

FINAL REPORT

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BENEFIT ANALYSIS OF SPC PANEL SP-2 PROJECTS

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Prepared by
Robinson-Page-McDonough and Associates, Inc.
Post Office Box 9
Greenland, New Hampshire 03840
(603) 436-7762

For
NATIONAL STEEL AND SHIPBUILDING COMPANY
Harbor Drive and 28th Street
Post Office Box 85278
San Diego, California 92186-5278

In Behalf Of
SNAME SPC PANEL SP-2

OUTFITTING AND PRODUCTION AIDS

Under the
NATIONAL SHIPBUILDING RESEARCH PROGRAM

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November 1993

Task N8-90-11

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P R E F A C E

The National Shipbuilding Research Program has been sponsored during the past 20 years by the Maritime Administration, United States Department of Transportation, and by the United States Navy toward improving productivity in shipbuilding. The Program is operated through several Panels of the SNAME Ship Production Committee. During 1988 a survey was conducted in behalf of SPC Panel SP-3 on Surface Preparation and Coatings to determine (1) the benefit value that had accrued from the research projects sponsored by that Panel during the previous 15 years, and (2) how the management and administration of the Panel itself- meetings, discussions, activities - was seen by the using community. The report of this survey (NSRP 0303, July 1989) was well received. It was therefore decided to conduct a similar survey for each of the other active SPC Panels. In addition, available information on now inactive Panels SP-2 (Outfitting and Production Aids) and SP- 10 (Flexible Automation) would be reported if it appeared that such information might be helpful to the active Panels.

The modified survey of SPC Panel SP-2 on Outfitting and Production Aids is reported herein. The purpose of this survey was to gather and present user opinions and comments on the projects sponsored by Panel SP-2 toward better utilization of this research information.

The Task was conducted by Rodney A. Robinson, Vice President of Robinson-Page-McDonough and Associates, Inc. Personal interviews were conducted with several members of the shipyard Outfitting and Production Aids community to gain the necessary information. Conclusions and recommendations based on analysis of the findings are included in the report. The work, under NASSCO Purchase Order No. MU171117-D, began in October 1991 and was completed in November 1993.

EXECUTIVE SUMMARY

This Task has investigated the benefits derived from the projects sponsored by SNAME Ship Production Committee Panel SP-2 on Outfitting and Production Aids during the 15 year period when this Panel was active under the National Shipbuilding Research Program. It has found that several projects sponsored by Panel SP-2 produced information of potential value to the shipyard community, but that only minimal application of this material has been achieved. The reason for this situation is not obvious, but there is some sentiment that the manner in which the information has been presented may have contributed to the low application rate. That is, much of the information is a direct reflection of the practices (then) followed in the Japanese shipyards. This information was presented factually and completely, but without adjustment to suit the different atmosphere, operational conditions, and human relationships that exist in U. S. shipyards. It follows that if this information is “translated” into a more user-friendly format, and is adjusted to suit the context of U. S. shipyards, it may inspire major improvements in our performance, particularly in regard to our competitive position in the international commercial market. A recommendation to this effect has been included in this report.

This Task also identified a problem common to all SPC Panels, but particularly acute for those Panels that are no longer active. Attempts to assemble copies of meeting minutes, attendance rosters, and other material associated with the meetings of SPC Panel SP-2 met with only marginal success. After only six years of inactivity, the density of such documents has become so thin as to suggest that deliberate steps are needed to preserve such material for future reference. Of all the meetings held by this Panel, only the attendance rosters for three meetings were obtained, and none of the meeting minutes. Documents of this type are typically thrown out when their immediate purpose has been satisfied. For the active Panels, the problem of obtaining these documents is less severe because recent attendees have them handy. However, the recovery difficulty increases for the earlier meetings, some of which were attended by people no longer on the NSRP scene. A recommendation to correct this situation is contained in this report.

SPC Panel SP-2 was quite active during its 15-year existence. Much important research was sponsored and reported by this group, as even a cursory review of the information contained herein will disclose. As our shipyard community endeavors to gain a competitive posture in the international commercial market, the material produced by Panel SP-2 definitely should be included in deliberations aimed at improving our performance. Even though some of the SP-2 project activity took place over a decade ago, the information generated by this research clearly is still relevant. A modest amount of effort to study this information and adapt it to the current conditions in our shipyards could pay substantial dividends.

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FINAL REPORT



BENEFIT ANALYSIS OF SPC PANEL SP-2 PROJECTS

BACKGROUND

General Discussion

This Project was designed to investigate the benefits that may have resulted from SPC Panel SP-2 Outfitting and production Aids projects carried out during the 15 year period when this Panel was in active operation. The project would consist of interviews with members of the Outfitting and Production Aids community to gain information on these matters. The interviews would be on-site and face-to-face, to yield the most meaningful results. Analysis of findings would be published for principal consumption by the members of other active SPC Panels toward better utilization of this research information by the shipyard community.

