

LOCAL COMMAND WORK MEASUREMENT AS A BASIC  
STEP IN MANAGEMENT IMPROVEMENT

Prepared for

Personnel Analysis Division of  
Bureau of Naval Personnel

and

Office of Naval Research

by

The Ohio State University  
Research Foundation  
Contract Nonr 408 (05)

June 1951

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FINAL REPORT

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## SUMMARY

### SUBJECT

Final report on Navy Contract Nonr 495 (05), entitled "Experimental Development and Evaluation of Certain Management and Personnel Administration Techniques in the Naval Situation."

### PURPOSE

To report on research conducted on the subject of local command work measurement as a basic step in improving management at naval shore stations.

### NATURE AND OBJECTIVES OF THE PROJECT

1. Long-range objective is better manpower utilization and more effective over-all management of the shore establishment. Field surveys indicated personnel utilization is basic concern. The problems of the project were:
  - (a) Analyzing what are the conditions necessary to bring about improved personnel utilization at the local command, and
  - (b) What method or approach will bring about these conditions.
2. After evaluating the entire project, two assumptions were arrived at regarding factors that are necessary to bring about better personnel utilization:
  - (a) That naval personnel need to be properly motivated if better manpower utilization and other management improvements are to be accomplished, and that work measurement has the potentialities for providing this motivation. (See p. 2 of Section I, this report.)
  - (b) That in order for a work measurement system (or any other management techniques or program) to be successful, three basic conditions must prevail:
    - (1) The program must be introduced at lowest administrative echelon, while having backing of top echelon;
    - (2) Understanding and acceptance must be accomplished; and
    - (3) Some definite follow-up action must be taken. (See pp. 2-4, Section I, this report.)

3. In view of the above assumptions, one of the main purposes of the project became the development and evaluation of (1) a method of approach, and (2) a continuous program of work measurement that would result in better manpower utilization.

- (a) The approach and program developed by the project differ from other systems presently in use in the Navy in several basic ways. (See pp. 4-5, Section I, this report.)
- (b) The basic techniques of the project's approach to introducing work measurement to local commands are (1) use of small group meetings, and (2) staff assistance in "helping local personnel help themselves," along with use of the manual developed for the program.

This approach gives the local officer a degree of participation in setting up the system, which in itself results in high understanding and acceptance. Follow-up action is a feature of the program, which makes it more than "another report" and gives reason for establishing it on a continuous basis. (See pp. 4-5, Section I, this report.)

#### RESULTS OF FIELD SURVEY AND WORK MEASUREMENT PILOT STUDIES

1. Surveys of management problems and difficulties were made in the field. (USNIC's Great Lakes Area Headquarters during Fall, 1952.) (See pp. 6-7, Section II, this report.) Results indicated need for means of acceptability for manpower utilization. Work measurement was the logical answer.
2. As a result of the management surveys, work measurement pilot studies were conducted at two large naval stations. (USNMC's Great Lakes and San Diego, 9 February to 17 May 1953. See pp. 9-12, Section III, this report.)
3. Results of pilot studies indicate:
  - (a) The approach and consistency of use of a work measurement manual, small group meetings, the staff assistance in "helping the people help themselves," is successful in imparting knowledge of work measurement.
  - (b) Understanding is increased by working with the system. All groups were able to establish their own systems. (See pp. 13-14 on results affecting "Understanding," Section III, this report.)
  - (c) Active backing of top echelon is important to acceptance. Acceptance is related to fear of higher authority's misuse of work measurement data. Confidence of local personnel is dependent also on appropriateness of general need of work measurement. (See pp. 14-15 on results affecting "Acceptance," Section III, this report.)

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4. Uses being made of local command work measurement programs:
- (a) As of 1 June 1953 with less than three and a half months of operation of pilot studies, a majority of local officers have decided to continue their programs. Two out of three of the commands at one Training Center and two-thirds of the activities participating in the pilot studies at the other Training Center have decided voluntarily to continue work measurement. Some commands and departments have already decided to extend work measurement to more of their units, after their systems have been further developed. (See page 16, Section III, this report.)
  - (b) Specific examples of uses being made and plans to continue local work measurement are discussed on pages 16 to 19 in Section III, this report. Main uses are for automatic control of activities; analysis of work performed; support of personnel allowance increases and decreases; and an indication of areas needing management improvement.

#### CONCLUSIONS

The conclusions set forth here are an over-all summary of the general conditions which are necessary for the successful accomplishment of a program to improve management of naval shore stations, with emphasis upon local command work measurement as a basic step in such a program:

1. Work measurement can contribute to the motivation for improving manpower utilization.
2. Understanding is essential to success of the program.
3. Acceptance is also essential to the success of a local command work measurement system. Variation in acceptance depends upon any or all of the following: (1) misinformation; (2) fear of misuse of work measurement data; (3) low standards--in the minds of the local personnel; (4) the desire to prove the system; and (5) positive, aggressive leadership in the introduction of the program and follow up action.
4. Work measurement must be studied with operations and management of entire station. In the follow-up aspects of the program, lines of communication will tend to be kept open through flow of reports, and group discussions on results of reports. When projects are planned, consideration must be given to manpower available to do the work, as shown by work measurement data. (See pp. 23-26, Section V, this report for full discussion of above conclusions.)

## RECOMMENDATIONS

### 1. General Recommendations

- (a) That local work measurement programs as outlined in Attachment II, this report, be installed at all naval shore stations.
- (b) That a short orientation program in management be given officers in key administrative billets or being ordered to such billets.
- (c) That large shore stations have a Management Engineering office, staffed by one or more officers with appropriate training and qualifications.

### 2. Recommendations for Further Research and Development

- (a) To refine and standardize procedures and uses, such as (1) system of allocating time to subfunctions, and (2) methods of coordinating program at local command.
- (b) To further develop the local program toward greater usefulness for local commanding officers by coordinating systems of all local activities.
- (c) To carry on research to encourage local personnel to improve management by applying other management techniques to areas pinpointed by work measurement facts.
- (d) To incorporate improvements and refinements as they are developed in the present "Local Command Work Measurement Manual"--or if significant enough, develop a separate manual. (Recommendations are more fully described on pp. 27-33, Section VI, this report.)

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## SECTION I

### NATURE AND OBJECTIVES OF THE PROJECT

This project was initiated on 30 June 1952, under the following title:

"EXPERIMENTAL DEVELOPMENT AND EVALUATION OF CERTAIN  
MANAGEMENT AND PERSONNEL ADMINISTRATION TECHNIQUES  
IN THE NAVAL SITUATION."

The long range purpose was stated "to equip naval personnel in shore activities with proven analytical management personnel techniques, whereby maximum effectiveness may be achieved in the use of manpower, materials, space, and equipment."

Early in the project, it became clear that there are no such proven techniques which are automatically applicable to all management situations without at least adaptation. Further, there is no universal formula or simple set of rules to follow to insure good management. Improved management depends upon: (1) surveying and defining the difficulties, (2) determining solutions, and (3) developing the techniques and methods of successfully introducing and integrating such techniques.

Throughout the project emphasis was placed upon what the local command could do to improve the management of shore stations. The local command became the focus of attention, because it is the local command which is charged with the responsibility for proper utilization of manpower. Also, if any improvements in management are to be made, in the final analysis they must be accomplished at the local command.

Following the above line of reasoning, emphasis throughout the project was placed upon: (1) studying actual conditions in the field relative to the management of naval shore stations; (2) developing materials specifically for the people in the field and continually revising them on the basis of suggestions from naval personnel concerned with the day-to-day operations of shore stations; and (3) encouraging local officers to participate to a high degree in the management surveys and work measurement pilot studies.

As a first step, field surveys on management problems and difficulties were conducted. These surveys indicated that the problems were many and that they were spread over numerous areas of management. Out of the problem surveys came the conclusion, however, that personnel utilization is really the basic area of concern for the Navy. Consequently, attention was focused on personnel utilization with the realization that all other aspects of good management are related to it.

## A. THE PROBLEM OF THE PROJECT

The primary problem of the project was analyzing what are the conditions necessary to bring about improved personnel utilization at the local command, and what method or approach will bring these conditions into being. After evaluating the entire project, the following assumptions are made regarding the factors that are necessary for effective use of personnel:

### Assumption Number One

that naval personnel need to be properly motivated if better manpower utilization and other management improvements are to be accomplished, and that work measurement has the potentialities for providing this motivation.<sup>1</sup>

This general assumption is based on the following more specific assumptions:

- (a) Before improvements will be undertaken wholeheartedly on the local level, there must be some standards or some means to provide a measure of any progress that may be made. Work measurement answers this need.
- (b) Before noticeable improvements can be made in management problems, some means must be found to pinpoint these problems for officers at local commands or otherwise any program of management improvement will be an ineffective hit and miss proposition. Work measurement answers this need.
- (c) If standards are provided and a means of disclosing areas for improvement are present, then it is assumed that the naval officer is capable of making many improvements on a common sense basis.

### Assumption Number Two

that in order for a work measurement system (or any other management techniques or program) to be successful, three basic conditions must prevail:

- (1) the program must be introduced at the lowest administrative echelon, while having effective backing of the top echelon;

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<sup>1</sup> "Work measurement is a management tool which shows you facts about work turned out and the manpower it took to turn out that work." See Attachment II, "Local Command Work Measurement Manual."

- (2) understanding and acceptance must be accomplished; and
- (3) some definite follow-up action must be taken.

The first of these conditions, the importance of introducing work measurement or any other management technique at the local level, must not be neglected. Results of the project indicate it was just such participation by local officers which created a very favorable attitude for understanding and acceptance. When given the opportunity, officers in the field also can be a source of beneficial, practical suggestions that will strengthen any management program.

