.

Abstract: The Production Industrial Engineering Resource System (PIERS) is an automated system to improve industrial engineering. One of its components is Computer Aided Time Standards (CATS), a computer-assisted method to find, manipulate and store standards time data and existing standards to create new standards. CATS provides immediate, user friendly access to the over 18,000 elements of standards time data and standards published by all shipyards. The system evolved from the Department of Defense Computer Aided Time Standards program to collect, ll 15505 validate and publish standards time data in a single source for use by all Department of Defense work measurement organizations. (6 P.).

Keywords: Methods, standards

Paper No. 8:

Title: Flexible Standards: An Essential Innovation in Shipyards.

AUTHOR: L. D. Chirillo.

Abstract: An indispensable feature of effective flexible-system production is a file of standards which can be adapted to changing requirements, including requirements for modernizing naval ships, while at the same time permitting reapplication of significant corporate experience. This paper addresses such flexible standards and their significance. (12 p.)

Keywords: Flexible Standards

Paper No. 9

Title: IHI Zone Logic Application to Electrical Outfitting on Highly Sophisticated Ships.

Author: Shuji Sato

Abstract: Outfitting electrical cable in highly sophisticated ships, such as, research vessels, patrol boats, etc., has significant impact on every aspect of ship construction,

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modernization, overhaul and repair. In other words, cost, schedule adherence and quality for very sophisticated ships are fully dependent on the performance of electrical work. (8 p.)

Keywords: IHI zone logic, electrical outfitting

Paper No. 10:

Title: Simulation of Shipyard Material Handling Operations.

AUTHOR: Richard Storch

Abstract: The initial phase of a two part study to develop a simulation procedure for shipyard material handling operations is described. This phase involved investigation of software alternatives available for simulation, optimization, material handling and data base management. Additionally, material classifications, equipment choice figures of merit and a material handling equipment data base have been developed. This paper presents a discussion of the software investigation and presents choices and rationales to be used in the second phase. (15 p.)

Keywords: Shipyard Material Handling Operations

Paper No. 11:

Title: Harnessing Simulation of Naval Shipyards.

Author: Cynthia V. White.

Abstract: Simulation provides Naval Shipyards with a somewhat reliable and cost-effective method for analyzing information and guiding decisions. This paper discusses the future variable, methodology output and software of a simulation program. It will discuss how simulation programs are used today and how they may be used in the future. (7 p.)

Keywords: Simulation programs, simulation methodology

Paper No. 12:

Title: The First Time Integration of Product by Stage of Construction with Cost/Schedule Control Application.

Author: Matthew Reid.

Abstract: This paper addresses the successful integration of product by stage of construction with the fundamental principles of cost/schedule control application and the specific requirement to provide meaningful performance data in managing a major military defense program on schedule and within cost. (36 p.)

Keywords: Product by Stage Construction, cost/schedule control Application

Paper No. 13:

Title: NIDDESC: Meeting the Data Exchange Challenge Through a Cooperative Effort.

Author: John Kloetli and Dan Billingsley

Abstract: The application of Computer Aided Design (CAD) and Manufacturing (CAM) techniques in the marine industry has increased significantly in recent years. With more individual designers and ship yards using CAD within their organizations, the pressure to transfer CAD data between organizations has also increased. The Navy/Industry Digital Data Exchange Standards Committee (NIDDESC) provides a mechanism for public and private organizations to cooperate in the development of digital data transfer techniques. (15 p.)

Keywords: Computer Aided Design (CAD), computer aided manufacturing (CAM), exchanging data

Paper No. 14:

Title: Liability for Hazardous Wastes Produced During the Course of Ship Repair.

Author: John L. Wittenborn and William M. Guerry.

Abstract: This article reviews the structure and function of two principle federal hazardous waste statutes and explains how their myriad complex responsibilities and liabilities are applied in the context of a typical ship repair. (8 p.)

Keywords: Hazardous Waste During Ship Repair

Paper No. 15:

Title: A Study of the Causes of Man-Hour Variance of Naval Shipyard Work Standards.

Author: Howard M. Bunch.

Abstract: This paper is a presentation of a study conducted at a U. S. Naval shipyard during 1987. Concerning the relationship between engineering standards and the variances that were occurring in production budget and charged manhours. The 10 engineering standards having the greatest manhour variances were examined. These standards, as a group, accounted for about 62 percent of the manhour variance that was reported during the first nine months of 1987. The study indicated that, with one exception, all of the standards were "generic" in their application, i.e., they can be applied over a wide range of job orders. (8 p.)

Keywords: Man-Hour variance, shipyard work standards

Paper No. 16:

Title: Results From Use of an Integrated Schedule for Drawing Development and Equipment Procurement.

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Author: James R. Wilkins Jr.

Abstract: A computer program was developed to integrate schedules for drawing development and equipment procurement. The program also can be used either to develop a schedule for the fabrication and assembly stages of the construction process or to receive data from an existing construction schedule. In either case, the construction data is used to ensure that drawings are produced and equipment is purchased in time to support production planning. The program uses a commonly available database program, is suitable for use on a minicomputer and will allow a network of terminals to be used to enter data and obtain reports. (18 p.)

Keywords: Drawing Development, equipment procurement computer programs for Integrated Schedules

Paper No. 17:

Title: Significantly Reduced Shipbuilding Cost Through Constraints Management.

Author: Frank H. Rack.

Abstract: This paper discusses the use of Constraint Management as a process to overcome this resistance which can lead to significant reductions in ship construction times and costs. (17 p.).

Keywords: Shipbuilding Costs, reducing shipbuilding costs

Paper No. 18:

Title: A Design Oriented Model of Plate Forming for Shipbuilding.