This project was a direct follow-on to a similar project conducted in 1989 in behalf of SPC Panel SP-3 to (1) explore the benefits that may have resulted from the projects sponsored by that Panel during the previous 15 years, and (2) to evaluate how the management of Panel SP-3 itself was seen by the using community. The report on that project (NSRP 0303, July 1989) was well received, prompting the development of this current project, which consists of the same kind of analyses for all other active SPC Panels, as well as an update on the projects of Panel SP-3 since the original report. It was also decided to add a modified survey of currently inactive Panels SP-2 (Outfitting and Production Aids) and SP-10 (Flexible Automation) toward better utilization of their research findings. The report presented herein covers the area of projects sponsored by SPC Panel SP-2 on Outfitting and Production Aids.

Overview

Information on project benefits was gained through personal and anonymous interviews with 5 members of the Outfitting and production Aids community from 4 different shipyard locations. The interviews were conducted during the month of May, 1993. The survey would have benefited from interviews with a larger number of people, but difficulty was encountered in finding shipyard representatives who were still knowledgeable of SP-2 matters after the six years of Panel inactivity. Out of the 200+ people contacted for this survey (which involved all SPC Panels), only these 5 individuals were able to provide specific information on the projects sponsored by Panel SP-2.

Records of Panel SP-2 activities also were difficult to obtain, despite strenuous efforts to do so. Discussion with the last Chairman of Panel SP-2 (Louis D. Chirillo) disclosed that he had not retained any files of information on Panel meetings or activities. Contacts with a large number of people believed to be present at one or more of the Panel SP-2 meetings produced a listing of attendees for only three meetings: Dec '82 at Tacoma, WA; Nov '84 at Seattle, WA; and Jul '85 at Bedford, MA. Full minutes of these meetings were not located. A matrix of the attendees at these three meetings, and their company affiliations, appears on pages 3 through 6.

Several questions were designed to explore the aspects of this survey. The worksheets for gathering information on the benefits of individual projects are contained in Appendix A.

A detailed discussion of the findings is presented below. Those associated with the benefit analysis of panel projects begin on page 7. Conclusions reached from the findings are on page 25. The recommendations drawn from these conclusions are on page 26.

NAME	COMPANY	Date - Location		
		Dec '82 - Tacoma, WA	Nov '84 - Seattle, WA	Jul '85 - Cambridge, MA
ANDERSON, TED	Puget Sound Naval Shipyard		X	
ANTKOWIAK, EDWARD	Bowditch Navigation Systems			X
ARCENEUX, S.	McDermott Shipyards	X		
ATCHLEY, FRED	Ingalls Shipbuilding Division			X
BARNES, DON	Puget Sound Naval Shipyard		X	
BARRILLEAUX, E. A. (PETE)	Ingalls Shipbuilding Division			X
BASS, JOHN	Bethlehem Steel Corp - Sparrows Point		X	
BEDDINGFIELD, H. S.	Newport News Shipbuilding	X		
BELL, MALCOLM	A&P Appledore			X
CADDOCK, BOB	Puget Sound Naval Shipyard		X	
CHING, CAESAR	Puget Sound Naval Shipyard			X
CHIRILLO, R. D. (RICK)	L. D. Chirillo Associates	X	X	
CHIRILLO, LOUIS D.	L. D. Chirillo Associates	X	X	X
CURTIS, J.	Nickum/Spaulding Associates	X		
DAVIS, LARRY	Ingalls Shipbuilding Division		X	
DLUHOS, BOB	General Dynamics/Quincy Shipbldg Div.		X	
DORSEY, HARVEY	Puget Sound Naval Shipyard		X	
EDWARDS, O. G.	Lockheed Shipbuilding and Const. Co.	X		
ESAU, BERT	Puget Sound Naval Shipyard		X	
FARGO, ROBERT R.	Ingalls Shipbuilding Division			X
FRANK, L. W.	Lockheed Shipbuilding and Const. Co.	X		
FRANZ, M.	Nickum/Spaulding Associates	X		
GALISPEAU, G.	Tacoma Boatbuilding Company	X		
GAMBELLO, TONY	Philadelphia Naval Shipyard		X	
GAZZOLA, D.	Todd Pacific Shipyards Corp - LA Div.	X		
GRAHAM, JOHN	Newport News Shipbuilding	X	X	
HACKENBERGER, C.	Tacoma Boatbuilding Company	X		
HARDER, BILL	Bay Shipbuilding Corporation			X
HARNETT, NOREEN	Puget Sound Naval Shipyard		X	
HARRINGTON, NORM	General Dynamics/Quincy Shipbldg Div.	X	X	X
HAUGLAND, DAVE	National Steel and Shipbuilding Company		X	
HIGGINS, C. GARY	Peterson Builders, Inc.	X		
HOWSON, DICK	Peterson Builders, Inc.		X	
JARRETT, R.	Bethlehem Steel Corp - Sparrows Point	X		
JOYAL, RON	Puget Sound Naval Shipyard		X	
KERLEY, TOM	Peterson Builders, Inc.	X	X	