The second condition deals with understanding and acceptance. Evaluation of the techniques of "helping the local officers help themselves" indicates participation is a key to understanding. If a program is to be really effective, naval personnel must do more than understand it. They must accept it as a part of their own point of view and believe in its worth for themselves. This acceptance by naval personnel depends upon some or all of the following variables:

- (1) Appreciation of how the system will affect their own status, directly or indirectly.
- (2) Understanding of how the system may affect their own expenditure of effort on the job.
- (3) Degree of breadth of vision concerning over-all naval personnel and management problems.
- (4) Degree of fear that information coming from the system may be hastily and improperly used by higher administrative echelons and that decisions may be made on the basis of incomplete information.
- (5) Degree of participation on the part of the people at the division and departmental level in regard to the details of setting up the system.
- (6) Realization that the commanding officer considers the system important and that some follow-up action will be taken.

The third condition necessary to success of a work measurement system is a definite program of follow-up action. The work measurement system must be integrated or tied in with the operations and management of the whole command. The commanding officer and the executive officer must show an interest in work measurement and actually do something with the facts which are reported.

Work measurement data can be an aid to communication of ideas both up and down the chain of command. Periodic reports can be used in a number of ways. They can be used to inform higher authority what work is being performed. The work measurement reports can pin-point management problems.

One of the most important ways work measurement data can be used is in connection with planning the work of a local command. Work measurement can result in a better distribution of the work load and in arriving at a more realistic estimate of what the local command can do and within what time limits.

#### B. APPROACH OR METHOD RESULTING IN EFFECTIVE MANPOWER UTILIZATION

In view of the above assumptions of the conditions necessary for effective manpower utilization, it became one of the main purposes of the project to develop and evaluate a method of approach and a continuous program that would bring these conditions into being. The program developed by the project differs from other work measurement systems presently in use in the Navy in several basic ways:

- (1) Emphasis is placed on the improvement of the management of the local command--it provides a means of self-improvement of utilization of personnel through organizational analysis, allocation of work load, and similar management improvements.
- (2) It provides a means for continuous review and evaluation of operational performance to a higher degree than under a system that is not adapted to reflecting the local operational performance. The local command work measurement data are more representative of the work completed than systems designed for other purposes.
- (3) The local command work measurement program provides for participation by personnel who are concerned with the resultant data to a degree not present in systems designed primarily for Navy-wide budgetary reports. Such participation results in the local command using the program as a means of controlling and improving its operations, rather than considering work measurement as just another report.
- (4) The approach developed by the Ohio State group is designed to create effective communications up and down the chain of command on the local station--from the unit to the section, to the division, to

the department, on to the commanding officer and down again. The approach also provides for better communications with the bureau level. In the installation stage this communication is effected by the interchange of ideas between the people on different echelons regarding establishment of work units; how to keep the time spent on work units; establishment of standards, and like matters of common concern. While the lower echelons are encouraged to suggest and present reasons and facts, the final decision must, of course, rest with the concurrence and approval of the higher authority who is charged with the responsibility of effective operation of the organizational unit. In other words, if the Bureau of Naval Personnel is responsible for setting personnel allowances, which are in turn dependent upon work measurement standards, then the local command can suggest and argue for certain standards; but the standards set will have to be with the concurrence and approval of the Bureau.

The basic techniques used in introducing work measurement to local commands are: (1) use of work measurement manual, (2) use of the small group meeting, and (3) staff assistance in "helping local personnel help themselves." This approach gives the local officer a degree of participation in the establishment of the program, which in itself results in high understanding and acceptance. A feature of the program which makes it more than another report and gives reason for establishing it on a continuous basis, is the follow-up action. The techniques recommended to make the program an integral part of controlling and managing the station are the use of periodic reports, followed by continuous reviews by the commanding officer, requests for an explanation, and corrective action to solve any undesirable management situations. Attachment I gives the recommended procedure for installing the program. Attachment II, 'Local Command Work Measurement Manual,' describes fully the program developed and evaluated by the project.

Having presented the nature and objectives of the project as well as the basic assumptions under which experimentation and analysis were conducted, a description of the field work and experimentation carried out are presented in the following sections.

## SECTION II

### FIELD SURVEYS ON MANAGEMENT PROBLEMS AND DIFFICULTIES

In line with the emphasis on studying actual field conditions in the naval shore situation, field surveys of management problems and difficulties were conducted. These surveys are briefly described below.

#### A. PRELIMINARY INTERVIEWS AT USNTC, GREAT LAKES, ILLINOIS, AND USNTC, BAINBRIDGE, MARYLAND

The first field work at USNTC, Great Lakes and USNTC, Bainbridge was conducted in September, 1952. The purpose was to identify specific management difficulties and problems being experienced by naval officers ashore. Seventy-five interviews were conducted with a cross-section of naval personnel at all echelons of command at Great Lakes and Bainbridge. The kinds of management problems and difficulties found may be classified into the following eleven areas:<sup>2</sup>

1. Communications and coordination
2. Turnover and rotation
3. Paper work and red tape
4. Civilian employees and WAVES
5. Work measurement
6. Billet analysis
7. Handling people
8. Military duties
9. Public relations
10. Classification and promotion
11. Morale problems

In addition to the problems and difficulties found, there were some general impressions received from talking with people in the field. The following are the major impressions received:

- (1) The difference between management problems arising aboard ship and at shore stations is generally recognized by naval personnel.

<sup>2</sup> Appendix A of "Research Progress Report Number 2 to BuPers" dated 29 October 1952 presents a complete breakdown of the problems and difficulties expressed by naval personnel interviewed at Great Lakes and Bainbridge.

- (2) Officers coming from sea to administrative billets ashore are reluctant to delegate work to the point that would seem desirable.
- (3) A significant number of officers in key administrative positions are carrying such heavy work loads that it is necessary for them to put in long hours and use every short cut available. As a result, it appears that by the time all of the "fires" are taken care of, there is little time left for over-all planning and thinking about the job to be done.
- (4) Most officers recognize the need for some kind of indoctrination, aids, or hints to help them in their administrative duties. Any such aids must be relatively simple and practical in their application.

**B. COMMAND MANAGEMENT SURVEY AT  
USNTC, GREAT LAKES, ILLINOIS**

A command management survey, consisting of a questionnaire and follow-up interviews, was conducted at USNTC, Great Lakes during the period 13-20 November, 1952. The purposes of this survey were:

- (1) To get a measure of the degree of understanding of the management areas making up the subject matter of the questionnaire, namely, such areas as work measurement, organizational structure, the group discussion meeting, work simplification, etc.
- (2) To get a measure of the feeling or point of view toward the management areas making up the subject matter of the questionnaire.
- (3) To bring the management areas to the attention of naval personnel in an effort to increase their interest in the importance of good management.

The items in the questionnaire were based on information gathered from previous interviews in the field. Once the questionnaire was constructed, it was pre-tested with the voluntary assistance of officers of the NROTC of the Ohio State University and selected officers at the U.S. Naval Air Station, Columbus, Ohio. The final revised instrument was then administered to 205 naval personnel at Great Lakes. Out of the total of 205 questionnaires submitted, 194 were completed. This gave an unusually satisfactory return of 94.6 per cent and is indicative of the outstanding cooperation that was given the Ohio State representatives

by the Center Commander, his staff, and entire personnel on the station.

After the questionnaire was administered, follow-up interviews were held with selected officers whose questionnaires indicated they might be productive sources of information and reaction. Particular attention was given in the follow-up interviews to the subjects of work measurement and the group discussion meeting.

#### C. RESULTS OF THE COMMAND MANAGEMENT SURVEY

A detailed tabulation and analysis of the findings of the Great Lakes Command Management Survey are presented in "Research Progress Report No. 3 to BuPers." The major points coming from the survey may be summarized in the following two statements:

- (1) Specific areas of command management were uncovered which need attention, namely, the areas of organizational structure, assignment of personnel, incentives and motivation, communications and coordination of effort, work measurement, work simplification, differences in command leadership ashore and at sea, group conference techniques, and training and indoctrination in shore station management.
- (2) Some means of accountability for manpower utilization must be established. Work measurement appears to be the management tool which can establish this accountability and act as a motivator for bringing about management improvements leading to the ultimate objective of more effective manpower utilization.

As an outcome of the results of the Great Lakes Command Management Survey, work was begun on developing a work measurement manual for use at the local command level and plans were laid for the work measurement pilot studies which are described in the next section of this report.

## SECTION III

### WORK MEASUREMENT PILOT STUDIES

#### A. INTRODUCTION OF WORK MEASUREMENT AT USNTC, GREAT LAKES, ILLINOIS 9 FEBRUARY 1953 TO 28 MAY 1953<sup>3</sup>

##### 1. Introduction Period, 9-19 February, 1953

###### Objectives:

- (1) Try-out and evaluation of alternative methods of getting across the basic concepts of work measurement.
- (2) Evaluation of materials on work measurement.
- (3) Development of understanding and acceptance of work measurement on the part of local officers.
- (4) Introduction to local officers of manuals and techniques which will result in management improvements on a "relatively unrefined, common sense basis."

###### Procedure:

- (1) Backing was obtained from higher authority in the form of a memorandum from the Center Commander requesting cooperation and the submission of progress reports on specified dates.
- (2) Two group meetings were held with each of nine departments. Both meetings were used to introduce the "Work Measurement Manual" and to discuss work measurement. In the first meeting, the "before" test on knowledge and attitude toward work measurement was given. The second meeting was used additionally for the purposes of introducing other work measurement literature to participating personnel, and having them fill out small group meeting and materials evaluation forms.

<sup>3</sup> The introduction of work measurement at USNTC, Great Lakes, is more completely reported in "Research Progress Report No. 4 to BuPers," ONR Contract with Ohio State University, Nonr 495 (05), 6 March 1953.