Author: David Hardt, Andrew Wright and Edward Constantine.

Abstract: This paper will present a prototype of a tool, aimed at providing process information about bending and rolling of plate. The model presented is derived from the principles of mechanics and can provide a plethora of information. However, the unique aspect of this work is the development and presentation of design-oriented information such as optimization tradeoffs of process/material selection, and process control options ranging from purely manual to mechanized to fully automatic. (8 p.)

Keywords: Plate Forming for Shipbuilding

Paper No. 19:

Title: A Systems Approach to Small Parts Painting.

Author: Les Hansen.

Abstract: Shipyard painting is most often viewed as pure ship construction operations, where the painting of the hull, deck, superstructure, and cargo spaces make up the total effort and cost. This view may be justified when analyzing various trade production costs

part of the total ship cost. However, parts preparation and painting costs are significant when looked at in summary as a new construction or repair contract sub-cost item. (21 p.)

Keywords: Painting, Small Parts Painting

Paper No. 20:

Title: NAVSEA MCM-1 Product Model.

Author: Jeffery D. Arthurs.

Abstract: The Mine Countermeasure Minesweeper (MCM) Product Model is the Navy's first true representation of a fully Computer-aided Acquisition and Logistic Support (CALS) oriented information system that integrates automated processes to create, store, retrieve, use and exchange weapon system technical, logistics, manufacturing and management information. (12 p.)

Keywords: Mine Countermeasure Minesweeper

Paper No. 21:

Title: Information System Models-As a Tool for Shipyard Planning and Control.

Author: A. Y. Odabasi and D. R. Patterson.

Abstract: This paper proposes the use of information systems models of production as a tool to achieve rationalization and integration goals, and to create a learning organization. It is shown that through use of these models it is possible to identify cost-benefit ratios for various rationalization and modernization tasks, and to create an action plan for their implementation. (17 p.)

Keywords: System Models, shipyard planning and control

Paper No. 22:

Title: Total Quality Management (TQM).

Author: Gerry A. Damon.

Abstract: This paper discusses the application of the Deming philosophy and how the ideas of the Japanese Total Quality Control (TQC) concept have been integrated into the Shipyard's TQM effort. Pearl Harbor's challenge is to continuously improve shipyard processes so that we do the the right thing correct the first time; cost and schedule flow are predictable, and in control. (10 p.)

Keywords: Total Quality Management (TQM)

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Paper No. 23:

Title: Combining Welding Expert Systems with Welding Databases to Improve Shipbuilding Production.

Author: Han H. Vanderverldt, Sterling Johnston, Jerald E. Jones, Dawn White and B. Cleveland.

Abstract: This paper discusses the development of a computerized blackboard with a series of linked expert systems acting as a welding engineers' assistant, and software to download welding procedures from the weld designer to a welding workcell for automatic execution of the planned welds. The system will also employ sensors to record actual weld process parameters and a post weld analysis capability to examine these parameters and update the welding procedure between passes. These sensors include a seam tracker which will provide path corrections to the welding robot during a weld. (20 p.)

Keywords: Welding Expert Systems, welding databases, shipbuilding production

Paper No. 24:

Title: Designing the Future U.S. Naval Surface Fleet for Effectiveness and Producibility.

Author: CAPT. Clark Graham and LCDR Michale Bosworth, USN.

Abstract: By designing a future fleet architecture with producibility as a major requirement from the start, we hope to impact the acquisition cost significantly. One battle force concept titled "Distribute, Disperse, Disguise and Sustain" suggests two fundamental surface ship types; the Carrier of Large Objects (CLO) and the Scout Fighter. A CLO feasibility design in progress, Carrier Dock Multimission, is outlined to inform shipbuilding researchers of an initiative that promises to have significant impact on naval ship procurement and provide increased visibility within the U. S. Navy on producibility issues. (16 p.) **Keywords:** Design, producibility

NSRP 0320

UMTRI 84059

TITLE: NSRP 1990 Ship Production Symposium Proceedings.

AUTHOR: Symposium Participants.

ABSTRACT: This NSRP report contains papers presented at the 1990 National Shipbuilding Research Program Ship Production Symposium on August 22-24, 1990 in Milwaukee, Wisconsin. The theme of the symposium was "Preparing for the 21st Century: Focusing on Productivity and Quality Management." These proceedings are available as individual papers only.

KEYWORDS: Hazardous Material, ship design, freight transport, welding

Paper No. 1A-1:

Title: Standardization in Ship Structural Design.

Author: Dr. Geroge A. Kriezis.

Abstract: This paper presents two methodologies for the automatic structural design of the midship section based on ABS classification rules. The first method minimizes required steel based on the solution of a nonlinear minimization problem subject to bounds on the variables, linear and nonlinear constraints. The second method uses a heuristic algorithm based on the use of standard structural shapes. Alternate structural designs for oil carriers are evaluated on the basis of cost and weight. (11 p.)

Keywords: Structural Design, automation, cost, standards, expert system

Paper No. 1A-2:

Title: Manufacturing Lead Time-A Factor to Consider During Planning and Acquisition.

Author: William V. Ennis, Harry F. Speth, and Albert Meiskolainen.

Abstract: This paper addresses the methodology for solicitation, statistical consolidation, and final assessment of product information provided by over 1300 domestic primary and secondary manufacturers. This paper explains how this information is consolidated by the NAVSEA Shipbuilding Support Office, and how the information is used by Navy planners, designers, and acquisition managers. This paper also addresses the status of the U. S. supplier base. (11 p.)

Keywords: Suppliers, planning, lead time

Paper No. 1B-1:

Title: Shipyard Modelling - Approach to Obtain Comprehensive Understanding of Functions and Activities.