SPC Panel SP-2
Meeting Attendees
Alphabetical by Last Name

NAME	COMPANY	Date - Location		
		Dec '82 - Tacoma, WA	Nov '84 - Seattle, WA	Jul '85 - Cambridge, MA
KJERULF, SHEL	Express Engineering		X	
KLINE, ROGER G.	R. A. Steam, Inc.			X
KRUMINS, A.	Lockheed Shipbuilding and Const. Co.	X		
KRUMWEIDE, D.	National Steel and Shipbuilding Company	X		
LAMB, T.	Lockheed Shipbuilding and Const. Co.	X		
LEBER, R. P. (BOB)	Newport News Shipbuilding			X
MacDOUGALL, I.	A&P Appledore	X		
McNETT, D.	Tacoma Boatbuilding Company	X		
MILLER, DON	Puget Sound Naval Shipyard		X	
MORTON, RICH	Puget Sound Naval Shipyard		X	
NELSON, TIM	Peterson Builders, Inc.			X
NORWOOD, ASA	Puget Sound Naval Shipyard		X	
PEEL, D. DOUGLAS	Southwest Marine, Inc.			X
PLASSMEYER, JOE	National Steel and Shipbuilding Company		X	
POWELL, PAUL C.	Bath Iron Works		X	X
RADER, KEITH	National Steel and Shipbuilding Company		X	
REEVES, BOB	McDermott Shipyards		X	
ROSEBRAUGH, T. C. (TOM)	Puget Sound Naval Shipyard	X	X	X
SALKIND, M.	Supervisor of Shipbldg Office - Seattle, WA	X		
SAN MIGUEL, F.	McDermott Shipyards	X		
SAUCIER, J.	Tacoma Boatbuilding Company	X		
SCHAFFRAN, ROBERT W.	Maritime Administration	X	X	X
SHOCK, GLENN	Puget Sound Naval Shipyard		X	
SLATE, LEROY	Newport News Shipbuilding		X	
SNOW, ALEXANDER	General Dynamics/Electric Boat Division			X
STALLINGS, W. S.	Todd Pacific Shipyards Corp - LA Div.	X		
STORCH, RICHARD	University of Washington		X	X
STUMBO, STAN	Nickum/Spaulding Associates	X	X	
TORRECH, RALPH	Norfolk Shipbuilding Company			X
UMSTATTD, KRISTEN	C. I. A.			X
VAN ANTWERP, JIM	Puget Sound Naval Shipyard		X	
VINCK, ALEX	Southwest Marine, Inc.		X	
VON FANGE, CHUCK	Southwest Marine, Inc.		X	
WALKER, G. E.	Puget Sound Naval Shipyard			X
WALTERS, GARY	Puget Sound Naval Shipyard		X	
WEISZ, C.	Tacoma Boatbuilding Company	X		

SPC Panel SP-2
Meeting Attendees
Alphabetical by Last Name

NAME	COMPANY	Date - Location		
		Dec '82 - Tacoma, WA	Nov '84 - Seattle, WA	Jul '85 - Cambridge, MA
BELL, MALCOLM	A&P Appledore			X
MacDOUGALL, I.	A&P Appledore	X		
POWELL, PAUL C.	Bath Iron Works		X	X
HARDER, BILL	Bay Shipbuilding Corporation			X
BASS, JOHN	Bethlehem Steel Corp - Sparrows Point		X	
JARRETT, R.	Bethlehem Steel Corp - Sparrows Point	x		
ANTKOWIAK, EDWARD	Bowditch Navigation Systems			X
UMSTATTD, KRISTEN	C. I. A.			X
KJERULF, SHEL	Express Engineering		X	
SNO/SNOW ALEXANDER	General Dynamics/Electric Boat Division			X
DLUHOS, BOB	General Dynamics/Quincy Shipbldg Div.		X	
HARRINGTON, NORM	General Dynamics/Quincy Shipbldg Div.	X	X	X
HATCHLEY, FRED	Ingalls Shipbuilding Division			X
BARRILLEAUX, E. A. (PETE)	Ingalls Shipbuilding Division			X
DAVIS, LARRY	Ingalls Shipbuilding Division		X	
FARGO, ROBERT R.	Ingalls Shipbuilding Division			X
CHIRILLO, R. D. (RICK)	L. D. Chirillo Associates	x	X	
CHIRILLO, LOUIS D.	L. D. Chirillo Associates	x	X	X
EDWARDS, O. G.	Lockheed Shipbuilding and Const. Co.	x		
FRANK, L. W.	Lockheed Shipbuilding and Const. Co.	X		
KRUMINS, A.	Lockheed Shipbuilding and Const. Co.	X		
LAMB, T.	Lockheed Shipbuilding and Const. Co.	X		
SCHAFFRAN, ROBERT W.	Maritime Administration	X	X	X
ARCENEUX, S.	McDermott Shipyards	X		
REEVES, BOB	McDermott Shipyards		X	
SAN MIGUEL, F.	McDermott Shipyards	x		
HAUGLAND, DAVE	National Steel and Shipbuilding Company		X	
KRUMWEIDE, D.	National Steel and Shipbuilding Company	x		
PLASSMEYER, JOE	National Steel and Shipbuilding Company		X	
RADER, KEITH	National Steel and Shipbuilding Company		X	
BEDDINGFIELD, H. S.	Newport News Shipbuilding	x		
GRAHAM, JOHN	Newport News Shipbuilding	X	X	
LEBER, R. P. (BOB)	Newport News Shipbuilding			X
SLATE, LEROY	Newport News Shipbuilding		X	
CURTIS, J.	Nickum/Spaulding Associates	x		
FRANZ, M.	Nickum/Spaulding Associates	x		