- (3) After the group meetings, the nine groups were treated differentially as follows:
  - (a) Three groups were given individual staff assistance with an emphasis on "helping them help themselves" in devising a work measurement system.
  - (b) Three groups were given individual staff assistance in which the Ohio State representative took the lead in devising a work measurement system.
  - (c) Three groups were given no individual staff assistance.
- (4) About one week after the first group meeting, a third meeting was held with each of the nine departments. The purpose of this meeting was to give the "after" test on work measurement and to discuss progress thus far in getting the work measurement systems installed.
- (5) Members of the Ohio State group kept running logs throughout the course of the pilot study. Emphasis was placed on documenting problems or difficulties encountered, dominant attitudes of participating personnel, and gathering case material for revised editions of the "Work Measurement Manual."

## 2. Follow-up Period, 23-24 March and 25-28 May, 1953

The people in the nine experimental departments at Great Lakes were revisited by representatives of the Ohio State group on 23 and 24 March, 1953. The purpose of this visit was to observe what had been happening to the work measurement systems which had been started in February; to discover the kinds of difficulties the people were experiencing in installing work measurement; and to get additional reactions of naval personnel concerning the potentialities of work measurement for them. It was explained to the people at Great Lakes that a Revised Work Measurement Manual, based on the experience gained during the introduction period and the comments of the people involved in the experimental groups was being written. Copies of this revised second edition of the Work Measurement Manual were mailed to Great Lakes on 30 March, 1953.

A final follow-up visit was made to Great Lakes on 25-28 May 1953. At this time, the third revision of the "Work Measurement Manual" was given to participating personnel as a replacement for the second edition. The new edition was introduced by pointing out significant changes which

have been made in various parts of the "Manual." The Management Engineering Office was asked to help participating personnel in changing over to the procedures outlined in the latest edition of the "Manual."

In addition, an attempt was made to find out what uses the people had been able to make of their work measurement facts and how they felt about voluntarily continuing work measurement for their own use. These findings are reported later in the section which deals with "Results of the Work Measurement Pilot Studies."

B. INTRODUCTION OF WORK MEASUREMENT  
AT USNTC, SAN DIEGO, CALIFORNIA  
25 MARCH TO 29 MAY 1953<sup>4</sup>

1. Introduction Period, 25 March  
to 15 April, 1953

Objectives:

- (1) As a result of the field work at Great Lakes, the approach of "helping personnel help themselves" was judged to be the most effective approach. The main objective of the experiment at San Diego was to try out and evaluate further this general approach--on a much larger scale.
- (2) Further try-out and evaluation of (a) a revised edition of the Work Measurement Manual and (b) a revised Command Management Check-List (Form II).

Procedure:

- (1) As at Great Lakes, the Center Commander issued a memorandum, outlining the program, listing dates for progress reports from participating groups, and soliciting full cooperation.
- (2) Meetings were held with the Commanding Officers of the Service School Command and Recruit Training Command and their staffs to explain the program and determine what activities should participate in the study. It was decided it would be advisable

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<sup>4</sup> A detailed account of this pilot study is given in "Research Progress Report No. 5 to BuPers," ONR Contract with The Ohio State University, Nonr 495 (05), 25 May 1953.

for every department of the Administrative Command to participate. A meeting of Administrative Command department heads was conducted to explain the program and compile the list of participating personnel. In all, twenty-three groups participated in the program at San Diego as compared with nine at Great Lakes. This generally resulted in a larger number of persons attending subsequent small group meetings, usually fifteen to twenty, compared to ten or less in the Great Lakes meetings. Also, the greater number of persons participating reduced the amount of individual help it was possible to give participants at San Diego.

- (3) Two introductory meetings were held with each group, followed a week later by another meeting. The "before" test on knowledge and attitude toward Work Measurement was given during the first meeting. The remainder of the time was devoted to an explanation of Work Measurement and how to set up a local system. The third meeting was devoted to the "after" test on Work Measurement, and the administration of the Command Management Check-List (Form II) and the other forms evaluating the meetings and manual. Discussion was conducted on problems or difficulties encountered in establishment of a work measurement system.
- (4) Members of the Ohio State group acted in an advisory capacity to individuals setting up their systems. A log of critical incidents and problems was kept throughout the pilot study.

## 2. Follow-up Period, 25-29 May, 1953

A follow-up visit was made to San Diego the last week in May, at which time the third edition of the Work Measurement Manual was presented to the people who participated in the pilot study. The changes made in the revised manual were explained to the people and their reactions were solicited. In addition, the people who had been installing work measurement were interviewed to get at the problems which they were encountering in setting up their systems and to get their feelings and attitudes toward the continued use of work measurement at the local command level. The results of these interviews are summarized in the section which follows.

## C. RESULTS OF THE WORK MEASUREMENT PILOT STUDIES

The results reported here cover both the introduction period and the follow-up period of the work measurement pilot studies at Great Lakes and San Diego. These results come from (1) the evaluation forms used by the Ohio State group; (2) field logs kept by members of the Ohio State group; (3) on-the-spot observations of the installation of local work measurement systems; (4) personal interviews with personnel involved in setting up their own work measurement systems; and (5) the first work measurement reports which were submitted by the participating groups.

### 1. Results Pertaining to the Understanding of Work Measurement Facts

One tangible result of the work measurement pilot studies was a definite gain in understanding of work measurement as indicated by the "before" and "after" scores on the Work Measurement Information Form. At both stations, a large gain in knowledge of work measurement was indicated. The average per cent of total possible correct answers on the test showed an improvement of from 23.8% to 71.1% at one station and an improvement of from 45.7% to 73.5% at the other station.

### 2. Use of Small Group Meetings for Promoting Understanding

Another result coming from the pilot studies was a series of reactions about the value of the small group meetings in fostering understanding of work measurement. These reactions were obtained by use of a "Small Group Meeting Evaluation Form." Most of the people who responded to this form said they were convinced that the small group meeting was a help in bringing about understanding of work measurement.

The participants also indicated what they thought to be the most effective total program of presenting work measurement. The result was a decisive vote for the use of a manual in connection with group meetings and staff assistance in "helping the officer help himself." This result was also supported by statements (recorded in the field logs) that a manual alone will not do the job of getting the people to understand work measurement. More than one division head reported that more than a statement of the facts of work measurement is necessary; there must be actual experience in setting up a system with some staff help available.

### 3. Understanding Comes from Working with the System

A further result pertaining to the understanding of work measurement had to do with the comments in the field logs in regard to the difficulties and obstacles the people were encountering in achieving understanding. One result was the realization that the people cannot be taken too far too fast in work measurement indoctrination. It takes time just to get the mechanics of the system "shaken down." Results from the pilot studies indicated that the most difficulties were encountered in deciding upon the following factors which will result in a system representative of the work done:

- (1) Finding acceptable work units
- (2) Recording man-hours expended
- (3) Setting standards

### 4. All Groups Were Able to Establish Their Own Systems

Another tangible result of the pilot studies consisted of the work measurement reports which were submitted as a result of the local systems established. These reports consisted of actual data on the man-hours expended, work units completed, and performance rates for each sub-function of the various divisions and departments. While there was a great deal of variation in the quality and completeness of these reports, the fact that every group was able to present actual work measurement data is one positive indication that the people had some understanding of work measurement.

### 5. Results Pertaining to the Acceptance of Work Measurement

The people participating were given an opportunity to express their attitude toward work measurement at the very beginning of the introductory group meetings and again about a week later. The results indicate that initially there was a widespread, poorly defined feeling toward work measurement. The feeling toward work measurement was mixed--from those who saw great opportunity in it to those who saw no benefits at all. However, after a week's introduction to work measurement there was a definite trend toward feeling that it has real merit and a willingness to give it a try.

## 6. Active Backing of Top Echelon Important to Acceptance

Another result coming from the pilot studies was a realization of the great importance of the backing and interest of the head person in each echelon of the command. Observations and interviews in the field indicate that if the commanding officer is interested in work measurement and actively backs it, the department heads are more apt to accept it and push it. If the department heads are interested in work measurement and actively back it, the division heads are more apt to accept it and push it. The same result holds all the way down the chain of command to the people who actually put in the man-hours and turn out the work of the subfunctions.

## 7. Acceptance Related to Fear of Higher Authority

Basically few people, if any, want to have their activities measured. Results of the comments and reactions obtained during the pilot studies suggest that "fear of measurement" results from not knowing what action higher authority will take on the basis of the measurement findings. Naval officers tend to have an expectancy of negative action rather than positive action from higher authority. That is, they expect the results to be used to cut their personnel or as a basis for reprimand, and not to help them in a positive manner.

This attitude seems to be deep rooted in many naval personnel, and apparently has been developed as a resultant of previous experiences where information has been misused by higher authority, improper action was taken on incomplete information, or no action was taken when action was called for. Such negative actions are probably remembered more vividly than positive actions, and, as a result, reenforce negative attitudes or fear of higher authority.

In addition, naval officers have had many experiences of being called upon to carry out orders without adequate notice, and calling for personnel time beyond the normal demands. The result is that most naval officers feel much more secure, and logically so under present conditions, if they have more personnel on hand than needed for normal operations. They are then ready to handle any emergency without the chance of receiving a reprimand from "top side" for not being able to "deliver" as ordered. In many naval situations a reasonable amount of excess personnel for emergency situations is justified. Such excess should be accounted for as such, and taken into account by higher authority.

This basic fear bears an important relationship to acceptance by naval personnel. This matter needs full discussion during introductory stages of work measurement, but will only be adequately controlled after

naval personnel have been shown that action, both positive and negative, is taken on the basis of work measurement data, and that the attitude of higher authority is positive in nature. Increased acceptance of the system by naval personnel will then be greatly encouraged.

