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### **Paper No. 17: NASSCO Organization for the SPADES System**

U.S. DEPARTMENT OF THE NAVY  
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NAVAL SURFACE WARFARE CENTER

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NASSCO ORGANIZATION FOR  
THE SPADES SYSTEM

George A. Uberti  
and  
Jack Wasserboehr

National Steel and Shipbuilding Company  
San Diego, California

Mr. Uberti is Chief of Development Engineering, responsible for managing the computer support group. Formerly, he was Chief Marine Engineer at NASSCO. Prior to joining NASSCO, Mr. Uberti had over ten years experience in marine and nuclear engineering, research and development. He received his B.S. degree in Marine Engineering from the U.S. Merchant Marine Academy and his M.S. from MIT.

Mr. Wasserboehr is a Senior Programmer Analyst handling scientific/engineering applications at NASSCO, where he has worked for over ten years.

Two years ago, Nassco contracted for the unrestricted *use of* the SPADES system for ships under construction in the shipyard. As we set out to use SPADES, an internal company organization for its use emerged, resulting in an effective working relationship among the various departments of the company. These departments are Engineering, Production, and Computer Services.

SPADES was installed at Nassco as we were constructing our first two lines of tankers: the "handy" size Coronado Class and the Panamax size San Clemente Class. Since these ships were caught in the transition, N/C tapes were produced without full benefit of the SPADES modules. Data bases were established by digitizing on the Coronado and by loading on the San Clemente. Construction is underway for our third class of tankers, the 190,000 DWT San Diego Class, and we *are* making fuller use of SPADES on these ships.

Through SPADES, the San Diego lines were faired, the data base was established, and naval architecture calculations were made. Steel parts are being generated, nested, and burned.

Plates are being developed and rolled. Frame bending information is produced and used, although at this time we do not have a frame bender. The pin jig module is in the final stages of development and de-bugging, and we expect to produce pin jig dimensions in time to support the construction schedule.

The Nassco organization for SPADES evolved along regular functional lines within the departments affected. Loftsmen, who used to make full size wooden templates on the mold loft floor, are now the N/C programmers who cause the N/C tapes to be made. Engineers, who issue preliminary unfaired ships lines, are now able to complete the job, since the fairing operation does not require a drafting board the size of the mold loft floor. Computer service personnel, who run the company computer, have added SPADES to the services they provide. And finally, the responsibility for control of the SPADES system is assigned to the Computer Support Group in the Engineering Department, which has charge of all scientific and engineering programs used by the Engineering Department.

A word of explanation regarding the functions of the two "computer groups" as mentioned above is in order. *The Computer Semite* Department is a *major service* department of the company. As such, it owns the company computer and operates the **company's** administrative, accounting, and management systems. It provides computer programming services for

all departments in all areas except for scientific and *engi-*neering calculations. Scientific and engineering programming and related systems analysis are performed by a small Computer Support Group within the Engineering Department. Most of this work is in FORTRAN, as are the SPADES programs.

For most effective use of SPADES at Nassco, we have defined four company functions as illustrated by the boxes in Figure 1. Lines of communication among them have been established, as well as with the consultant, Cali. and Associates. The total operation is user-oriented, providing support and services as needed.