SPC Panel SP-2
Meeting Attendees
by Company Affiliation

NAME	COMPANY	Date Location	Dec '82 - Tacoma, WA	Nov '84 - Seattle, WA	Jul '85 - Cambridge, MA
STUMBO, STAN	Nickum/Spaulding Associates		x	X	
TORRECH, RALPH	Norfolk Shipbuilding Company				x
HIGGINS, C. GARY	Peterson Builders, Inc.		x	+	
HOWSON, DICK	Peterson Builders, Inc.			x	
KERLEY, TOM	Peterson Builders, Inc.		x	x	
NELSON, TIM	Peterson Builders, Inc.				x
GAMBELLO, TONY	Philadelphia Naval Shipyard			x	
ANDERSON, TED	Puget Sound Naval Shipyard			x	
BARNES, DON	Puget Sound Naval Shipyard			x	
CADDOCK, BOB	Puget Sound Naval Shipyard			x	
CHING, CAESAR	Puget Sound Naval Shipyard				x
DORSEY, HARVEY	Puget Sound Naval Shipyard			x	
ESAU, BERT	Puget Sound Naval Shipyard			x	
HARNITT, NOREEN	Puget Sound Naval Shipyard			x	
JOYAL, RON	Puget Sound Naval Shipyard			x	
MILLER, DON	Puget Sound Naval Shipyard			x	
MORTON, RICH	Puget Sound Naval Shipyard			x	
NORWOOD, ASA	Puget Sound Naval Shipyard			x	
ROSEBRAUGH, T. C. (TOM)	Puget Sound Naval Shipyard		x	x	x
SHOCK, GLENN	Puget Sound Naval Shipyard			x	
VAN ANTWERP, JIM	Puget Sound Naval Shipyard			x	
WALKER, G. E.	Puget Sound Naval Shipyard				x
WALTERS, GARY	Puget Sound Naval Shipyard			x	
KLINE, ROGER G.	R. A. Steam, Inc.				x
PEEL, D. DOUGLAS	Southwest Marine, Inc.				x
VINCK, ALEX	Southwest Marine, Inc.			x	
VON FANGE, CHUCK	Southwest Marine, Inc.			x	
SALKIND, M.	Supervisor of Shipbldg Office - Seattle, WA		x		
GAI IPEAH, G.	Tacoma Boatbuilding Company		x		
HACKENBERGER, C.	Tacoma Boatbuilding Company		x		
McNETT, D.	Tacoma Boatbuilding Company		x		
SAUCIER, J.	Tacoma Boatbuilding Company		x		
WEISZ, C.	Tacoma Boatbuilding Company		x		
GAZZOLA, D.	Todd Pacific Shipyardss Corp - LA Div.		x		
STALLINGS, W. S	Todd Pacific Shipyards Corp - LA Div.		x		
STORCH, RICHARD	University of Washington			X	X

SPC Panel SP-2
Meeting Attendees
by Company Affiliation

BENEFIT ANALYSIS OF PROJECTS SPONSORED BY SPC PANEL SP-2

General Discussion

This section contains information on all of the SP-2 projects investigated, including a description of each project, the pertinent information surrounding that project, and an analysis of the benefit value gained from that project to date. The NSRP Number is that assigned to each report in the NSRP Bibliography of Publications 1973-1992, published (now annually) by the University of Michigan for the National Shipbuilding Research Program. The projects investigated are those listed in this specific publication (1973-1992). The analysis portion has been drawn from the comments offered by those interviewed, and is intended to provide a general indication of how the project has been received by the shipyard industry. Appendix A was the worksheet used during the interviews.

For each of the active SPC Panels covered by this survey, a section was included at this location in each Final Report to provide a rapid visual idea of the relative benefit value that has been gained from the projects of each Panel that were investigated. Each Project was assigned a number of *'s (from 1 to 9) to indicate the relative benefit value gained from that project; the more *'s, the larger the benefit value gained. While these ratings were recognized as surely subjective, they were intended to represent the general opinions of those interviewed as a reflection of the overall industry attitude surrounding these projects.

In view of the small number of interview inputs available for Panel SP-2 projects, however, there was an insufficient basis for the assignment of *'s to these projects. The comments offered by those interviewed have been included below, and do provide at least some indication of project benefits.