#### 8. Acceptance Affected by Appreciation of General Need for Work Measurement

Higher authority has need of work measurement data to account for use of naval personnel and as an aid in controlling and directing subordinate activities. Results of pilot studies indicate that officers who have an appreciation of the problems of higher authority, other departments and commands, and the Navy as a whole, tend to accept work measurement more readily and are quicker to see uses for it. Throughout the introduction periods it was found difficult in many cases to interest individual officers in the broad implications of work measurement which involved the Navy as a whole or as it might affect the operation of the local command.

#### D. HOW WORK MEASUREMENT IS BEING USED IN THE FIELD

As of 1 June 1953, the work measurement systems developed by the local activities participating in the pilot studies at Great Lakes have been in operation approximately three and a half months. At San Diego their local systems have been in operation less than two and a half months. Even in this short time, a majority of local officers have apparently discovered sufficient use for their systems to decide to continue them, even if on a voluntary basis. At one of the Training Centers two thirds of the activities participating in the pilot studies decided voluntarily to continue work measurement after the termination of the pilot study. At the other Training Center two of the three commands decided to continue their systems after the pilot study activities were finished. Some commands and departments have already decided to extend work measurement to more of their units, after their systems have been further developed. Policy is to iron out details of reporting data, setting standards, and carrying on a follow-up action, using present pilot-study systems. After their systems have been refined, then it is planned to extend work measurement to additional units.

#### 1. Examples of How Work Measurement is Being Used in the Field

The following examples are a few excerpts from field evaluations of local systems, first reports of work measurement data and follow-up interviews by the Ohio State group.

--Service School Commands find a report of the time spent on in-service training and in writing examinations gives an automatic check on these functions not previously reported in a routine manner.

--As a result of the reports on time spent on writing examinations, one Service School Command has reorganized some of its schools in such a manner that examinations for several of the divisions teaching the same course are now being written by a specialized staff, instead of each division writing its own. This results in elimination of duplication of effort.

--One Commissary Officer reports as follows:

"Comparison of work measurement facts between operating galleys has been useful, although many factors enter into variations. However, a work measurement system serves to point up the variance and alerts a department to investigate these variances."

As a result of their work measurement system, this department is suggesting closing two out of five galleys. One already has been closed and it is anticipated the other will be closed within a few weeks.

--Work measurement data disclosed different liberty systems in operation in the galleys. Liberty and work periods are now standard throughout the division.

--Another division officer reports:

"It is considered that work measurement will be of continuing value to the \_\_\_\_\_. In particular, it is believed that it will be of value in estimating personnel requirements, and will be an indication of possible need for management studies and improvements. However, until the work measurement system has been in effect for a much longer time, its value will be limited. . ."

--A department head writes a part of his evaluation of a local work measurement system as follows:

"For inexperienced supervisory personnel or people who are new to their jobs, work measurement data is very valuable to properly indoctrinate them into their work."

--Another department, using work measurement information, questioned why a function of talking to people at a window and filing cards took so much time. This stimulated thinking in the direction of reducing the time for this operation. The department head decided to install Kardex equipment to accomplish this end. Work measurement information will be used to

support a request for the equipment and to check on the reduction in time achieved by using the new equipment. It is estimated that a saving of personnel by one-third can be realized, and that the equipment will pay for itself in one year as a result of these savings.

--In one individual's department, personnel have been reduced from 29 to 20, as a result of rotation, without receiving replacements. To adapt to these reductions it has been necessary to shift personnel around. Work measurement has proven a helpful guide in this task. The same person has found work measurement of use in shifting personnel around to compensate for fluctuations in work loads.

## 2. Specific Indications of Voluntary Plans to Continue Work Measurement

Probably the best evaluation of the local command work measurement studies is shown by what the local people plan to do with work measurement after the pilot studies are finished. Accordingly, there are presented here actual statements of participating personnel in regard to their plans for voluntarily continuing work measurement. These statements were made in reports to the Center Commanders who at the request of the Ohio State group asked for comments and reactions about the value of work measurement for the people who had been giving it a try. The people were also asked to indicate how much time was spent in gathering the data and in operating the work measurement system. The responses to this question indicated that most of the people considered the time taken to be a negligible factor and well worth the results to be gained.

The following statements are selected from the reports of the two-thirds at one station and the two out of three commands of another station who said they would voluntarily like to continue their work measurement systems.

--One department head reported:

"Because of the benefit already observed from the program it has been decided to continue it indefinitely in the \_\_\_\_\_ whether or not it is adopted for the entire Center."

--A Service School Administrator said:

"It is the intent of the school to continue some form of work measurement for its own information and use."

--Another department head said:

"In most cases the present system is considered satisfactory. It is believed the work measurement system should be continued inasmuch as the time spent in compiling the figures is not excessive considering the value of the results."

At the end of the pilot study at one station, the Commanding Officer of one of the commands indicated his desire to continue with work measurement by the following statement which went to all of his department heads:

-"The results obtained to date on the work measurement program, recently introduced by the Ohio State University, give an indication of the usefulness of such a system. However, it is considered that the merit or shortcomings of the program can only be realized after a conscientious trial for an extended period of time. In order to give proper consideration to the worth of Work Measurement, departments are directed to continue developing the system until further notice."

## SECTION IV

### MATERIALS DEVELOPED

During the term of the project a number of materials, and methods of introducing management techniques were developed and evaluated. The two discussed below (Attachment II, "Local Command Work Measurement Manual" and Attachment III, "Command Management Check-List") are the ones that have been developed for use in installing a local work measurement program. The recommended method of introducing work measurement is discussed in Section I of this report and Attachment I gives "Recommended Procedure for Installing Work Measurement at Local Commands."

Other materials were developed for the experimental phases of the project for use by the Ohio State group and are considered not generally applicable to future installations of work measurement. They include the "Before" and "After" test used to test degree of knowledge imparted through use of the manual and other staff assistance, the form to evaluate the effectiveness of the group meeting, and the form for evaluating the usefulness of the manual to the local officers.

#### A. LOCAL COMMAND WORK MEASUREMENT MANUAL

The Local Command Work Measurement Manual has been divided into three parts. Part I, entitled, "Work Measurement and Its Place in Naval Shore Station Management," discusses the benefits and advantages of a local system and outlines the objectives of such a program. The examples used in this section are based on actual experiences in the field.

Part II deals with the three technical steps that must be undertaken to set up a simple system of collecting and reporting work measurement data. These three steps are (1) defining the areas of "measurable" work; (2) determining work units for the proposed system; and (3) reporting the work measurement data. These three steps do not include the policy decisions and organizational analysis that should precede, nor the continuous review and suggested action that should follow after the system has been in operation for a sufficient time.

Part III entitled "Continuous Review of Work Measurement Facts Leading to Programs of Specific Management Improvements" is written for the officer to whom the basic data are sent, and suggests to him methods of analyzing the data. This analysis discusses the uses and place of work measurement in the over-all control of the station. The emphasis is on the need for continuous review of operations and follow-up of effects of any changes in management policies and procedures.

## Evaluation of the Manual

Thirty-six of the personnel cooperating in the work measurement pilot studies at Great Lakes and seventy-seven at San Diego were asked to evaluate the manual, recording their responses on an evaluation form. There is a very close agreement between the results at the two Training Centers. Most of the respondents (89% at Great Lakes and 85.8% at San Diego) said the manual is understandable. Likewise, most gave the manual a vote of confidence as being worth keeping in a work measurement program, 81% at Great Lakes and 78% at San Diego. A high percentage of the respondents at both stations see practical ways of using the information in the manual in helping them in their jobs, 81% at Great Lakes and 78% at San Diego.

The Ohio State group received many practical useful suggestions from the field, which formed the basis for the four revisions of the manual. The fourth edition of the manual constitutes Attachment II of this report.

### B. COMMAND MANAGEMENT CHECK-LIST (FORM II)

The "Command Management Check-List" grew out of a general survey form which was pre-tested by the Ohio State group, and then used at USNTC, Great Lakes, Illinois. The present check-list was tested at USNTC, San Diego, California, 25 March - 15 April, 1953. The check-list now contains forty problem statements from the original survey, and ten additional problems suggested by later field experiences. The Command Management Check-List is reproduced in Attachment III of this report.

Two of the most frequent uses of check-lists are for survey purposes and "self-analysis." The purpose of the check-list, as used at USNTC, San Diego, California, was to incorporate it into the setting up of a local command work measurement program. Used in this manner the check-list became a "self-analysis" instrument which served as a device for helping the local officer analyze his organization in regard to existing administrative problems. Thus the local officer could study the organizational problems before going into the mechanics of work measurement.

The check-list can also reflect the problems of the group and thus be used as a survey instrument. In addition to uncovering problems, use can be made of check-list results in small group meetings to discuss common problems.

### Evaluation of the Check-List

The naval officers at Great Lakes and San Diego were asked to fill out the Command Management Check-List. Reactions were received in follow-up interviews. It was concluded that the check-list may be particularly effective when used as an aid in finding out what people deem to be the problems in their organizations. Used in this manner the check-list can be used as a first step in a survey of the entire organization and should aid in indicating where work measurement could be profitably installed.

## SECTION V

### CONCLUSIONS

Results of the field work support the basic assumptions stated in Section I of this report on "The Nature and Objectives of the Project." Specific results of the field work are given in summary form in Sections II and III of this report. For further detailed analysis of these findings reference is made to the five progress reports submitted to the Personnel Analysis Division of the Bureau of Naval Personnel. The conclusions set forth here are an over-all summary of the general conditions which are necessary for the successful accomplishment of a program to improve management of naval shore stations, with emphasis upon local command work measurement as a basic step in such a program.