Author: Joachim Brodda

Abstract: This paper discusses the problems associated with the application of CIM elements in a shipbuilding environment. A production modelling process is presented with actual examples provided from German research and development efforts. An evaluation of the benefit of structured shipyard modelling, and a look at complementary research and development actions conclude the paper. (17 p.)

Keywords: Process modelling, CIM, IDEF

Paper No. 1B-2:

Title: Managing the Environmental/Health/Safety Risks at a Major Shipyard.

Author: Marian H. Long, Corey W. Briggs, Garry Higgins.

Abstract: This paper discusses the approach used by one shipyard for hazard identification, assessment, control, and risk management. This includes a major risk

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screening, consequence modelling, and generation of practical risk control options and comprehensive, multidisciplinary emergency response plans. (6 p.)

Keywords: Environment, safety, health, risk management

Paper No. 2A-1:

Title: Acquisition of Ten ANZAC Frigates.

Author: CDRE Peter Dechaineiux and Les Jurgens.

Abstract: This paper addresses the lead-up activities, including the establishment of a joint project office, Australian and New Zealand Defense-Committee involvement, tendering, evaluation, and negotiation associated with the acquisition of ten ANZAC Frigates. This paper also presents an overview of the ship construction techniques and the division of work. (7 p.)

Keywords: Acquisition, design evaluation, contracts, PWBS

Paper No. 2A-2:

Title: Task Definition as a Route to Effective Production of Modern Warships.

Author: Dennis MacCoy and David C. Dobson

Abstract: This paper describes the approach used by a United Kingdom shipyard to effectively plan and control the construction of modern warships. The paper describes a task-based method of establishing a build strategy, work packages, material definition, process engineering, and labor cost control. (15 p.)

Keywords: Task definition, product work breakdown structure, cost control, production control

Paper No. 2B-1:

Title: Total Quality Management (TQM) for Survival.

Author: Gary Adams.

Abstract: This paper presents how Portsmouth Naval Shipyard is using the concepts of TQM to improve performance, communicate more clearly, and focus on customer demand. Methods of training, team building, identification of customer needs, process improvement, and performance measurement are discussed. (7 p.)

Keywords: Total Quality Management (TQM), quality

Paper No. 2B-2:

Title: Financial Question – Industrial Engineering Answers.

Author: Alan J. Kaitz and George Winter.

Abstract: This paper evaluates factors associated with making financial decisions about capital equipment. Obtaining accurate and useful information about equipment utilization is discussed. The effects of equipment utilization on workload planning, evaluation of equipment needs, identification of bottlenecks, identification of excessive downtime, and identification of capacity relative to new opportunities are discussed. (5 p.)

Keywords: Cost, equipment, capital improvement

Paper No. 3A-1:

Title: Advanced Industrial Measurement System for Productive Shipbuilding.

Author: Albert W. Horsmon, Jr. and Charles J. Lupica.

Abstract: This paper discusses the equipment, methodologies, accuracy, limitation, and costs associated with many advanced industrial measurement systems available for shipyard use. The paper provides some actual on-sight evaluation of various methods used to measure the erection joint of a hull block. (16 p.)

Keywords: Measurement, accuracy control, quality

Paper No. 3A-2:

Title: Index Based Management Information Systems: A Study in Structured Operations.

Author: Charles E. Bentsen.

Abstract: This paper is a critical analysis of two systems approaches to understanding the job requirements of ship repair and effectively executing such work. The approaches are MRP I and II and project-based management information systems (MIS or PBMS). The development and use of Index-based PBMS is discussed. (8 p.)

Keywords: Information systems, MIS, index-based, expert systems

Paper No. 3B-1

Title: Shipyard Skills-Tracking System.

Author: John Walker Hartigan.

Abstract: This paper discusses the Shipyard Skills Tracking System (SSTS), which is being implemented in Naval Shipyards to identify and record specific job-related skills in their industrial workforce. The paper discusses how this information is then used to properly allocate the workforce on critical tasks, and to accurately assess personnel availability and training requirements for upcoming work. (8 p.)

Keywords: Skilled labor, resource management, training

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Paper No. 3B-2:

Title: Shipbuilding and the Malcolm Baldrige National Quality Award.

Author: Mitchell E. Steller and Barbara Lamb.

Abstract: This paper examines how shipyards in the U. S. can benefit from participation in the Malcom Baldrige National Quality Award program. The paper focuses on the application and examination of the seven categories of the award selection criteria as they apply to shipbuilding. (7 p.)

Keywords: Quality, total quality management (TQM), award

Paper No. 4A-1:

Title: Cost Effective Planning and Control.

Author: George J. Bruce and Kenneth Reay.

Abstract: This paper discusses planning and control methods that were originally developed to regain control of shipbuilding projects that had become chaotic, and that have now evolved into a methodology for use on shipbuilding projects from beginning to end. (5 p.)

Keywords: MIS, planning, production control, performance measurement

Paper No. 4B-1:

Title: Solving SARA Compliance with Computerized Hazardous Materials Tracking.

Author: Don Johnston and Dave Schoenleber.

Abstract: This paper describes the design, development, and use of a computerized method developed by Peterson Builders to track hazardous materials in compliance with the requirements of the Superfund Amendment and Reauthorization Act (SARA) Title III, and the Emergency Planning and Citizen Right-to-Know Act (EPCRA). (8 p.)

Keywords: Environment, hazardous materials

Paper No. 4B-2:

Title: Hazardous Waste Minimization Program at Philadelphia Naval Shipyard.

Author: James G. Kardas, Arvind M. Nadkarni, and Carl M. Olson.