Detailed Discussion of Individual Projects

Each of the individual projects investigated are discussed below in the chronological order in which they were carried out. Included is: NSRP Number; *TITLE*, *AUTHOR*; *DATE*; *COST* (where available); *ABSTRACT*; and *BENEFIT ANALYSIS*.

NSRP 0031

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

AUZHOR: McDonnell Douglas Astronautics, for Todd Pacific Shipyards.

DATE: August 1973

COST: (Not available)

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.)

BENEFIT ANALYSIS: One person interviewed was familiar with this report. He commented that "Engineering for Production" was the theme of this project. No application of this material was cited.

NSRP 0036

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

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

DATE: April 1974

COST: (Not available)

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. H, 218 p.)

BENEFIT ANALYSIS: Two people interviewed were familiar with this report. One commented that this research had "found that 25% of productivity can be lost due to outside work in the weather". The other person said that his shipyard had participated in this project, and that they were "still using it".

NSRP 0037

TITLE: Shipbuilding Alignment with Lasers.

AUTHOR Boeing Airplane Company, for Todd Pacific Shipyards.

DATE: April 1974

COST: (.Not available)

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 provides sufficient knowledge for someone already experienced in alignment techniques to adapt lasers to existing procedures as well as implementing new procedures. (1 17 p.)

BENEFIT ANALYSIS: One person interviewed was familiar with this report. He indicated that his shipyard had “worked on this one”. No application of the findings was cited, however.

NSRP 0038

TITLE: Use of Scale Models as a Management Tool.

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

DATE: May 1974

COST: (Not available)

ABSTRACT: The objective of his 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.)

BENEFIT ANALYSIS: Two people interviewed were familiar with this report. One said that his shipyard had applied this material during the new construction period in the 1970's, and that it had been useful. The other person said that his shipyard “did not use this material, but should have used it”.

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

DATE: August 1974

COST: (Not available)

NSRP 0060

TITLE: Fiberglass Reinforced Piping for Shipboard Systems.

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

DATE: August 1976

COST: (Not available)

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.)

BENEFIT ANALYSIS: Only one person interviewed was familiar with this report, but he indicated that his shipyard had installed such a system "on some tankers".

NSRP 0069

TITLE: Rectangular Vent Duct Standards.

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

DATE: May 1977

COST: (Not available)

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.)

BENEFIT ANALYSIS: Only one person interviewed was familiar with this report. He indicated that his shipyard "had used this one" on a limited scale, and might do so again in the future.

NSRP 0071

TITLE: Plastics in Shipbuilding.

AUTHOR: Springborn Laboratories. for Todd Pacific Shipyards Corp.

DATE: August 1977

COST: (Not available)

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.)

BENEFIT ANALYSIS: None of those interviewed were familiar with this report.

NSRP 0075

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

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

DATE: August 1978

COST: (Not available)

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.)

BENEFIT ANALYSIS: None of those interviewed were familiar with this report.

NSRP 0079

TITLE: Stern Frame and Hawsepipe Construction Technology.

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

DATE: 1978

COST: (Not available)

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 stem frame and hawsepipe design and construction techniques. The findings from the interviews were evaluated to determine different, more productive stem frame and hawsepipe configurations for single screw 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 stem frame and hawsepipe configurations. (200 p. approx.)

BENEFIT ANALYSIS: None of those interviewed were familiar with this report.

NSRP 0084

TITLE: Photogrammetry in Shipbuilding: Measuring a Complex Casting.

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

DATE: February 1979

COST: (Not available)

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.)

BENEFIT ANALYSIS: Only one of those interviewed was familiar with this report. He indicated that his shipyard had "looked at it at one point". No indication of application was cited.

NSRP 0090

TITLE: Special Structural Shapes: Factors Affecting Usage in U.S. Shipbuilding.

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

DATE: July, 1979

COST: (Not available)

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.)

BENEFIT ANALYSIS: Only one person interviewed was familiar with this report. and he offered no indication of application by his shipyard.

NSRP 0096

TITLE: Outfit Planning.

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

DATE: December 1979

COST: (Not available)

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 could lead to improving outfit procedures in the U.S. shipbuilding industry. (89 p.)

BENEFIT ANALYSIS: Three people interviewed were familiar with this report. One said that "this idea started SP-2 along the road", adding that his shipyard "does pre-outfitting as much as possible". A second person commented that this report was "definitely used", adding that people from his shipyard had traveled to another shipyard "for specific training in this area". The third person indicated that this material was "used in scheduling work as a basis for group technology initiatives in 1980/81". He added that this approach had "now evolved into the AIM (Advanced Industrial Management) model" being promoted in the Naval shipyards.

NSRP 0098

TITLE: Improved Tank Testing Methods.

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

DATE: January 1980

COST: (Not available)

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.)

BENEFIT ANALYSIS: Only one person interviewed was familiar with this report. He commented that his shipyard had "tried to adopt" this material, but gave no indication of their success.