#### A. WORK MEASUREMENT CAN ACT AS A MOTIVATOR FOR IMPROVING MAN- POWER UTILIZATION

Work measurement is an administrative technique, which operates as a barometer in indicating the manpower used and the resulting output. When used in the proper manner, it will operate as a motivating force for improved management. Conditions necessary for its success are the proper setting of attitude and acceptance, including "acceptable" standards and the wholehearted backing by higher authority. Under these conditions work measurement provides a means of focusing attention on areas of management where improvement is needed and for providing a means of indicating when progress is made. Results of the project indicate work measurement provides the means for the motivation necessary to encourage proper manpower utilization and administrative practices and procedures. (See pp. 16-18, Section III, on "How Work Measurement Is Being Used in the Field.")

#### B. UNDERSTANDING IS ESSENTIAL TO THE SUCCESS OF ESTABLISHING A WORK MEASUREMENT SYSTEM

Results of the project indicated the following factors important to promulgating adequate understanding of a local work measurement system:

- (1) A manual on the basic concepts and uses of work measurement is needed. Such a manual must be written so as to be understood by all administrative echelons. This fact was a guidepost in composing the "Local Command Work Measurement Manual."

- (2) Introduction by group participation and discussion supported by higher administrative backing appears to be much more effective than by means of a directive and a manual. (See pp. 13-14, Section III, for results pertaining to understanding.)
- (3) In evaluating the methods and materials used in introducing work measurement, suggestions from personnel in the field indicate that use of such visual aids as flip-charts and graphs would facilitate understanding.

C. ACCEPTANCE IS ALSO ESSENTIAL TO  
THE SUCCESS OF A LOCAL WORK  
MEASUREMENT SYSTEM

More than understanding is necessary for assuring the success of a work measurement system--whole-hearted acceptance is necessary, too. Results of the experiments in establishing local systems indicate "acceptance" is an important factor for the success of the program. Great individual differences in this regard were noted among the officers participating in the experiments. There were also great variances both in the lapse of time before acceptance was forthcoming and the degree of acceptance.

Variation in acceptance depends upon any or all of the following:

- (1) Attitude. There appears to be considerable relationship between degree of acceptance of naval personnel and their perspective into the complexity and importance of management problems at naval shore stations and the Navy as a whole. (See p. 16, Section III of this report.)
- (2) Fear or anxiety. Degree of acceptance is related to the fear naval personnel possess regarding unwarranted action which may be taken as a result of misinterpretation of work measurement data. There seems to be a fear at each level of organization that the level above will not fully understand work measurement reports and so take action not in the best interests of the level below. Acceptance depends in large measure upon handling the work measurement data properly, which infers positive actions on part of top echelon officers. Proper recognition should be given to those showing improvement, and explanation sought from those whose performance shows an unfavorable trend. (See p. 15, Section III, this report.)

- (3) Confidence in Standards. Standard must be set which are not only fair and equitable, but which local naval personnel have had a role in establishing. Results of pilot studies indicate acceptance is encouraged by participation of the local command in recommending standards on basis of conditions in the field. If the system is to affect decisions at the bureau level, standards must be set with the concurrence and approval of the bureau.
- (4) Time to prove the system. Experience indicates that before acceptance is forthcoming, naval personnel must have the experience of observing uses of the system in successful operation. (See p. 14, Section III, this report.)
- (5) Confidence in Leadership. One of the most important factors affecting acceptance is the leadership aspect. Not only is acceptance by the top echelon important to acceptance by the whole station; but positive leadership is essential. Action must be taken by the top as a result of work measurement reports. Praise for good performance is as necessary as reprimand for poor performance. (See p. 15, Section III, this report.)

**D. WORK MEASUREMENT MUST BE TIED  
IN WITH OPERATIONS AND MANAGE-  
MENT OF ENTIRE STATION**

To be successful, work measurement must be applied throughout the entire station. There must be understanding and acceptance at all echelons of the organization. All naval personnel in supervisory positions and responsible for the results of the work measurement reports should participate in the procedure of the reporting, especially selecting work units and setting standards. (See p. 14, Section III, this report.)

In the follow-up aspects of work measurement, lines of communication must be open--free up and down for best flow of information regarding the operations of the station and factors affecting it. Systematic reporting at regular intervals is essential. While local personnel should make sure their system reflects as nearly as possible their operations, whenever possible standard forms and procedures should be used to facilitate communications.

At larger naval stations staff assistance is necessary to direct and coordinate the program throughout the station. This staff will help in indoctrinating new officers who are constantly rotated from sea

to shore duty and also act in a staff capacity in summarizing the results for the commanding officer, focusing attention on management problems calling for staff assistance. This staff assistance is presently being given at some stations by the Management Engineering Office. Such staffs may include among their functions the duties of presenting recommendations for follow-up action. They may also be instrumental in standardizing procedures of reporting by the different activities.

Work measurement data must play an active role in planning the activities of the station. When projects are planned, consideration must be given to the manpower available to do the work. Likewise, when work measurement indicates excess personnel, action should be taken.

## SECTION VI

### RECOMMENDATIONS

#### A. GENERAL RECOMMENDATIONS

- (1) That local work measurement systems, as outlined in the Work Measurement Manual developed by this project, be installed at all naval shore stations.
- (2) That commanding officers, executive officers, and other key administrative officers receive a short orientation program in work measurement and other management techniques immediately prior to being ordered to top administrative billets ashore. This training should bring to bear all appropriate training media.
- (3) That large shore stations have a Management Engineering office, staffed by one or more officers with appropriate training and qualifications.

#### B. RECOMMENDATIONS FOR FURTHER RESEARCH AND DEVELOPMENT

- (1) That further follow-up research be carried out on local command work measurement systems in order to bring about greater refinement and standardization of procedures and uses. For example, further research needs to be conducted on the problem of developing an automatic system for accurate allocation of time to the different sub-functions. (See Attachment IV)
- (2) That a local command work measurement program be initiated that will coordinate all the systems of individual activities at a large shore station. This research and development would differ from previous studies in that it would set up a system designed primarily to afford the commanding officer a means of controlling and comparing the different sections and divisions of the entire station. Pilot studies done by the Ohio State group emphasized individual systems for each local activity within a command. Next step is to coordinate individual systems of a station so they can be more useful to the commanding officer of the entire station.

- (3) That as soon as local command work measurement systems get into actual operation, experimental work be carried on in regard to encouraging naval personnel to apply other management techniques toward improving weaknesses pinpointed by work measurement facts.
- (4) As further improvements and refinements are developed, it is recommended they be included in the present "Local Command Work Measurement Manual"--or if significant enough, that a separate manual be developed. It is to be expected that such improvements will develop along the lines outlined in the above recommendations. Examples of expected improvements are as follows: (1) better methods and techniques for allocating time to subfunctions; (2) more accurate means of setting standards; and (3) refined procedures for coordinating work measurement data from individual activity systems, which will give the commanding officer the data he wants for over-all control and yet will not sacrifice the element of the data being representative of the work performed by each activity.

ATTACHEMENT I

Recommended Procedure for Installing Work Measurement  
at a Local Command

## ATTACHMENT I

### RECOMMENDED PROCEDURE FOR INSTALLING WORK MEASUREMENT AT A LOCAL COMMAND

The most promising method for getting the naval officer to understand, accept, and effectively use work measurement is one which includes use of a manual accompanied by staff assistance in "helping the officer help himself." With some few exceptions the distribution of a manual alone is not an effective means of getting the naval officer to understand, accept and use work measurement. The manual should be, therefore, a part of a general indoctrination program carried out by staff assistance.

The following outline is for the use of the staff designated to carry out the introduction of the program. This method of installation has been devised after making empirical investigations at three large naval shore stations. Nevertheless, as more experience is gained, need for modification of this approach will undoubtedly become apparent. For this reason, the tentative outline will probably need to be somewhat revised and adapted to each local situation. However, the general approach of "helping the officer help himself" should lead to highly satisfactory results.

The distinction to be drawn between the above "helping the officer help himself" approach and the familiar "expert" approach is quite basic. In the latter approach the "expert" takes the lead in getting a work measurement program into operation, and therefore actually does the work of installation. In the approach "helping the officer help himself," the staff officer gives the department the responsibility of devising and putting into operation a work measurement program. The staff officer takes an active part only when necessary to solve problems in order to keep the program going.

Four steps are necessary for the introduction of a work measurement program using the approach of "helping the officer help himself." The steps are:

1. Orientation of the commanding officer;
2. Orientation of key personnel in each department;
3. Individual field work in each department;
4. Continucus review and follow-up.

These recommended steps for installation of a work measurement program are outlined below.

STEP ONE: ORIENTATION OF COMMANDING OFFICER

Work Measurement and Its Place in Naval Shore Station Management

1. What is work measurement?
2. Why is work measurement valuable?
3. Illustrations of how work measurement has been used. The following examples could be cited:

In one individual's department, personnel have been reduced from twenty-nine to twenty, as a result of rotation, without receiving replacements. To adapt to these reductions it has been necessary to shift personnel around. Work measurement has proven a helpful guide in this task.

The same person has found work measurement of use in shifting personnel around to compensate for fluctuations in work loads.

Another person who handles the administration of five galleys observed that comparable data from the galleys varied tremendously. Investigation showed that different liberty systems were being used. Liberty and work periods were standardized. Work measurement data helped uncover these discrepancies.

A service school reorganization has been stimulated in a large measure by work measurement information.

Choice of Departments

Ideally, complete coverage of a base should be instituted simultaneously. However, if the number on the staff is limited, then decisions have to be made as to the priority of activities scheduled for installation.

Role of the Commanding Officer

1. As a motivational factor, the importance of the top executive's interest in work measurement is quite apparent. This motivation can be accomplished by requiring:
  - a. monthly performance reports from all components reporting directly to him or his second in command;

- b. monthly or quarterly conferences concerning the significance of the reports;
- c. approval of the standards and methods, developed by each reporting group in compliance with directives. This approval may be delegated to one of his staff.

