SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

June 1977
NSRP 0003

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Proceedings of the REAPS Technical Symposium

Paper No. 6: Hierarchical Application of Computers for an Automated Pipe Shop

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

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUN 1977	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuilding Research Program: Proceedings of the REAPS Technical Symposium Paper No. 6: Hierarchical Application of Computers for an Automated Pipe Shop	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Building 192, Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

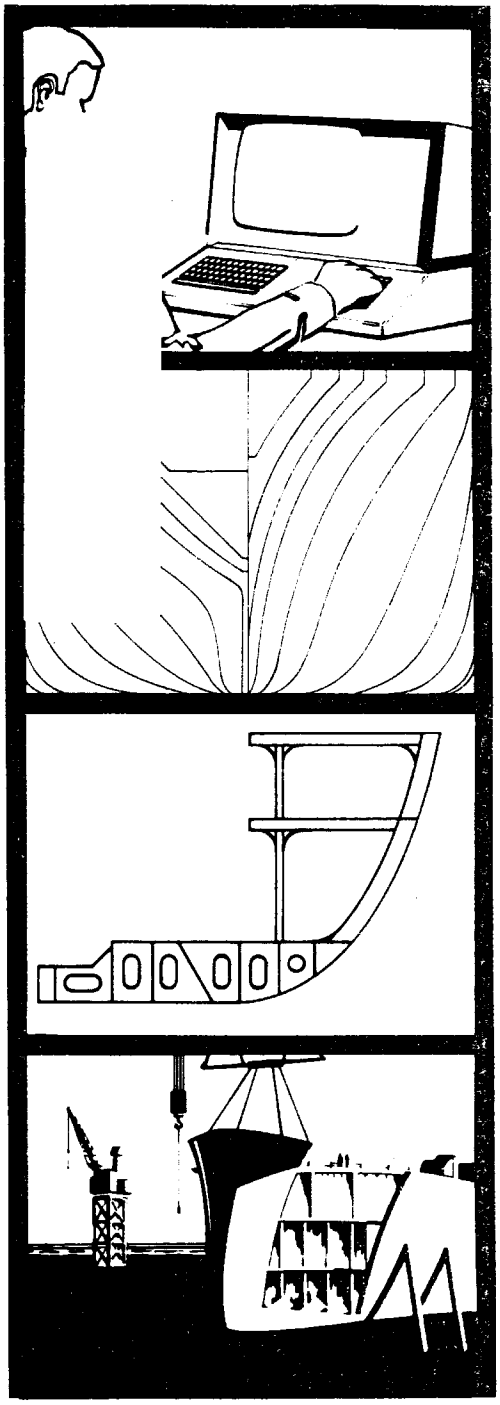
14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**12**	

DISCLAIMER

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



R ESEARCH
AND
E NGINEERING
FOR
A UTOMATION
AND
P RODUCTIVITY
IN
S HIPBUILDING

Proceedings of the
REAPS Technical Symposium
June 21-22, 1977
New Orleans, Louisiana

HIERARCHICAL APPLICATION OF COMPUTERS FOR AN AUTOMATED PIPE SHOP

Hirohiko Aya
Mitsui Engineering and Shipbuilding Co., Ltd.
Tokyo, Japan

As General Manager of the Systems Project Department, Mr. Aya is responsible for planning and coordinating corporate systems development projects. His past experience includes structural engineering in ship design and the development of MES'S computer network.

Mr. Aya is a past chairman of Japan's GUIDE/SHARE Group (1975-6).

1. Introduction

As computer technology advances, the cost of automation is reduced. Recently, the technology of integrated circuits has developed rapidly, and the appearance of the micro-processor has become a center of attraction. It is expected that this will bring new possibilities for CAD/CAM. At the same time, the business environment of the shipbuilding industry has been changing rapidly. We must cope with the versality of production. In this new environment, efforts at further systems development are being made steadily. I will discuss the present status and new possibilities for automation.

Computer utilization of the Mitsui Engineering and Shipbuilding Company (MES) has been characterized by forming a link in the chain of management improvement programs.

Computerization of the piping job is one of the most important problems to be overcome in modernizing a shipyard. To sol ve this problem, in 1972 MES developed and implemented the semi-automated pipe fabricating shop system ("MAPS") at the Chiba Shipyard.

2. Objectives and Implementation of the "MAPS" system

2.1. Present Status

"MAPS" was implemented at Chiba Shipyard in 1972. Its basic objective was to increase productivity and reduce costs .

"MAPS" consists of two subsystems. One furnishes the full numerical information required for fabrication of various kinds of pipes in the pipe shops . The other is an automated pipe fabricating system operated by numerical information cards, which does not require any experience or judgment by pipe workers.