NSRP 0117

TITLE: Product Work Breakdown Structure.

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

DATE: November 1980

COST: (Not available)

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.)

BENEFIT ANALYSIS: Three people interviewed were familiar with this report. One said that his shipyard "was involved here", because his "President is a believer in these ideas". A second person indicated that his shipyard has utilized this material and might do so again. The third person commented that this material is "also used for AIM", and that it was the subject of a paper written by him on this subject. He predicted future use of this technology by his shipyard.

NSRP 0124

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

COST: (Not available)

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.)

BENEFIT ANALYSIS: None of those interviewed were familiar with this report.

NSRP 0143

TITLE: Process Analysis via Accuracy Control.

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

DATE: February 1982

COST: (Not available)

ABSTRACT: This book addresses modern industrial methods as successfully applied by Ishikawajima-Harima Heavy Industries Co., Ltd. (Daiichi Works 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.)

BENEFIT ANALYSIS: Four of the five people interviewed were familiar with this report. One said that "these items were from the Japanese ways", adding that "we should have listened better". A second person said that this report was "great", adding that his shipyard now has an accuracy control group but admitting that "this is not followed" at his shipyard. A third person said that his shipyard "had an accuracy control group, but ...". The fourth person commented that his "shipfitter department did something with it", and might do so again in the future.

NSRP 0147

TITLE: Pipe-Piece Family Manufacturing.

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

DATE: March 1982

COST: (Not available)

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 outproduces 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.)

BENEFIT ANALYSIS: Four people interviewed were familiar with this report. One called it "great", adding that "it coincided with product orientation" efforts at his shipyard. Another person said that his pipe shop was currently undergoing a restructuring program, "using this information in the process". In all, three instances of substantial application of this material were cited during the interviews.

NSRP 0163

TITLE: Line Heating.

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

DATE: November 1982

COST: (Not available)

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.)

BENEFIT ANALYSIS: Four of those interviewed were familiar with this report. Three instances of substantial application were cited. One person commented that "only a few shipyards have used line heating". He added that "the key is to use a young person who does not know that it cannot be done". He pointed to two shipyards where line heating "is done really well".

NSRP 0164

TITLE: Product Work Breakdown Structure - Revised.

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

DATE: Revised - December 1982

COST: (Not available)

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.)

BENEFIT ANALYSIS: Four people interviewed were familiar with this report. Three instances of substantial application of this material were cited during the interviews. One person commented that his shipyard had been involved in the performance of this project, adding that they were one of the first shipyards to do module construction.

NSRP 0169

TITLE: Integrated Hull Construction, Outfitting, and Painting.

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

DATE: May 1983

COST: (Not available)

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.)

BENEFIT ANALYSIS: Three people interviewed were familiar with this report. Each cited substantial application of this material in their own shipyard. One person commented that this report "did get out into the shipyard workforce, and so was well applied"- A second person said that his shipyard was "looking for opportunities to do it all the time". He added that his shipyard had "tried to adapt this new construction technology into the repair area", and that this effort was currently going forward for a specific repair project coming up in the immediate future.

NSRP 0178

TITLE: Tank Sealing with Coating Materials.

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

DATE: September 1983

COST: \$89,636.

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.) (Project identified as 2-80-3.)

BENEFIT ANALYSIS: None of those interviewed were familiar with this report.

NSRP 0179

TITLE: Design for Zone Outfitting.

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

DATE: September 1983

COST: (Not available)

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.)

BENEFIT ANALYSIS: Four of the five people interviewed were familiar with this report. Three separate instances of substantial shipyard application were cited during the discussions.

NSRP 0193

TITLE: Design Modeling.

AUTHOR: Hitachi Zosen Corporation. for Todd Pacific Shipyards.

DATE: July 1984

COST: \$83,912.

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.) (project identified as 2-82-4.)

BENEFIT ANALYSES: Only one person interviewed was familiar with this report, but he called it “great”. adding that the material had been applied substantially in his shipyard and was found to be quite useful.

NSRP 0196

TITLE: Pre-Contract Negotiation of Technical Matters.

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

DATE: December 1984

COST: \$78,000.

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.) (Project identified as 2-82-2.)

BENEFIT ANALYSES: Two people interviewed were familiar with this report. One said that this material was “necessary for the far eastern shipyards”, adding that “we do not need to implement what they do”. The second person said that his shipyard “might have used it, but I doubt it”.

NSRP 0210

TITLE: Product Oriented Material Management.

AUTHOR: IHI International, for Todd Pacific Shipyards Corporation.

DATE: June 1985

COST: \$95,000.

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.) (Project identified as 2-82- 1.)

BENEFIT ANALYSIS: Two people interviewed were familiar with this report. One called it “good”, but did not cite any specific application of the material. The second person said that his shipyard may have used this material somewhat, along with other information from IHI.

NSRP 0213

TITLE: Shipyard Organization and Management Development.