2. Any great interest in work measurement, except by a few conscientious officers, is unlikely unless it is known that reports go to the commander's office, and that something is done about them.

#### Value to the Commanding Officer

1. Work measurement serves as a means of constant review and follow-up.
2. Work measurement serves as a means of communication since it enables the commanding officer to "get the word" better on what is going on in the departments of his command.
3. Work measurement should be instituted only as a permanent program since its value increases considerably as more data are collected with the passage of time. This accumulation of work measurement facts should prove indispensable as a management aid for planning and forecasting. Thus, it is inextricably tied in with effective manpower utilization.

#### STEP TWO: ORIENTATION OF KEY PERSONNEL IN EACH DEPARTMENT

##### Visit the Department Head

1. Discuss the proposed program for this department including the following points:
  - a. What is work measurement?
  - b. Why is work measurement valuable?
2. Schedule a group meeting of key personnel in the department.
3. Leave with department head the Local Command Work Measurement Manual for distribution to key personnel several days in advance of group meeting.

Hold a Group Meeting, or Meetings  
if Necessary, of Key Personnel in the  
Department in Order to Complete  
the Following Schedule.

1. Give "Command Management Check-List" with replies kept anonymous.
2. Discuss the proposed program in general terms.
  - a. What is work measurement?
  - b. Why is work measurement valuable?
  - c. How has work measurement been used?
3. Cite the three necessary steps for setting up work measurement in the specific department. Discuss department in terms of:
  - a. Defining subfunctions,
  - b. Selecting work units, and
  - c. Setting up a reporting system.
4. Devote the last part of the meeting to a discussion of proposed plans for developing their own work measurement program.

STEP THREE: INDIVIDUAL FIELD WORK  
IN EACH DEPARTMENT

Revisit the Department a Number  
of Times to Check on Progress  
in Developing a Work Measure-  
ment Program

1. Encourage individuals to take responsibility for setting up their own program.
2. Give individual help as needed.
3. Encourage additional group meetings to clarify any misunderstandings or problems encountered in the introduction of the program.

Keep a Running Log of Any  
Problems and Attitude Reactions

This log can serve as a basis for further refinements of the Local Command Work Measurement Manual and of the general presentation.

Analyze Command Management  
Check-List

Check-list results should be tabulated by departments in order to aid in analysis of problems. These results may be combined to give a picture of the problems of the total statica.

STEP FOUR: CONTINUOUS REVIEW AND  
FOLLOW-UP

Analysis of Work Measurement  
Data Based on Temporary Standards

1. After setting up the mechanics of the program and after data are being collected, then performance rates of subfunctions should be compared to the temporary standards.
2. Trends of the Index of Productive Efficiency should be watched by the department head and higher authority. However, deviations should not be used as a basis for administrative action until the findings of the work measurement data are well substantiated by other investigations.

Set Standard Performance Rates

1. After performance rates for individual subfunctions have been gathered long enough to establish a definite trend, for example, six months, effort should be directed toward more realistic standards based upon all the available data.
2. Standards should be set through the participation of the controlling authority--the department head to whom the work measurement report is submitted--subject to the concurrence and approval of the commanding officer.
3. It is the function of the commanding officer to standardize the reporting procedures of his command. (This responsibility will usually be delegated to some staff officer, such as the Management Engineer.)

4. The Bureau could be used as the agency for promoting homogeneity of work units by gathering data from the various commands, and then making suggestions to the local commands who may accept or suggest an alternative to the Bureau for their consideration and final decision.

Analysis of Work Measurement  
Data Based on Standard Per-  
formance Rates

1. After setting up standard performance rates, the monthly Index of Productive Efficiency and monthly Performance Rates should be analyzed as to trends.

2. Explanations to the commanding officer should account for deviations, both favorable and unfavorable, from the previous month or months.

Location of Problem Areas Through  
a Continuing Follow-up

1. A logical development of a continued adverse trend would lead to an inquiry as to its cause.

2. Corrective action could be taken to solve the problem if its origin can be traced to influences amenable to local action.

3. A report of corrective measures taken should accompany the work measurement report to the commanding officer, or an explanation should be given why no action is feasible.

**ATTACHMENT II**

**LOCAL COMMAND WORK MEASUREMENT MANUAL**

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Division Officers Guide, U.S. Naval Institute, 1952.

The Navy Shore Establishment Work Measurement System Interim Manual, SECNAVINST 5202.1 dated 31 July 1952.

Work Measurement in Performance Budgeting and Management Improvement, Executive Office of the President, Bureau of the Budget, March 1950.

Work Measurement Program Manual for Naval Aeronautical Activities, Bureau of Aeronautics, Dept. of the Navy, Prepared by Industrial Relations Branch, Personnel Division, (Revised 1 Jan. 1952).

Work Measurement Performance Evaluation Program, Sixth Army Manual M6-18, dated 1 July 1951.

Work Measurement Manual for Naval Ordnance Establishments, O.P. 1832 (First Revision), Bureau of Ordnance Publication dated 1 July 1951.

## PREFACE

Forces and pressures from several directions--the needs of national security, the limitations of natural resources and manpower, and public opinion inquiring into the effectiveness and economic operation of the military organization--present urgent demands for better manpower utilization, quantitatively and qualitatively. Work Measurement can provide the administrative control necessary to measure the effectiveness of a military organization with respect to the quantity of work accomplished, with a given amount of manpower. This aids in the solution of the problem of quantitative control of manpower. Work Measurement can aid indirectly in the improvement of the quality of manpower utilization by increasing management effectiveness.

It is important to note that Local Command Work Measurement differs from other Navy Work Measurement Programs in terms of objectives and the general approach used to install and develop the program. Local Command Work Measurement is particularly distinguished by an approach which supplements directives and manuals with small group meetings and personal staff assistance, in "helping personnel to help themselves." This approach has the advantages of (a) bringing into focus local management problems that previously escaped attention; (b) assuring a degree of participation by local people which leads to better understanding, acceptance and use of Work Measurement; and (c) providing a measure by which to indicate where local management improvement will contribute most to better utilization of manpower and material resources.

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## INTRODUCTION

This manual consists of three major parts and accompanying appendices. Part I--"Work Measurement and Its Place in Naval Shore Station Management"--discusses the benefits and advantages of a local system and outlines the objectives of such a program. The examples used in Part I are based on actual experiences in the field, but possible solutions are often the suggestions of the Ohio State University group and may or may not have been accepted by the local command.

Part II deals with the actual technical steps that must be accomplished to establish a simple system of reporting local Work Measurement data to higher authority. In three steps, the officer-in-charge of the group activity being measured (or his chief petty officer, as the case may be) is given all the information necessary (1) to define areas of "measurable" work he will include in his system; (2) to determine good work units for his system; and (3) to develop forms for reporting the Work Measurement data.

Part III--"Continuous Review of Work Measurement Facts Leading to Programs of Specific Management Improvements"--is divided into two sections: (A) "Procedures for Analyzing Basic Data," and (B) "Suggestions for Applying Work Measurement Data." Section A of Part III is written with a different audience in mind than in the case of the three steps in Part II. The latter is for the officer, chief petty officer, or civilian supervisor who will gather basic data. Section A of Part III is written for the officer to whom the basic data are sent, and this section suggests methods of analyzing the data. (At the larger Naval Shore Stations, such as the Naval Training Centers, the analysis of the data will probably become the responsibility of the Management Engineering Office or some like staff organization.)

Section B of Part III discusses the uses and place of the Work Measurement system in the over-all control of the station. The place of Work Measurement as a useful technique in continuous review of operations and follow-up of effects of any changes in management policies and procedures also are discussed at length.

Appendices A and B provide specific instructions for setting permanent standards and forecasting personnel needs for future periods. These sections are relevant to the continuous review of work measurement facts discussed in Part III, but it is not necessary to consult them until work measurement has been in effect for approximately six months.

Appendix C consists of work sheets to be used when reading Part II.

Appendix D cites a list of selected references on management. This will be of interest to those people who want to learn more about the management area.

Appendix E is a glossary of work measurement terms as they are used in this Manual.

PART I

WORK MEASUREMENT AND ITS PLACE IN  
NAVAL SHORE STATION MANAGEMENT

A. WHAT IS WORK MEASUREMENT?

WORK MEASUREMENT IS A MANAGEMENT TOOL.....

WHICH SHOWS YOU FACTS.....

ABOUT WORK TURNED OUT.....

AND THE MANPOWER IT TOOK TO TURN OUT THAT WORK.

1. Explanation of Basic Work  
Measurement Terms

Work Unit - a tangible and countable expression of work turned out. For example: transfer orders written; men processed; tons moved; rations fed.

Performance Rate - the number of man-hours expended divided by the number of work units completed. The performance rate gives you the number of man-hours spent per work unit. Example:

$$\text{Performance rate} = \frac{\text{man-hours expended}}{\text{work units completed}}$$

$$= \frac{100 \text{ man-hours}}{50 \text{ reports completed}}$$

$$= 2 \text{ man-hours per report completed.}$$

Subfunction - a group of related processes or divisions of work within a single work function. For example, WAVE Sales might be a subfunction of Clothing and Small Stores; Correspondence might be a subfunction of the administrative section of the Personnel Department.