Abstract: This paper discusses Philadelphia Naval Shipyard's comprehensive plan to reduce the generation of hazardous waste in compliance with the Chief of Naval Operations' goal to reduce hazardous waste generation by the Navy by 50 percent before 1992. Waste identification, prioritization, treatment, recycling, and elimination are discussed. (4 p.)

Keywords: Environment, hazardous waste

Paper No. 4B-3:

Title: The Development of CO₂ Blasting Technology in Naval Shipyards.

Author: Jimmy W. Fuller.

Abstract: This paper describes CO₂ blasting and explains how this method can help eliminate hazardous waste, dust fumes, and contaminated water associated with slag abrasives. The paper describes actual testing of this method in a Naval shipyard.

Keywords: Blasting, surface preparation, environment

Paper No. 5A-1:

Title: Modelling and Transfer of Product Model Digital Data for the DDG 51 Class Destroyer Program.

Author: CDR William R. Schmidt, James R. Vander Schaaf, and Richard V. Shields.

Abstract: This paper describes the development of the CAD and data management technology, and the actual CAD model for DDG 51 program. The paper also discusses the specifics of the parallel efforts in digital data transfer (DDT) implemented by the AEGIS Destroyer Program. (25 p.)

Keywords: Design, CAD, 3-D modeling, digital data transfer, database management, configuration management

Paper No. 5A-2:

Title: Computerized Angle Measurement for Inclining Experiments.

Author: Victor Y. Chen and Peter K. Weinrich.

Abstract: This paper examines the application of electric angle measurement instrumentation, combined with portable computer technology, to the measurement of the angles of inclination during inclining experiments. The configuration, function, methods of data acquisition, and associated software are discussed for a particular system, CAMS. This system is compared to traditional pendulums and mechanical tangent inclinometers in the areas of accuracy, cost effectiveness, and ease of use. (6 p.)

Keywords: Inclining

Paper No. 5B-1:

Title: An Evaluation of the Fillet Weld Shear Strength of Flux Cored Arc Welding Electrodes.

Author: R. W. McClellan.

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Abstract: This paper presents the results of a study of the longitudinal and transverse shear strength of flux cored arc welding fillet metals. Conclusions are also presented regarding process efficiency, quality, and the potential for reducing weld fillet size. (15 p.)

Keywords: Welding, flux core, fillet shear strength

Paper No. 5B-2:

Title: Shipboard Aluminum/Steel Welded Transition Joints Evaluation and Improvement.

Author: Edward Gaines and John Banker.

Abstract: This paper presents the results of a study into aluminum/steel transition joint manufacture and quality testing required by material specification, the adequacy of design, guidelines and production practices, and the cost effective methods for corrective action on faulty joints. Recommendations are provided for modification of product design, installation methods, testing methods, and materials. (17 p.)

Keywords: Welding, aluminum/steel joints

Paper No. 6A-1:

Title: What Can Adhesives Offer to Shipbuilding?

Author: I. E. Winkle, M. J. Cowling, S. A. Hashim and E. M. Smith.

Abstract: This paper presents an overview of recent research into the feasibility and advantages of using toughened structural adhesives to replace some conventional welding for primary structures in the shipbuilding and associated marine industries. The concept is explored through its application to the stiffener/plate connections of thin plate grillage structures. (17 p.)

Keywords: Joining, welding, adhesives, composites

Paper No. 6A-2:

Title: Large Scale Processing Machinery for Fabrication of Composite Hulls and Superstructures.

Author: John F. Raymer.

Abstract: This paper discusses the use of large scale mechanical systems (impregnators) for impregnating and positioning composite materials in the manufacture of large composite marine structures, including hulls over 60 meters (200 ft) in length. The paper provides an overview of some impregnator installations, the selection process used for choosing an appropriate impregnator system, and production engineering factors to consider. The paper also discusses properties of composite materials. (8 p.)

Keywords: Composites, impregnator

Paper No. 6B-1

Title: Importance of Considering Life Cycle Maintenance and Modernization Costs in the Design of Navy Ships.

Author: F. W. Bankes and M. H. Spicknall.

Abstract: This paper presents several examples of actual design-related maintenance and modernization problems, along with possible design solutions, identified through a survey of U. S. Naval shipyards. The paper also provides recommendations for increasing consideration of maintenance and modernization costs in Navy ship design through education, through the development of specific communication interfaces between design and maintenance and modernization production functions, and through research. (8 p.)

Keywords: Maintenance, modernization, overhaul, design, cost

Paper No. 6B-2:

Title: CAD/CAM in Phased Maintenance.

Author: Bruce A. Carr, Thomas M. Houlihan, and Michael A. Polini.

Abstract: This paper describes how Jonathan Corporation uses CAD/CAM to support its phased maintenance activities on three classes of ships, and for long-lead-time and short-lead-time availabilities. The paper describes how information is gathered and verified, how technical analysis is prepared and submitted to the Navy. (15 p.)

Keywords: CAD/CAM, maintenance, overhaul

Paper No. 7A-1:

Title: Development of Design and Fabrication Method of Thin Steel Plate Structure and its Application to a Passenger Ship.

Author: Tomoya Hamasaki.

Abstract: This paper presents how IHI approached the construction of a passenger ship superstructure with 4.5 mm thick steel deck plates with the objective of minimizing weld distortion. The paper describes how structural design and construction methods were reviewed, selected, tested, applied to the ship, and verified. Quality and cost measurement methods and data are discussed. (7 p.)

Keywords: Welding, structural design, quality, cost, thin plate

Paper No. 7A-2:

Title: SEAWOLF Producibility II: Transition From Design to Production.

Author: CDR B. R. Brucker and R. W. Baseler

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Abstract: This paper reviews the work accomplished during the Seawolf detailed design effort. Initiatives such as digital data transfer, sectional construction drawings, planning and sequence documents, and computer integration of information are discussed. (13 p.)