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

DATE: October 1985

COST: \$41,000.

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.) (Project identified as 2-82-3.)

BENEFIT ANALYSIS: Four of the five people interviewed were familiar with this report. One said that the project “did not take it far enough” to be useful. Another called it “good”, adding that the material had been applied on a limited scale in his shipyard, and might be again in the future. A third person said that his senior management “took a big interest in this one”. He stated that he was the first shop superintendent at his shipyard to have an engineering background, adding that “this is what the report says to do”.

NSRP 0214

TITLE: Process Analysis via Accuracy Control, Revised.

AUTHOR: IHI International Division, for Todd Pacific Shipyards.

DATE: August 1985

COST: (Not available)

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.)

BENEFIT ANALYSIS: Two people interviewed were familiar with this report. Both cited limited application of this material at their shipyards, with the possibility of further application in the future.

NSRP 0238

TITLE: Flexible Production Scheduling System.

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

DATE: April 1986

COST: (Not available)

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.)

BENEFIT ANALYSIS: Four of the five people interviewed were familiar with this report. One of them cited substantial application of this material in his shipyard, where it was found to be useful. Two others cited limited application of this material, with the possibility of further application in the future.

NSRP 0239

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

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

DATE: May 1986

COST: \$84,000.

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 inhouse 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.) (Project identified as 2-84- 1,)

BENEFIT ANALYSIS: Two of those interviewed were familiar with this report, but no application of the material was cited.

NSRP 0240

TITLE: Product Oriented Safety and Health Management.

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

DATE: May 1986

COST: \$78,000.

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.) (Project identified as 2-84-3.)

BENEFIT ANALYSIS: **Two** of those interviewed were familiar with this report. One of them indicated that this material had been applied once in his shipyard, but that no further application of it was anticipated.

NSRP 0249

TITLE: Analytical Quality Circles.

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

DATE: September 1986

COST: \$78,000.

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.) (Project identified as 2-84-2.)

BENEFIT ANALYSIS: Three of those interviewed were familiar with this report. Two of them indicated that this material had been applied on a limited scale in their shipyards. and might be applied again in the future.

NSRP 0260

TITLE: Flexible Production Indices.

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

DATE: April 1987

COST: (Not available)

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.)

BENEFIT ANALYSIS: Two of those interviewed were familiar with this report. One of them commented that this material had been applied once in his shipyard. but that no further application of it was anticipated.

CONCLUSIONS FROM THE FINDINGS

Two principal conclusions have been drawn from this survey, as follows:

1. Panel SP-2 research findings have not been applied effectively in U. S. shipyards.

Analysis of the responses offered by those interviewed, and informal discussions with several other people generally aware of SP-2 matters and currently close to the NSRP and the activities of other active SPC Panels, suggest that the projects sponsored by SPC Panel SP-2 were directed at areas where improvements in U. S. shipyards are still needed. In analyzing comments on why so few of the reported findings have been applied in U. S. shipyards, it appears that the manner in which the material has been presented may contribute to the low implementation rate. Many of the SP-2 project reports contain a direct reflection of practices that were then being carried out in Japanese shipyards, where there exists major differences in U. S. shipyards in worker attitudes, organizational setup, financial support, vendor relationships, and a variety of other cultural and philosophical considerations. When attempts were made to apply the information in the context of U. S. conditions, it “did not fit”, as many comments revealed. A few U. S. shipyards were moderately successful in applying at least some of the information. They appear to be the ones where the local senior management was in tune with the Japanese ideas and procedures and provided the driving force to utilize them. Other shipyards simply appear to have become frustrated in their attempts to understand and apply the material to their own operations.

Since there is a large amount of potentially helpful information contained in the reports sponsored by Panel SP-2, as even a cursory review of the information presented on the preceding pages of this report will reveal, consideration should be given to the study, understanding, adjustment, repackaging, and representation of this material in a form suitable for easy reception by our shipyard community. Selected topics should receive priority attention, as determined by the prospective users of this information. A series of workshops conducted at several locations around the Country could serve as the transmission vehicle.

2. Information on the meetings and activities of SPC Panel SP-2 is no longer available.

Attempts to assemble information on the meetings and associated activities of Panel SP-2 were only marginally successful. Many contacts were made with people who attended one or more of the Panel meetings, but rarely were copies of the minutes or a listing of attendees found. As time goes on, even less information is likely to survive. There appears to be no single location where meeting minutes and reports on related activities of any SPC Panel can be found. For active Panels, the problem of obtaining such material is greatly lessened, because recent attendees still have the documents handy, although it is still a challenge to obtain older material. For inactive Panels, once this information disappears it cannot be reconstructed.

Consideration should be given to a deliberate arrangement whereby a copy of each and every set of SPC Panel meeting minutes, roster of attendees, and selected support information (enclosures, appendices, attachments, etc.) is placed in a permanent file at a published location. It

s common for major changes in operations, facilities, vendor relationships, and other aspects of shipyard life to consume many years of effort before they become reality. The valuable history of these issues, as contained in the meeting minutes and associated documents, often can greatly assist the process. Although the usage traffic for such a file would undoubtedly be quite low, the guaranteed availability of this information would surely be worth the modest expense of such an arrangement.