2. Simplified Illustration of  
Arriving at Work Measurement  
Facts

Assume for the moment that you are interested in getting some work

measurement facts about the officer transfers and receipts handled in the Officer Personnel Section of the Personnel Department. A tangible and countable expression of work output here is "transfers and receipts processed." Thus the work unit for the subfunction "transfers and receipts" is the transfers and receipts processed. Now that you have a way of expressing the work output for the officer transfers and receipts, there remains the task of counting the number of work units turned out and relating this work output to the time spent in turning them out. Let us assume that at the end of a certain four-week period you counted 640 officer transfers and receipts which had been processed during that month. If you had two men working on the processing of these transfers and receipts and they each worked 40 hours a week for four weeks on this job, you would have spent 320 man-hours on this subfunction during the month. (Eighty hours a week times four weeks equals 320 man-hours. For purposes of illustration, four weeks are considered a month, although calendar time is slightly different.)

With these facts on the work turned out and the man-hours it took to turn out the work, you can now relate the two and get a performance rate for the "transfers and receipts" subfunction. See Figure 1 below for a complete presentation of this simplified example. A more detailed explanation of how to set up a Work Measurement System will be given in Part II of this manual.

#### Simplified Illustration of Arriving at Work Measurement Facts

Figure 1

Personnel Department  
Officer Personnel Section  
U. S. N. Station "X"

(1) Subfunction	(2) Description of Work Unit	(3) Man-hours Expended	(4) Work Units Completed	(5) Performance Rate (Man- hours per work unit) Col. 3 ÷ Col. 4
Transfers and Receipts	Transfers and Receipts Pro- cessed	320	640	0.5 manhours or 30 minutes

It should be emphasized in looking at the illustration in Figure 1 that work measurement is a tool which shows you facts--a tool which translates reality into numbers. How these facts can be used and the place they have in helping naval officers do a better job of managing will be explained in the sections which follow.

B. WHY WORK MEASUREMENT IS A VALUABLE MANAGEMENT TOOL

It is in the best interests of the Navy that good management prevail at all levels of the Naval Establishment. But how does the local department head or commanding officer know whether he has good management? How can the local officer overcome any weaknesses unless these weaknesses are brought to light?

Work Measurement a Barometer

Work Measurement is a tool which helps disclose weakness and irregularities. It may be thought of as a barometer which helps give a fix on management effectiveness. Work Measurement is not an end in itself, and it solves no problems by itself. Work Measurement simply locates clues, reveals facts, discloses relationships. As such, it can be a useful guide to action.

Work Measurement a Motivator

Thus a work measurement system is a necessary first step in a program of management improvement, because the work measurement facts serve as a motivating force which encourages local officers to discover weaknesses and take action to overcome them through programs of specific management improvements. In addition, work measurement is a motivator because it assists the commanding officer in establishing accountability for consistent, continuous management improvement.

Work Measurement--a Means of Communication

Likewise, work measurement is a valuable tool because analysis of the various departments' work measurement facts enables the commanding officer of a local station to better "get the word" on what is going on in the departments of his command. The Work Measurement reports also enable departments and officers to gain appropriate recognition from the commanding officer as well as provide him with a means of reporting to those higher authorities to whom he is responsible. In short, Work Measurement facts are worth more than opinions for the officer doing a good management job.

C. WORK MEASUREMENT NOT THE ONLY  
ELEMENT IN GOOD MANAGEMENT

Work Measurement is not the only tool or element in good management and should not be used in an attempt to replace all other management tools. But of all management techniques available, Work Measurement is the best "STARTER." Why? Because:

- (1) it shows where a detailed analysis of Naval management problems may be beneficial, and
- (2) it lends itself to the development of a broad approach to the solution of management problems, taking into account the many factors which relate to these problems.

One of the purposes of this manual then, is--through the installation of a local Work Measurement system--TO ENCOURAGE OFFICERS IN ADMINISTRATIVE BILLETTS TO DEVELOP A SYSTEMATIC METHOD OF ATTACKING MANAGEMENT PROBLEMS. Such a method of attack should include viewing every management problem as a part of an ever-changing situation that is made up of a good many important factors. Changing any one of the factors may affect the performance of the entire organization. The successful officer takes all the factors in the situation into account in making decisions relating to running his organization.

While it is beyond the scope of this manual to list all the principles and elements of good management, it does seem appropriate to mention briefly some of the more important considerations that are apt to be encountered in connection with setting up and using a local Work Measurement system. They are as follows:

Objectives

Consider:

- (1) What is the ultimate objective of your station?
- (2) How does your organization contribute to the objectives of the station?
- (3) What functions should you be performing?
- (4) What functions are you performing?

### Organizational Structure

Consider:

- (1) Are the lines of authority clear?
- (2) Are assigned duties clear-cut and well understood?
- (3) Do some men have more than one boss?
- (4) How many people are reporting to any one leader?
- (5) Is responsibility matched with authority?

### Coordination of Action

Consider:

- (1) Do the people in your division understand the functions of others in the division?
- (2) Do the people in your division know what goes on in other divisions and how each person's work fits into the total objectives of the station?
- (3) Do you have a satisfactory method for controlling the progress of work as it goes through your division?

### Billet Analysis and Personnel Assignment

Consider:

- (1) Are the specific requirements in each billet known and stated in writing?
- (2) Are men assigned to billets which utilize their highest skills?

### Work Simplification

Consider:

- (1) Can work methods be improved?
- (2) Is there duplication of effort in getting out the work?
- (3) Can the flow of work be improved?
- (4) Can your office or shop space layout be improved?

### Training

Consider:

- (1) How are training needs determined?
- (2) Is there an adequate training program?
- (3) How are new personnel indoctrinated?

(Appendix D gives some selected references which naval personnel may use to advantage in looking further at the principles and elements of good management.)

### D. RELATION OF QUALITY TO WORK MANAGEMENT

One of the first questions that is usually raised in regard to Work Measurement is: "Does work measurement affect the quality of work?" Or, "How does Work Measurement account for quality?" The answer to the first question is that Work Measurement is but one of many factors usually affecting quality. The answer to the second question is simply that the local Work Measurement system being discussed in this manual does not even attempt to measure quality. Quality must be measured by some other means. The best that can be done is to relate it to Work Measurement data indirectly.

For example, consider the case of the application of Work Measurement to a group whose main subfunction is typing letters. Quality could be reflected in the number of errors and erasures per page. The work unit could be based on pages typed. The performance rate, then, would be in terms of so many hours or minutes per page. The Work Measurement system itself would never measure quality directly, but as the time per page typed decreased (performance rate improved) it would be important

to watch also the quality factor in terms of errors per page. Obviously, when quality began to fall, it would be advisable to encourage yeomen to type at a little slower speed (less effective performance rate.)

As a practical consideration, it should be decided what degree of quality is desirable or necessary before a Work Measurement system is ever established, then set up periodic quality tests to see that quality is maintained. This could be added to the Work Measurement report by simply noting the quality of the work being measured. (No effort has been made to add a quality report to the examples of Work Measurement reports, since the nature of quality reports would have to vary so widely for the many different types of work units being measured.)

E. ILLUSTRATIONS OF HOW WORK MEASUREMENT HAS BEEN USED AND HOW IT TIES IN WITH OTHER MANAGEMENT TECHNIQUES

Bringing Into Focus Weaknesses  
or Problems Where Improvement  
Can be Made

The case of the Seamen Guard at one U. S. Naval Training Center illustrates how Work Measurement can bring into focus a problem upon which action can be taken. There are eight gates at this Center. It is the main function of the Seamen Guard to provide the security protection on these gates.

A local Work Measurement system was set up. The number of people passing through the gate constitutes the work unit, and a report is made bi-weekly. The basic data of (1) man-hours expended and (2) work units completed are kept on an hourly basis at each gate.

It was this hourly count which, after being in operation for only a short time, indicated a possible area of management improvement in assigning seamen to gates. It revealed that one or two gates were being manned by two seamen in the early morning hours when the traffic was much less than that which one seaman guard was handling during the day-time hours.

The point is that (a) Work Measurement brought the problem into focus, and (b) Work Measurement of itself did not indicate whether the condition was right or wrong, nor what action should be taken. There are a number of factors that enter into the consideration of whether a gate should be open or closed, the hours when it should be open, and the number of guards for adequate security.

The factor of the QUALITY of the security enters into the decision. If for fire or security reasons it is decided that it is necessary to have a twenty-four hour watch, then the traffic count will not be a consideration. Another factor is COORDINATION OF ACTION. Even on this relatively simple matter of gate guards, it may be necessary to coordinate with other departments. For example, if the gate in question is used to receive a large body of recruits, it will be necessary to coordinate the activities of the Seamen Guard with the other departments concerned, so the proper number of guards will be on hand at the time needed.

In order that the machinery can be set in motion by which this coordination may be effected most efficiently, it is necessary that the ORGANIZATIONAL STRUCTURE of the Security Department be well outlined and understood by all concerned. For example, it is necessary for cognizant authority to know whom in the Security Department to notify. This individual in turn needs to know whom to inform. This calls for at least an informal understanding of the objectives and functions of the department and who is to perform them. So it is that even a simple problem touches many phases of good management.

#### Planning and Control of Workload

Another example of the use of Work Measurement is the Tabulating Machine Unit. The Tabulating Machine Unit of the Personnel Department seemed to be burdened with a peak work load at the beginning of the month. This was largely due to the fact that so many reports had to be turned out before the 15th of each month.

A look at the Work Measurement facts for the Tabulating Machine Unit revealed that while the "reports" subfunction had a heavy workload at the beginning of each month, the "key punching" and "daily processing" subfunctions actually experienced a "slack" period during this time. This discovery showed the section head where men could best be pulled at the beginning of the month to work on the peak-load job in getting out the monthly reports.

In doing a good management job, no one element of management can be considered in isolation. Thus there is more to handling effectively the above problem than simply deciding to pull some men off one desk and adding them to the working force which is putting out the monthly reports. What are some of the other important considerations?