Keywords: Design, CAD, 3-D modeling, digital data transfer, database management, configuration management

Paper No. 7B-1

Title: Photogrammetry as an Advance Planning Tool for Naval Shipyards.

Author: Harold Ingram and Felicia K. Dudeck.

Abstract: This paper presents several case studies in which Naval shipyards have used photogrammetry prior to the execution of work in order to plan and accomplish the work more efficiently. (14 p.)

KEYWORDS: Photogrammetry, overhaul, repair, planning

Paper No. 7B-2

Title: Photogrammetry, Shipcheck of USS Constellation (CV64) Arresting Gear Engines.

Author: Peter L. Sparacino, Joseph W. Krulilowski, and John F. Kenefick.

Abstract: This paper outlines the methods and techniques for using photogrammetry as a planning tool. It also demonstrates the practicality of collecting dimensional data from existing ship structures and foundations, and using this data directly in the manufacturing phase. (4 p.)

Keywords: Photogrammetry, maintenance, modernization, overhaul, repair

Paper No. 8A-1

Title: In Search of a Level Playing Field: The Shipbuilders Council of America and the Issue of Foreign Shipbuilding Subsidies.

Author: John J. Stocker.

Abstract: This paper discusses the origins of decisions by the SCA to file a petition charging Japan, South Korea, West Germany, and Norway with unfair trade practices in shipbuilding and repair. The progress of negotiations between the U. S. Trade Representative and foreign governments is presented as are the actions of the OECD to address the reduction of subsidies. The paper provides insight into the future courses of action of the U. S. Government and the SCA in these areas. (11 p.)

Keywords: Subsidies, competitiveness

Paper No. 8A-2:

Title: The Path to U. S. Shipbuilding Excellence-Remaking the U. S. into a World Class Competitive Shipbuilding Nation.

Author: Professor Ernst G. Frankel.

Abstract: This paper prescribes a path for regaining a U. S. commercial shipbuilding competitiveness, and formal steps that will be necessary, in the opinion of the author, to remake the U. S. into a world class shipbuilding nation. Many statistics are provided on the status of the U. S. and world shipbuilding industry. (10 p.)

Keywords: Competitiveness, technology, human resources, management, marketing, design, standards, supplier base

Paper No. 8B-1

Title: An Assessment of Opinions on Producibility Within the Naval Sea Systems Command.

Author: Richard Byrnes and Henry Marcus

Abstract: This paper is a summary of the results of a survey that was conducted to help NAVSEA come to a consensus as to what actions should be taken to include producibility as an important factor in Navy ship design. The objective of the survey was to sample the opinions of many associated with NAVSEA on the subject of producibility. The survey was to be used as a basis of information in a series of NAVSEA producibility workshops. (14 p.)

Keywords: Design, producibility

Paper No. 8B-2:

Title: Political Changes in Eastern Europe and the World Shipbuilding Market.

Author: Dr. Boris S. Butman.

Abstract: This paper discusses recent political and economic events in Eastern Europe and their potential effects on the world shipbuilding market. Shipbuilding organizations and capacities in the Eastern Block, and possible business relationships with them, are discussed. (11 p.)

Keywords: Market, competitiveness, Eastern Europe

NSRP 0324

UMTRI 78284

TITLE: A Conceptual Information Model Data Base Design for Outfit Planning.

AUTHOR: Richard L. Diesslin.

DATE: September 1982

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ABSTRACT: This study's objective was to develop a conceptual data base design model (information model) description which details the required function, information requirement, and data relationships to support outfit planning. This information model defines and relates outfit items to the various material lists, purchase orders, schedules, work packages, work aids, and instruction. (104 p.)

KEYWORDS: Database Design, outfit planning

NSRP 0335

UMTRI 82205

TITLE: The National Shipbuilding Research Program Informational Booklet and Guide.

AUTHOR: Lynwood Haumschilt.

DATE: January 1991

ABSTRACT: A background/history statment covering the multi-disciplined cooperative nature of the NSRP's drive for applied research implementation is followed by a policy statement. The overall guiding objectives are followed by a description of the NSRP organization. A timetable for project submittal is followed by directions concerning "How to" submit a proposal abstract. A sample proposal abstract is contained. (28 p.)

KEYWORDS: Proposal preparation, shipbuilding research

NSRP 0340

UMTRI 78284

TITLE: NSRP 1991 Ship Production Proceedings.

AUTHOR: Symposium Participants.

ABSTRACT: This NSRP report contains papers presented at the 1991 National Shipbuilding Research Program Ship Production Symposium on September 3-6, 1991 in San Diego, California. The symposiums' theme was "Building the Ships and Boats of 2010: The Way Forward". These proceedings are available as individual papers only.

KEYWORDS: Ship Production, steel hulls, welding, portable arc welding robots, zone technology, ship design, expert systems, dry docking timbers and blocks

Paper No.IIA-1:

Title: A Return to Merchant Ship Construction: The International Impact of the NSRP and American Technology.

Author: Raphael Gutierrez and Antonio Sarabia.

Abstract: This paper discusses the status of shipbuilding industry in the mid-eighties. Many spanish shipyards were commercially uncompetitive. After making a strong reentry in the commercial shipbuilding market, they engaged in a process of reorganization of the entire production system according to modern Japanese practice. (9 pg.) market

Keywords: Competitiveness, commercial shipbuilding market

Paper No. IIA-2:

Title: Breaking the Chains of Tradition and Fantasy-A Revolutionary Approach to the Constraints on Productivity.

Author: James Rogness.