RECOMMENDATIONS FROM THE CONCLUSIONS

The following recommendations have been drawn from the conclusions:

1. Efforts should be directed at better application of the research material produced by SPC Panel SP-2. Each of the active SPC Panels should select those SP-2 reports most directly in line with their present interests, and endeavor to re-focus attention on the application of this information to the future benefit of the shipyard community. In particular, Panel SP-4 on Design/Production Integration, and Panel SP-8 on Industrial Engineering, each in their respective areas, should actively pursue the review, adjustment, repackaging, and representation of the research material that was produced by Panel SP-2. A joint Ad Hoc Committee from these two Panels could serve as referee for this undertaking.

2. Arrangements should be made to have one copy of every set of SPC Panel meeting minutes, roster of attendees, and selected support information placed on permanent file at a published location that will be conveniently available to the shipyard community. This location could be SNAME, the office of the respective NSRP Program Manager, the Chairperson of each Panel, NSWC - Carterock Division, the NSRP Library at the University of Michigan, or some other suitable place. This arrangement should be made promptly, as much of the information currently in existence will soon disappear.

APPENDIX A

Project Benefit Analysis Worksheet

SPC Panel SP-2

SP-2 PROJECTS LISTING

NSRP	KEY	REMARKS
0031	Frame Spacing, Alternate Shapes for Longitudinal, and Wider Plates for Productivity 1973	
0036	Cost Effectiveness Study of Weather Protection for Shipbuilding Operations (2 Vols) 1974	
0037	Shipbuilding Alignment with Lasers 1974	
0038	Use of Scale Models as a Management Tool 1974	
0043	NDT: Low Cost Alternatives to Film Radiography 1974	
0058	Photogrammetry in Shipbuilding 1976	
0060	Fiberglass Reinforced Piping for Shipboard Systems 1976	
0069	Rectangular Vent Duct Standards 1977	

NSRP	SP-2 KEY	REMARKS
0071 Plastics in Shipbuilding 1977		
0075 Phase I: Photogrammetric Dimensioning of Distributive Systems Models 1978		
0079 Stem Frame and Hawsepipe Construction Technology 1978		
0084 Photogrammetry in Shipbuilding: Measuring a Complex Casting 1979		
0090 Special Structural Shapes: Factors Affecting Usage in U.S. Shipbuilding 1979		
0096 Outfit Planning (IHI) 1979		
0098 Improved Tank Testing Methods 1980		
0117 Product Work Breakdown Structure (IHI) 1980		

SP-2

NSRP

KEY

REMARKS

- 0124 Photogrammetric Dimensioning of
Ships' Engine-Room Models
1981
- 0143 Process Analysis via Accuracy
Control (IHI)
1982
- 0147 Pipe-Piece Family Manufacturing
(IHI)
1982
- 0163 Line Heating (IHI)
1982
- 0164 Product Work Breakdown Structure -
Revised (IHI)
1982
- 0169 Integrated Hull Construction,
Outfitting, and Painting (IHI)
1983
- 0178 Tank Sealing with Coating Materials
1983
- 0179 Design for Zone Outfitting (IHI)
1983

N S R P	SP-2	KEY	R E M A R K S
0193 Design Modeling 1984			
0196 Pre-Contract Negotiation of Technical Matters (IHI) 1984			
0210 Product Oriented Material Management (IHI) 1985			
0213 Shipyard Organization and Management Development (IHI) 1985			
0214 Process Analysis via Accuracy Control, Revised (IHI) 1985			
0238 Flexible Production Scheduling System (IHI) 1986			
0239 U.S. Shipbuilding Accuracy - Phase I 1986			
0240 Product Oriented Safety and Health Management (IHI) 1986			

NSRP	SP-2	KEY	REMARKS
0249 Analytical Quality Circles 1986			
0260 Flexible Production Indices 1987			

KEY RATING DESCRIPTION

- 0 No knowledge/ no interest
 - 1 Interested; will look at information
 - 2 Have information; considering it
 - 3 Have studied information; no application intended
 - 4 Information looks useful; application planned
 - 5 Applied once; no further application seen
 - 6 Have applied on limited scale; may apply again
 - 7 Have applied substantially; information useful
 - 8 Constant application on-going; information valuable
 - 9 Need more information; wider application
-

RATING SYSTEM FOR NSRP PROJECTS EVALUATION

.Additional copies of this report can be obtained from the National Shipbuilding Research Program Coordinator of the Bibliography of Publications and Microfiche Index. You can call or write to the address or phone number listed below.

NSRP Coordinator
The University of Michigan
Transportation Research Institute
Marine Systems Division
2901 Baxter Rd.
Ann Arbor, MI 48109-2150
Phone: (313) 763-2465
Fax (313) 936-1081