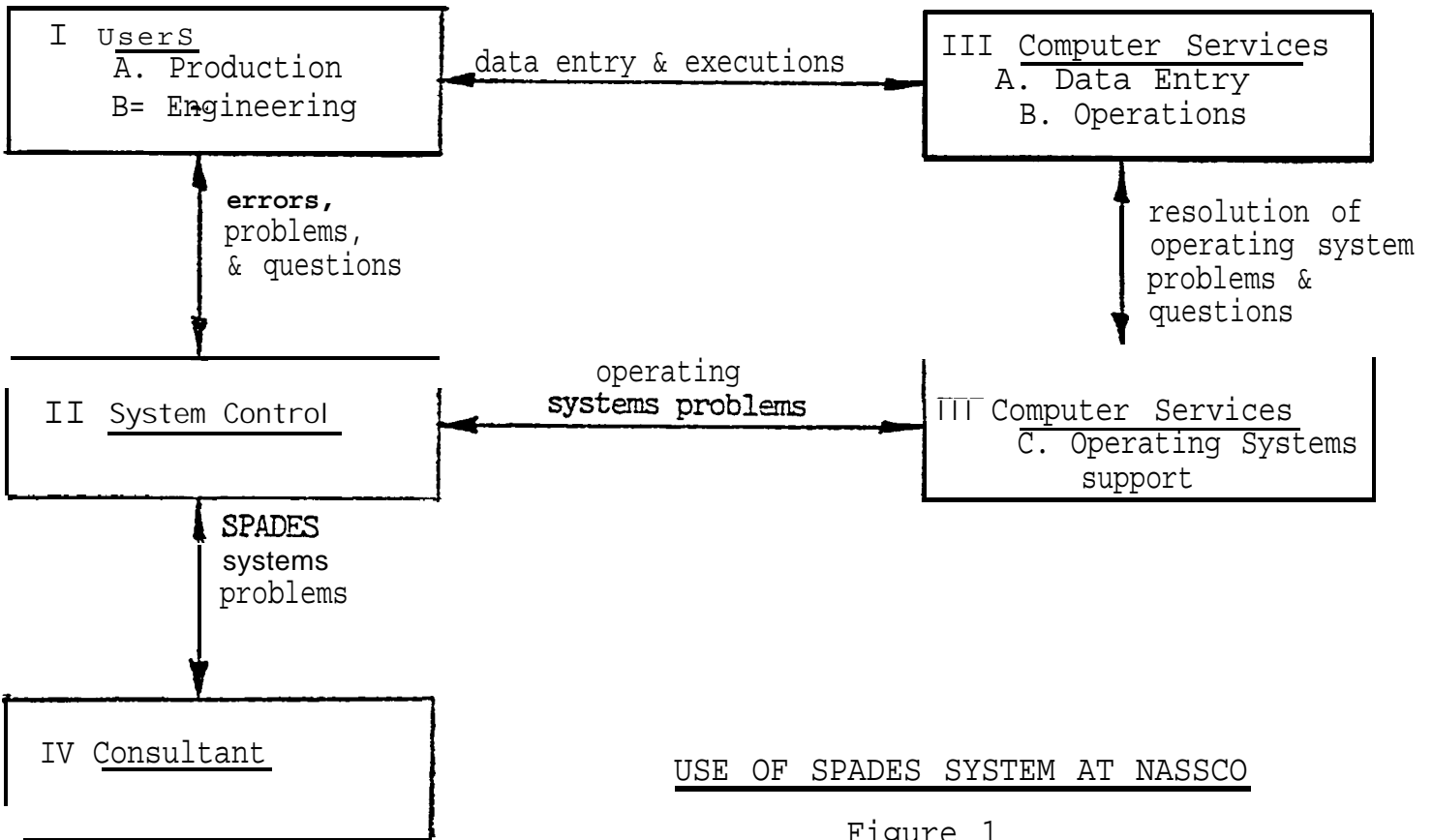
The user *functions* are divided between engineering and production. There are eight SPADES modules, three of which are primarily used by the Engineering Department, three primarily by the Mold Loft, and two used jointly or by either as needed.

The three engineering modules are: the Fairing and Drawing module, which fairs the hull, generates and loads frame definitions, and draws body plans; the Hullload module, which defines and loads the **remaining** ship geometry; and the Hullcal module, which is a package of naval architecture routines.

FUNCTIONS

- I Users
  - A. Production - Mold Loft
  - B. Engineering - Hull Division
- II System Control
  - A. Engineering - Computer Support Group
- III Computer Services
  - A. Data Entry
  - B. Operations
  - C. Operating Systems Support
- IV Consultant
  - A. Cali and Associates

LINES OF COMMUNICATION



USE OF SPADES SYSTEM AT NASSCO

Figure 1

The three modules used by the Mold Loft are: Part Generation module, which produces information and a tape for drawing the part; Nesting module, which produces a tape of nested parts for the burning machine; and Plate Development module, which produces tapes for burning shell plates.

The Manufacturing Aids module is used jointly by Production and Engineering. This consists of four programs.

The first of these prints the offset booklet; a second calculates pin heights for the pin jig; a third prints girth length tables; and the fourth calculates and draws frame bending information.

Another joint-use module is the Utility module. This is a group of five programs used for direct access to the data base. This group is needed to accomplish such tasks as initialization for a new ship, reports of information stored on data base, new copies of output tapes, copying an input deck to a new name, and modifying or adding an input deck for later execution.

It should be noted that the Engineering Department fairs the lines, loads the data base, and keeps it up to date. Access to the data base for making changes is limited to the Engineering Department.

The SPADES programs are currently being executed on NASSCO'S own in-house computer. This is an IBM/370/145 DOS virtual storage computer. The peripheral equipment directly used in conjunction with this computer are a card reader, a line printer, a card punch five tape drives, and twelve disk drives. The SPADES output from this computer consists of printed information and punched cards. The punched output is then converted by the Mold Loft equipment into paper tapes which can be used on the drafting machine and, when applicable, on the burning machines.

Figure 2 shows an approximate physical layout of the terminal, mini-computer, and drafting machine equipment installed in the mold loft. It shows also the processing flow from the N/C programmers through the equipment to the drafting and burning machines. The central unit in the system is the mini-computer, which is programmed to control the processing and flow of information through the system. The system permits the simultaneous use of the drafting machine and terminal equipment (card reader, line printer, paper tape punch).