(a) Numerical Information System (Software of "MAPS" System)

In the numerical information system, values of coordinates are put

into the computer from pipe arrangement drawings by reading start point, bending points and end points, and also branch points if necessary. Piping specifications, such as materials, working pressure, working temperature, types of fittings, coating, painting, testing, outfitting schedule and limitations of processing machines are also put into the computer in similar procedures. Then, necessary cards for numerical control of the machine and information for production control and material control are punched or printed out.

(b) Automated Pipe Fabricating System (Hardware of "MAPS" System)
Fundamental concepts in developing the new system were:

- Line production with practical automation
- Numerical control
- A constitutional improvement in conversion of worker into operator.

In the "MAPS" system, we succeeded in direct cost reduction during the past five years. It has resulted in a 60 percent reduction in man-hours covering 70 percent of the pipe fabricating jobs.

Through this experience, we have found these secondary but essential effects:

- Increase in accuracy resulted in cost reduction in the fitting stage after fabrication
- Reduction in faulty fabrication made the production line stable.

As a result, more part programmers are required.

2.2. Graphic Piping System

As expected computer graphics is one of the most powerful means to promote rationalization of NC data processing. Nevertheless, because of high expense in hardware and difficulty in developing application software, practical use was delayed. In order to solve these problems, we have developed a new computer graphic system, the "GRAPH MINI" system. Some of the features of this system are:

- Adoption of digital techniques
- New hardware architecture with a dedicated graphic processor
- Adoption of a virtual memory system to a minicomputer.

Based on the fundamental techniques mentioned above, practicability and cost performance were thoroughly pursued. We have connected a general purpose, large computer as a host computer through a data communication cable to a dedicated minicomputer, connected to the graphic display device as an intelligent terminal. In this system, conversational pattern process function was shifted to the minicomputer. Therefore, the host computer can devote itself to executing problem processes and problem oriented data base manipulation. The basic software of "GRAPH MINI" was implemented by MES under commission from the Information-technology Promotion Agency (1.P.A.).

The graphic NC system for steel plate flame cutting, the so called "GNC" system, is the first practical application of "GRAPH MINI". It was implemented at Chiba Shipyard in 1975. In the "GNC" system, we realized high working efficiency with low cost by exploiting a mini-based turnkey system. The GNC system has saved 60 to 70 percent of man-power as compared with a conventional system.

We started the development of a Graphic Piping System, the "GPS" system, in 1975.

In our company, piping jobs are very common not only in the shipbuilding yard but also in the chemical plant shop and in energy plant construetion. The feasibility study to develop the graphic piping system was carried out in advance, and the integration of this CAD project was a success.

At present, the first release of the "GPS" system has been implemented. This release is intended for chemical plant use. The second release will be completed by the end of 1977. At this time, the function of the Numerical Information System of "MAPS" will be added to the GPS system. The new functions are shown in Fig. 1.

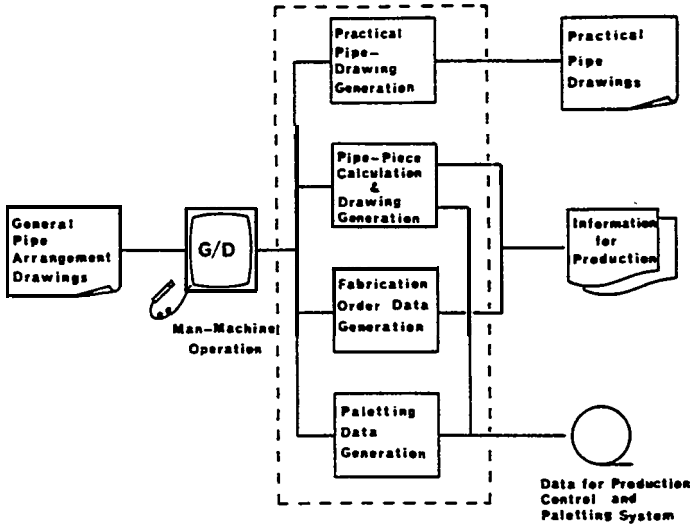


Fig. 1. Function of GPS System

	Development Start (Main Computer)	Technical Target	Company's Effectiveness
1st step	1971-72 1973 (IBM 370-155)	.Centralization .No-conversion	.Down time cost of computer (20%)
2nd step	1973-75 1976 (IBM 370-168)	.Multi operation .Graphics .Factory data gathering .Minicomputer	- Labor saving .Increasing engineering power
3rd step	1976-78 1979 (IBM 3033)	.Computer network .Corporate data base .Micro processor	" Total cost reduction .Management efficiency improvement

Fig. 2. MACSNET Long Range Plan

The "GNC" and "GPS" systems will coexist in one minicomputer. The "GPS" system is expected to reduce by 50 percent the number of part programmers and draftsmen in the production design stage.