Abstract: One of the most valuable opportunities currently available to U.S. shipbuilder's may exist in the realization that many of the constraints limiting productivity in shipbuilding are actually self-imposed, arising from traditional management and organizational policies which run counter to the new and changing realities of modern industry. (8 pg.)

Keywords: Productivity

Paper No. IIB-1:

Title: Panel Line Development.

Author: C.Reed Turner.

Abstract: This paper is a joint effort of an American Shipyard and an independent engineering company that is trying to resolve issues impacting a variety of panel productions. The development of this area would decrease facility costs and increase productivity. Ongoing efforts are in progress to confirm that this type of Submerged Arc Welding (SAW) will consistently meet the requirements of current standards for military and commercial ships. (12 pg.)

Keywords: Submerged Arc Welding (SAW), One Side Welding (OSW) Systems, high yield steels, panel line

Paper No. IIB-2:

Title: Intelligent Automated Welding for Shipyard Applications.

Author: S. Madden, H. H. Vanderveldt and J. Jones.

Abstract: This paper discusses three significant computer technology advances which have been incorporated into the WELDEXCEL prototype. First is a computerized system for allowing multiple knowledge sources (expert systems, humans, data systems, etc.) to work together to solve a common problem (the weld plan or blackboard). The second, a methodology for the blackboard to communicate to the human user. The third, an artificial neural networks (ANS's), which are based on biological neural networks (e.g. the human brain), that can do neural reasoning tasks about difficult problems. (13 p.)

Keywords: Welding, expert systems, computer aided process planning, computer aided design, computer aided manufacturing

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Paper No. IIB-3:

Title: Portable Arc Welding Robots-A Practical Shipbuilding Tool?

Author: Peter Williams, Peter Orrick.

Abstract: An overview of the application of portable welding robots in shipbuilding is given, with particular reference to a pilot project undertaken at a British shipyard. A general basis for cost justification is outlined, and applications and limitations of the robot system discussed. Particular attention is drawn to the requirements imposed on other shipyard systems when using robots. (11 p.)

Keywords: Welding, robots

Paper No. IIIA-1:

Title: Maintaining the Shipbuilding Technology Base-Looking at Other Markets.

Author: H. Bruce Bongiorni.

Abstract: This paper introduces a discussion on U.S. shipyards ability to handle large, complex projects, the range of skills among their work force, and their proximity to water transportation. Examples of shipyard participation in new markets demonstrates these strengths. (8 p.)

Keywords: Marketing

Paper No. IIIA-2:

Title: Maquiladora Operations for Shipbuilding.

Author: Gary Laughlin, Guillermo Gomez

Abstract: This paper discusses the Maquiladora program that was established by the Mexican government. This paper tries to establish a maquiladora operation as a cost saving possibility. Today, a maquiladora is a plant in Mexican assembling components of a product that will be eventually sold in the United States and/or throughout the world. (16 p.)

Keywords: Maquiladora, global market

Paper No. IIIB-1:

Title: Composite Materials and Naval Surface Combatants: The Integrated Technology Deckhouse Project.

Author: Pat Cahill.

Abstract: This paper discusses the Integrated Technology Deckhouse (ITD) Project that has been steadily progressing toward the goal of constructing Naval combatant deckhouses out of an integrated system of steel and composites. The approach of the ITD Project has

resolved problems and issues in phases, with each phase becoming progressively narrower in scope and greater in detail. (9 p.)

Keywords: Composite materials, deckhouse

Paper No. IIIB-2:

Title: Permanent Composite Cladding of Deteriorating Steel Hulls.

Author: Albert W. Horsmon, Jr.

Abstract: This paper discusses the repair, the events leading up to the repair, including U.S. Coast Guard approval, the structural and production decision making processes involved in the repair of the steel steam yacht MEDEA, and the projected use of an integrated production system for similar future applications are described in this paper. (7 p.)

Keywords: Composite cladding, MEDEA, fiberglass reinforced plastics (FRP)

Paper No. IVA-1:

Title: A Future Role of Quality in Shipbuilding – Reducing the Odds.

Author: M. Raouf Al-Kattan.

Abstract: This paper discusses a methodology for the assessment of design and production capability as an approach to quality improvement in the shipbuilding industry and addresses the all important cultural factor that is key to the success of any performance improvement program. (13p.)

Keywords: Shipbuilding

Paper No. IVA-2:

Title: Management of Technological Change and Quality in Ship Production.

Author: Ernst G. Frankel

Abstract: This paper discusses the management of technological change and quality in ship production is presented as a formal step by step procedure which should be undertaken at regular (quarterly or at least yearly) intervals to assure that the yard maintains its quality and performance in process and product terms. (6p.)

Keywords: Management, ship production, design, quality

Paper No. IVA-3:

Title: Improving Your Competitive Position Through Total Quality Management (TQM).

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Abstract: This paper discusses how Total Quality Management (TQM) is now a requirement throughout government and industry solicitations, This new requirement, resulting from many activities propagating throughout industry and government, influences the contractor/customer relationship profoundly. (7p.)

Keywords: Total Quality Management,

Paper No. IVB-1:

Title: Using Fiber Optics for Laser Cladding.

Author: John Bartley, Paul Denney and Al Grubowski.

Abstract: This paper discusses the development of a shipboard laser materials processing system that utilizes fiber optics for the refurbishment of navy structures. (8p.)

Keywords: Laser Cladding System, fiber optics

Paper No. IVB-2:

Title: Areal Coverage Using Friction Surfacing.

Author: Peter Lambrineas and Peter Jewsbury.

Abstract: This paper discusses the areal coatings of 304 and 316 marine grade stainless steel that were made on flat mild steel substrates using a low-pressure friction surfacing technique and various deposition configurations . (9p.)