Nassco's Computer Service Department is currently investigating the hardware and software requirements to connect the Mold Loft equipment to the 370 system through a data phone. The software required seems to be the major problem at this time.

BEGIN

INPUT FORMS ARE CODED BY NC PROGRAMMERS IN MOLD LOFT

**NOTE :**  
HAND TRANSMITTAL IS INDICATED BY DASH LINES.

PAPER TAPE IS PUNCHED

PAPER TAPE FED TO PAPER TAPE READER/DIRECTOR

SHORT JOBS ARE PUNCHED IN MOLD LOFT  
KEY PUNCH

DATA PHONE

CARD READER

LINE PRINTER

PAPER TAPE PUNCH  
MINI COMPUTER CORE STORAGE

LARGE JOBS ARE SENT TO COMPUTER SERVICES FOR KEYPUNCHING

MINI-COMPUTER  
CONTROLS PROCESSING & FLOW OF INFORMATION THROUGH SYSTEM

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JOBS ARE THEN EXECUTED ON NASSCO'S IBM 370 COMPUTER. SHIP INFORMATION IS LOADED TO THE DATA BASE. PUNCHED OUTPUT CARDS AND PRINTED INFORMATION ARE PRODUCED.

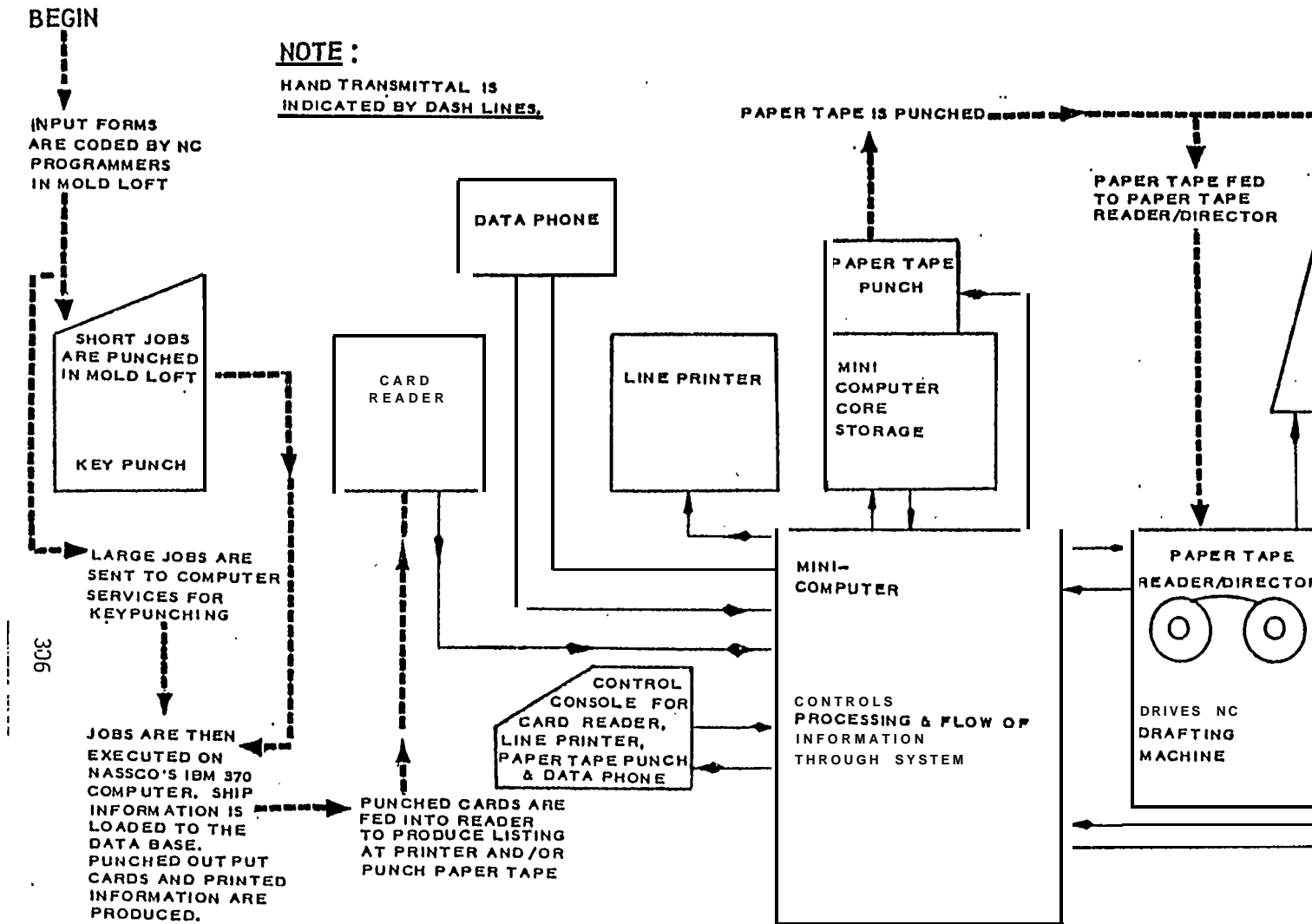
PUNCHED CARDS ARE FED INTO READER TO PRODUCE LISTING AT PRINTER AND/OR PUNCH PAPER TAPE