3.′ Hierarchical Application of Computers

3.1. MES'S "MACSNET" Plan

In 1970, we faced increased expense for computer usage and input data preparation. To solve this problem, we projected a long range plan for hierarchical computer network development and called this plan "MACSNET".

The basic objective of "MACSNET" was to create the environment to select the optimum computer hardware for every type of advanced application. In order to obtain the maximum effect with minimum risk, "MACSNET" was divided into three steps as shown in Fig. 2.

The second step of this plan has been completed, and the third step is being developed currently.

3.2. Distributed Computing for Automated Pipe Shop

The basic requirements of control equipment for a more advanced automated pipe shop are:

- Low cost
- Easy use
- High reliability
- Easy maintenance
- Flexibility
- Communicability

The state of the art of micro processor technology has already satisfied these requirements. It gives evidence of greater potentiality when the integration of individual control of automated equipment and semi-automated equipment is possible in the commercial base. Fig. 3 shows an example of the future plan.

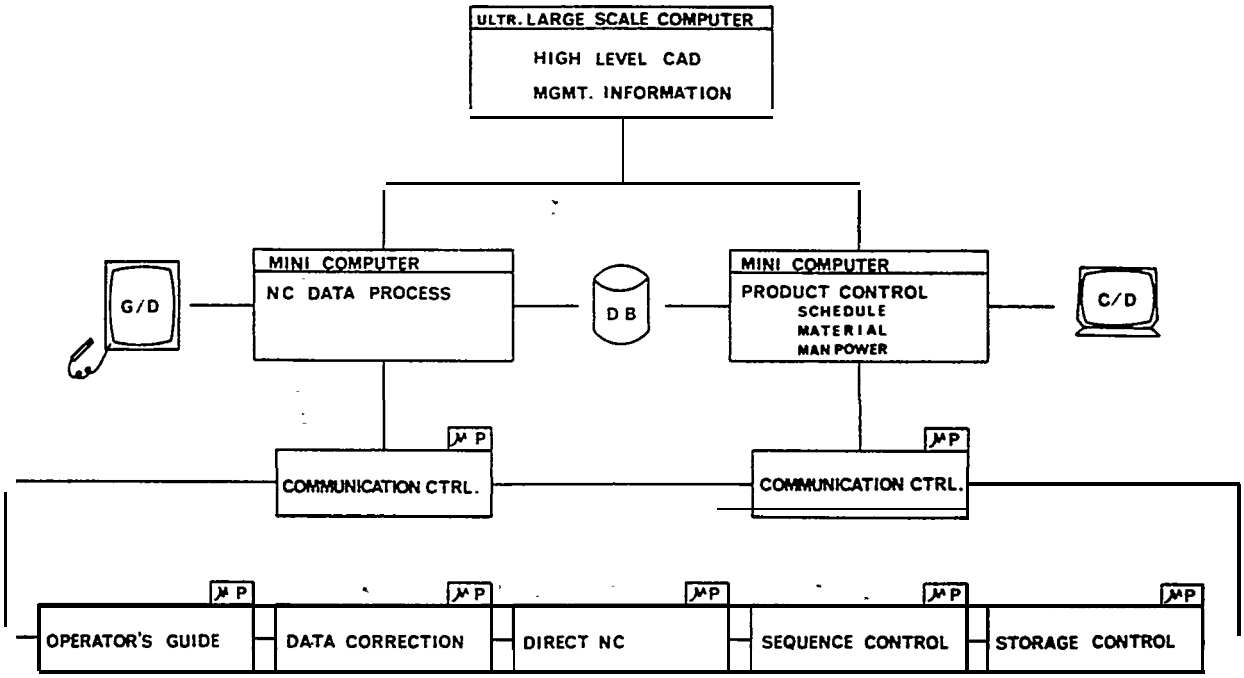


Fig. 3. Example of the Future P1an of Automated Pipe Shop

Great changes in the quality of utilized computer technology will be necessary so as to realize the integrated manufacturing system. They are:

(a) Computer architecture design
- Function sharing
- Reliability and flexibility
- Cost reduction using minicomputers and micro processors

(b) New peripherals
- Interactive graphics display
- Factory data gathering device

(c) Communication
- In house: data high way
- Computer network

(d) Software
- Programming support system for distributed computing
- Trade-off software and hardware
- Standardization of aplication

4. Conclusion

System development is now proceeding in line with the improvement program of management. Increasing computerization development of the graphic piping system in the shipyard is being promoted to meet the new business environment in chemical and energy plant construction. The technical challenges for the future automated pipe shop are:
- More flexible control using micro processor technology
- More adaptable production using interactive computer graphics.

The state of the art of computer technology plays an important role in promoting further computerization of the pipe shop. A long term approach is necessary. Although the development now proceeding is still incomplete, I have described its outline. I appreciate your frank criticism. My thanks to the many colleagues with whom I have discussed this program.