Keywords: Welding, area coatings, coating techniques

Paper No. IVB-3:

Title: Recent MIT Research on Residual Stresses and Distortion in Welded Structures.

Author: Koichi Masabuchi

Abstract: This paper discusses the development of technologies of reducing residual stresses and distortion through in-process control. (15p.)

Keywords: Welding, expert systems, knowledge-based systems

Paper No. IVB-4

Title: Shipyard Aluminum/Steel Welded Transition Joints.

Author: Edward Gaines and John Banker

Abstract: This paper summarizes long term studies of aluminum to steel explosion welded transition joints to determine causes of separation and the development of the latest transition techniques. (6p.)

Keywords: Aluminum, welding, transition joints

Paper No. VA-1:

Title: Infrastructure Study in Shipbuilding: A Systems Analysis of U. S. Commercial Shipbuilding Practices.

Author: Michael Wade and Zbigniew J. Karaszewski

Abstract: This report documents the results of the first phase of the Infrastructure Study in Shipbuilding (ISIS) which documents the current processes used to build commercial ships in the United States. The results have brought an increased understanding of the commercial process and have also provided a strategic planning tool. (20 p.)

Keywords: Infrastructure, commercial shipbuilding, process modeling

Paper No. VA-2:

Title: Ship Conversion Project Monitoring – From the Customer’s Viewpoint.

Author: Edward S. Karlson.

Abstract: This paper addresses continuing project monitoring and progress evaluation by the customer. Such monitoring of ship conversions includes ongoing comparisons between the shipyards planned and actual performance with respect to resource application and schedule adherence. (10p.)

Keywords: Ship Conversion, performance measurement

Paper No. VB-1:

Title A Data Model for the Integration of the Pre-commissioning Life-cycle Stages of the Shipbuilding Product.

Author: M. Welsh, J. Lynch and P. Brun.

Abstract: This paper discusses some aspects of work being carried out on the NEUTRABAS project under ESPIRIT II European research program. The aim of this project is to specify and implement a neutral product definition database for large marine-related artifacts, covering a large part of the complete product life-cycle. (20p.)

Keywords: NEUTRABAS Project, esprit ii, database integration, product life-cycle.

Paper No. VB-2:

Title: Manufacturing Software for Shipyards.

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Author: Charles Zigelman

Abstract: This paper explores how shipbuilding is related to other manufacturers in ways that are significant for the selection of manufacturing computer systems. Some of these issues include master scheduling, configuration management and project based production and inventory control. (7p.)

Keywords: Manufacturing Software, computer systems

Paper No. VIA-1:

Title: Zone Technology Implementation at Philadelphia Naval Shipyard – Phase III.

Author: M. D. Petersen-Overton.

Abstract: Phase three of zone technology at the Philadelphia Naval Shipyard is contained. This involves the completion of the USS Kitty Hawk service life extension program (SLEP), the final planning and commencement of the USS Constellation, SLEP using 100 percent Zone Technology and future utilization of Zone Technology. (16p.)

Keywords: Zone Technology, service life extension program (SLEP), uss kitty hawk

Paper No. VIA-2:

Title: Information Required From Planning Yards to Support Zone Logic.

Author: Richard Storch and L. D. Chirillo.

Abstract: This paper provides guidance for planning yards that will support zone logic, an operational approach consistent with modern manufacturing practices. The need for them to act as production engineering surrogates until implementing yards are designated, is also addressed. Typical planning yard output are also described. (22p.)

Keywords: Zone Logic, manufacturing, planning

Paper No. VIB-1:

Title: Modeling for Ship Design and Production.

Author: Jurgen Wollert

Abstract: Some modeling application and computer integrated manufacturing (CIM) processes, within European shipbuilding research and development projects will be highlighted from the viewpoint of an integrated product and process modeling approach. Projects referenced include Neutral Database for Complex Multifunctional Systems (NEUTRABAS), Real Time Monitoring and Control of Construction Site Manufacturing and Marine Industry Applications of Broadband Communications. (15p.)

Keywords: Product Modeling, process modeling, computer integrated manufacturing,

Paper No. VIB-2:

Title: Developing and Using an Expert Systems for Planning the Production of Structural Piece-Parts.

Author: Mark Spicknall

Abstract: This paper presents an example of how expert systems can be developed and used for planning structural piece-part production. First, expert systems are briefly and generically described. Then the production processes within a shipyard-like structural piece-part production facility are defined within an expert system shell. (24p.)

Keywords: Expert Systems, planning, structural piece parts

Paper No. VIIA-1

Title: Stochastic Expert Choice in Ship Production Project Management.

Author: Ernst G. Frankel

Abstract: This paper discusses stochastic expert choice in ship production project management, or the analytic hierachical process (AHP), which offers an approach that allows consideration of all factors including risk attitudes of those involved. (6p.)

Keywords: Stochastic Expert Choice, analytic hierarchical process

Paper No. VIIA-2:

Title: Implementation of PC-Based Project Management in an Integrated Planning Process.

Authors: Richard J. Newumann and David J. McQuaide.

Abstract: This paper discusses the implementation of pc-based project management in an integrated planning process. National Steel and Shipbuilding Company is developing a computer-based model which will serve as a tool to assist planning organizations in developing, updating, and revising Master Production Schedules (MPS) as well as manning and facilitating utilization reports. (17p.)

Keywords: Planning

Paper No. VIIB-1:

Title: Photogrammetry – Automating the Collection of Shipcheck Data.

Authors: Peter L. Sparacino and William Arguto.

Abstract: This paper explores the use of stereo photogrammetry to gather shipcheck data for shipboard distributive systems. These systems are, piping, ventilation, cableways, compartment arrangements and structural components. (8p.)