CONTROL CONSOLE FOR CARD READER, LINE PRINTER, PAPER TAPE PUNCH & DATA PHONE

PAPER TAPE READER/DIRECTOR  
DRIVES NC DRAFTING MACHINE

INFORMATION FLOW THROUGH SPADES HARDWARE

Figure 2



The SPADES software consists of 840 FORTRAN programs and sub-programs. These routines have one of three classifications: data base routines, general purpose routines, and specific module routines. The last are routines that are used in only one of the eight user modules. The data base and general purpose routines are just what their names imply and, are available for use by any of the eight modules.

The SPADES System is constantly in a state of development as Cali and Associates modify it to correct or *improve* the system. When they come out with a new version or modified routines, Nassco gets a source copy of all affected routines. We received our first version (for the in-house computer) of the SPADES system, consisting of approximately 720 FORTRAN programs and sub-routines, in May 1975. Our current production version was issued to us in December 1975.

In a typical revision of the SPADES system, Nassco receives approximately 50 to 150 new or modified sub-routines, which are then integrated into the current SPADES System to produce the new version. This task is performed by the Computer Support Group at Nassco. Occasionally, between major revisions, Nassco will receive a small number of *new or revised routines* to *correct* a problem or add a new capability. These sub-routines *are also* added, tested, and debugged by the Computer Support Group.

One of the responsibilities of the Computer Support Group is the maintenance of the SPADES System. This involves providing the user with the most current versions of the SPADES modules, providing the user with the easiest method to use the modules, and keeping the impact of SPADES on our relatively small computer system at a minimum by using it in the most efficient manner possible.

In order to accomplish the above tasks three computer systems libraries are used, and one private SPADES library is used. All source routines are stored on a large card image library. The routines are compiled from this library and the object module is cataloged to the SPADES private relocatable library. Each SPADES module is link-edited and the executable phase is cataloged to the system core image library. We keep three executable phases for each module on this core image library. The first is the current production version, the second is the previous production version, and the third is a test version. All job control language (JCL) required to execute each module is stored on the system procedure (Procs) library. Thus, a user needs only to call for the appropriate Proc to execute the desired SPADES module.

All testing of new *or* modified versions of SPADES modules, and all the maintenance of SPADES information on the above-mentioned libraries is done by the Computer Support Group.

A logical approach has been developed for the solution of user problems, which may originate in engineering or in the mold loft. The Computer Support Group makes the following interrogations in the sequence listed. The process stops with the first "yes" answer, and appropriate corrective action is taken. All problems to date have been solved by this procedure. only about 20% have gone beyond step 6.

1. Is problem system-related (operations, JCL, etc.)?  
If yes, correct the system problem and resubmit the job in question.
2. Is problem mis-use of a command?  
If yes, inform user of *correct use* of the command.
3. Is problem due to incorrect data base information?  
If yes, notify hull-load group to make correction.
4. Is user under mis-conception of what is actually on Data Base? If yes, get ship file report to show user what is actually on Data Base.
5. If all "no's" Up to this point, then rerun jobs With trace print on to determine more precisely where problem is occurring and to find values of variables at the the of problem occurrence.

6. Does trace print reveal that 1, 2, 3, or 4 is the problem? If yes, then follow ABOVE procedures.
7. Does trace print reveal a bug in the SPADES program? *If yes*, then pinpoint the bug, determine a solution, and notify appropriate person at Cali & Associates to get approval for solution.
8. If all "no's" up to this point, then Engineering Computer Support Group is unable to completely resolve problem. Call appropriate person at Cali & Associates.
9. Were Cali & Associates able to solve problem over phone? If yes, implement the change.
10. If all "no's" up to this point, then mail all applicable information and trace print to Cali & Associates for *more detailed investigation*.

We have found that the Nassco organization and procedures described above work effectively for the SPADES system as currently configured. New SPADES developments are in the works, and we expect that they will continue to be handled as at present. We can foresee new shipbuilding, applications as SPADES begins to do more things, perhaps in piping, ventilation, or electrical areas. *When this comes to pass*, new user groups in the departments affected would be given access to SPADES, retaining the functional organization that appears to work well.

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