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Keywords: Photogrammetry, automation, shipcheck data

Paper No. VIIB-2:

Title: Productive Method and System to Control Dimensional Uncertainties at Final Assembling Stages in Ship Production.

Author: Markku Manninen and Jarl Jaatinen.

Abstract: Methods are presented for dimensional control of block assemblies by separating the dimensional control from the positional control of the block. Also described is a real dimensional control case and an evaluation of different measurement technologies in performing the proposed task. (7p.)

Keywords: Dimensional Control, positional control, accuracy

Paper No. VIIB-1

Title: Technology Survey of Small Shipyards in the Pacific Northwest.

Author: Richard Storch.

Abstract: Specific questions that exist concerning small shipbuilding can be placed in four general categories. These include (1) the current economic nature of the industry, (2) the current technical nature of the industry, (3) identification of available technology that can be used to improve the industry, and (4) research and development issues that can be pursued to improve the industry. (16p.)

Keywords: Shipyard Surveys, shipbuilding research, shipbuilding economics

Paper No. VIIB-2:

Title: Strength Properties of Drydocking Timbers and Blocks.

Authors: Ben S. Bryant, Rollo F. England, Jack G. Gates, Ross L. Haith and Jonathan M. Ross.

Abstract: This paper describes a study to gain timber strength knowledge at the detailed level by testing actual docking block timbers. The tests were conducted on individual timbers, timbers formed into layers, and timbers with in full-sized docking block build-ups. (12p.)

Keywords: Drydocking, timbers, blocking

Paper No. IXA-2:

Title: Life Cycle Design for Marine Vehicles.

Authors: M.M.A. Pourzanjani and J. Knezevic.

Abstract: This paper proposes a new approach to design, a life cycle engineering approach, which presents an integrated approach for bringing competitive products and systems into being in such a way as to minimize their deficiencies and life cycle cost. This involves the integration of performance, producibility reliability, maintainability, manageability (human factor) and supportability. (9p.)

Keywords: Life Cycle Design, ship design, Computer Aided Design, Computer Aided Manufacturing

Paper No. IXB-1:

Title: The Eight-Hour Workday: An Unattainable Goal.

Authors: Alan J. Kaitz and James R. Miller.

Abstract: This papers discusses the daily obstacles a industrial engineering an analyst encounters when attempting to complete tasks assigned. Personal time, fatigue, mental stress and physical stress etc. are described and discussed when relating to employee productivity. (5p.)

Keywords: Productivity, employee development

Paper No. IXB-2:

Title: Shipyard Trade Skill Testing Program.

Author: John Walker Hartigan.

Abstract: Tests have been developed for seventeen trades and validated by trial administrations at each of the naval shipyards. Part of the development process was a task analysis performed for each of the trades. Computer programs used for test generation allow the test designer to specify which tasks are to be measured in any given test and allow the tests to accommodate difference in job content and procedures at the several locations. (4p.)

Keywords: Trade Skills, trade skills testing

Paper No. IXB-3:

Title: A Summary Report: A Survey of The Principal Elements of Safety Programs at Nine American Shipyards.

Author: Frank J. Long

Abstract: This paper is a summary of a survey that was designed to collect a significant amount of detailed information concerning the principal elements of safety programs currently in effect in major American shipyards. (6p.)

Keywords: Shipyard Safety, safety programs

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328	Methods Improvement Workshop for the Shipbuilding Industry	144	\$15.00	\$28.80
329	The Effects of Substrate Contaminants On The Life of Epoxy	160	\$15.00	\$32.00
330	1990 Clean Air Act: Impact on Shipyard Painting Operations	23	\$7.50	\$4.60
331	National Workshop on Human Resource Innovation in Shipbuilding/Ship Repairs	233	\$15.00	\$46.60
332	Evaluation of New Surface Preparation & Coating Techniques in Ballast Tanks Interim	23	\$7.50	\$4.60
333	The Definition of a Shipyards Engineering Requirements to be Met by a Design Agent	41	\$7.50	\$4.60
334	Recommendations On The Use of Interactive Instruction for Training Shipyard Trade	31	\$7.50	\$8.20
335	The National Shipbuilding Research Program Informational Booklet and Special Proje	29	\$7.50	\$5.80
336	Practical Guide for Flame Bending of Pipe	100	\$7.50	\$20.00
337	Employee Involvement: White Collar Workforce Phase I	32	\$7.50	\$6.40
338	Visual Reference Standards for Weld Surface Conditions and User's Guide for Weld R	27	\$7.50	\$5.40
339	Design and Planning Manual for Cost Effective Welding	445	\$17.50	\$89.00
340	1991 NSRP Ship Production Symposium Proceedings			\$0.00
341	Procedure Handbook for Shipboard Thermal Sprayed Coating Applications	207	\$15.00	\$41.40
342	Hazardous Material Tracking Systems: Scanning Module	26	\$7.50	\$5.20
343	Evaluation of Hitachi Zosen Portable Welding Robotics	51	\$7.50	\$10.20
344	Marine Industry Standards Planning Workshop: Report of Proceedings	71	\$7.50	\$14.20
345	Environmental Compliance Inspection Checklist for Shipbuilding Facilities	126	\$15.00	\$25.20
347	Implementation Guide for Approaching Shop Floor Control	82	\$7.50	\$16.40
348	Improved Techniques for Labor Expenditure Collection	54	\$7.50	\$10.80
349	Balloting of Hull and Mechanical Standards	237	\$15.00	\$47.40
350	Staging Systems for Ships During New Construction and Repair	40	\$7.50	\$8.00
354	Standard Practice for Selection and Application of Marine Deck Coverings	305	\$17.50	\$61.00
356	Feasibility Study of Small Computer Application of Multi-Trade Scheduling	24	\$7.50	\$4.80