#### (1) ORGANIZATIONAL STRUCTURE

In pulling men from the "key punching" and "daily processing" subfunctions and assigning them to the "reports" subfunction, are the lines of authority made clear after the shift is made? Do the men from "key punching" and "daily processing" report to a new petty officer in

the section doing the "reports" subfunction? If so, does the petty officer in the "reports" subfunction section know exactly who is reporting to him? Do the petty officers in charge of "key punching" and "daily processing" know for sure the men who are no longer reporting to them?

## (2) COORDINATION OF ACTION

Do the personnel in "key punching" and "daily processing" understand what goes on in the "reports" subfunction and why it is important to transfer some personnel "to lend a hand" at the beginning of the month to get out the monthly reports? The point is that before coordination can be developed to any high degree, the personnel in one section or subfunction must have explained to them the functions of others in the organization and how what is done in each place relates to the fulfillment of the objectives of the organization. Also the personal objectives of the personnel doing the work must be taken into account.

## (3) HUMAN RELATIONS ASPECT

In pulling men from one part of an organization and assigning them temporarily to work in another part of the organization, consideration should be given to what might be termed the human relations aspect of the situation. By this is meant the status factors and emotional reactions which are present in the group. These human relations factors may not be so important in the illustration of the Tabulating Machine Unit where men were being shifted within a relatively small, close-knit group. However, they could be important considerations, say, in shifting men from the Personnel Office to the Commissary Department. The point to be made is that any resentment on the part of personnel to fit into a new situation should be anticipated and considered in the total job of striving for effective management. Men so transferred must understand the need for effective personnel utilization.

## (4) TRAINING AND INDOCTRINATION

Another element of effective management which has a bearing on the problem described in this illustration is the matter of training and indoctrination. Specifically, before a decision is made to transfer men temporarily from one part of an organization to another, it should be established that the men to be transferred are properly trained to handle the kind of work to which they are being transferred. Otherwise, more harm than benefit may come from the transfer.

Again, this case of the Tabulating Machine Unit is an illustration of how Work Measurement points out the problem, but its solution depends upon handling properly a number of factors in the work situation.

## Determining Manpower Requirements

One of the most important illustrations of use of work measurement deals with personnel allowances. Nearly all shore activities are faced with the problem of supporting personnel allowances by presenting facts regarding man-hours expended and an accounting of what the Navy gets for those man-hours. The more intangible the output the more knotty the problem becomes.

One Service School was presented with the problem of forecasting how many additional instructors would be needed to carry an increased student enrollment. The school had the standards established by higher authority for the number of students to be in one class room; but what about standards for the instructor's time to perform his other necessary duties, such as examination writing, In-Service Training, etc.?

Work Measurement has not been the whole answer to the problem; but it has done two things: (a) resulted in a study and analysis of exactly what duties instructors are performing, and (b) afforded an accounting of how many man-hours are being spent on each duty or subfunction. For example, the Training Officer now receives a regular report on "In-Service Training," since the man-hours spent on this and the number of topics covered is a regular part of the work measurement report.

Even in a school situation other management factors come into play. If SPECIALIZATION is to be practiced, in the form of all instructors using the same examinations for instance, then a great deal of COORDINATION OF EFFORT must take place. Planning and scheduling are a big problem, too, in any school situation. Another factor important to a school is a program of TRAINING AND INDOCTRINATION for its own instructors. On the professional subjects, schools give great and justifiable place to their Instructor Training and In-Service Training programs.

To summarize the case, by breaking down the problem into duties or subfunctions, it is more realistic to estimate the man-hours it will take to perform the additional work load and thus arrive at an educated estimate of the number of instructors necessary to do the job, than to try to estimate the total work load all at once.

## Indicating Trend in Performance Record of Group

By watching over a period of time the man-hours expended, work units completed, and the man-hours per work unit on each subfunction, a department head was able to see whether the utilization of his manpower was increasing, decreasing, or staying about the same. When his manpower utilization was decreasing, (that is, taking more man-hours to turn out each work unit) the Work Measurement facts did not automatically show

why the decrease in utilization. The facts caused the department head to begin to wonder "why" the downward trend. Was it due to inefficient work methods? Was it due to low morale? Was it due to lack of training; or, was the downward trend due to a drop in the workload? If the downward trend was due to a drop in the workload, was it a seasonal or temporary drop, or was it the result of a long-term policy to cut down workload? If it were the latter, plans should be considered to make a systematic reduction in personnel, with the least disruption possible.

#### Reducing Opinions to Facts

A division head, for example, may feel pretty sure he is running an efficient shop and that his utilization of manpower is continually improving. This, however, may be looked upon as "only one man's opinion" without some actual facts on the manpower used and the work turned out.

Consider the example of leading petty officer in the Supply and Commissary Department who comes to his division head to complain that he needs more personnel to get the job done. If the division head has Work Measurement facts on past performance, he is in a good position to make the leading petty officer really justify his request for additional personnel. Thus the division officer protects himself from being given a "snow job" by a would-be empire builder. And so Work Measurement provides a better chance of decisions being made on the basis of facts, rather than on the basis of who is the best talker.

#### Indicating the Need for Management Studies

Suppose for example that Work Measurement facts in the disbursing office show a consistently decreasing number of checks and cash payments being made per man-hour expended. If a preliminary analysis of this definite trend shows no unusual circumstances which account for it, a more thorough management study on work process and work flow might be indicated. The point to be made is that Work Measurement facts indicated the need for such a study.

#### Checking the Results of Action Taken

If action has been taken in regard to improvements in organization, procedures, methods, equipment, or training, Work Measurement facts can be used to evaluate the effectiveness of these improvements. For example, facts showing the relation between man-hours expended and work units completed before and after installation of a new work flow plan would be a good check on its effectiveness.

Summary: In summary, the following quotation gives the essence of the importance of Work Measurement to the officer at the local command level:

Work Measurement provides one vital means of regularly reviewing and appraising operating and management practices. By providing accurate and reliable data concerning man-hours expended and work units accomplished, the Work Measurement system highlights the areas in need of study. In addition, continued observation of the performance data will show the effects of actions taken. Thus, are pointed up the before-and-after effects of procedural, organizational, layout and related changes.

#### F. SELECTING THE OBJECTIVES OF YOUR WORK MEASUREMENT SYSTEM

At first, you will probably not want to try to apply Work Measurement to all of the uses described above. But the above examples may well be used as a guide for the local officer in setting objectives for his own Work Measurement System.

These uses of Work Measurement are summarized briefly below for quick reference.

- (a) Bringing into focus weaknesses or problems.
- (b) Planning and control of work load.
- (c) Determining man-power requirements.
- (d) Indicating trend in performance record of group.
- (e) Reducing opinions to facts.
- (f) Indicating the need for management studies.
- (g) Checking the results of action taken.

Determine now what you want work measurement to do for you. (A sample work sheet is provided in Appendix C for recording the objectives you select for your Work Measurement System.)

## FART II

### STEPS IN SETTING UP WORK MEASUREMENT

THREE STEPS for setting up a system:

- A. Identifying possible areas of Work Measurement, and determining subfunctions.
- B. Selecting work units.
- C. Setting up a reporting system.

#### A. STEP ONE: IDENTIFYING POSSIBLE AREAS OF WORK MEASUREMENT, AND DETERMINING SUBFUNCTIONS

Identifying possible areas of Work Measurement involves what should be measured and what it is possible to measure. What should be measured is the work that is necessary for accomplishing the principal objective of the group. Measurement takes place in terms of "evidences" of the performance of such work.

Broadly speaking, all work of an organization may be classified into:

- (1) Operative Work.
- (2) Managerial Work.\*

Operative Work is concerned with turning out projects and is more the production type of work that is easily countable in terms of physical units turned out. Some examples are: recruits trained, page typed, and miles driven. Managerial Work consists of planning, organizing, and controlling the work of others. It is supervisory work. It is concerned with groups, and its effectiveness is judged by the effectiveness of the group it controls. Leadership is one of its main functions. This makes Managerial work highly intangible and difficult to count in terms of work units turned out. Some examples are duties of officers-in-charge and division officers, and training officers of schools.

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\* See Appendix E (Glossary) for a more detailed definition of managerial work and military management.

## Operative Work

A large part of operative work is measurable. That is, it will be possible to count work units and record the time it takes to produce them. In general, initial use of work measurement as a management tool will be best facilitated by measuring most or all of the measurable operative work.

Not all operative work, however, lends itself to Work Measurement. There is some work, the output of which is most difficult to measure in quantitative physical units. The activities of the fire department, and similar watch standing frequently fall in category of unmeasurable operative work. But do not succumb to the tendency to take the "easy" way out and classify a good deal of work as unmeasurable which could in fact be measured. It should be recognized that some watch-standing can be and probably should be included in the category of measurable operative work. A case in point is the Seamen Guard on the gates. The number of vehicles and pedestrians often make good work units, and information on traffic through the gates can provide valuable facts for management improvement.

An important point to remember in regard to operative work is that any work measurement system must have a certain amount of flexibility. Work which lends itself to measurement, and is worth measuring, should be measured. Where it is not possible to measure the work, or the value of measuring it can be questioned, other ways of handling it should be considered. One possibility is to simply list the functions and the time being spent on each. (Specific situations may suggest other ways of handling such cases, but listing the functions and time spent on them seems most promising.)

An excellent illustration of a situation which calls for flexibility is in the case of a station band. It is difficult to measure the work of a band and the value of such measurement can be questioned. But it does make sense to list the functions of the band and time spent on them. Thus a band director can record the number and amount of time spent on drills, concerts, practice sessions, etc.

While flexibility is a necessity, work measurement should account for a large enough portion of the total operative work to indicate that: (a) it makes useful contributions to the objectives or mission of the organization, and (b) that the number of personnel on board is justified. Measuring three-fourths or eighty per cent of the operative work done will usually meet these conditions; and it is usually possible to measure this much of the work.

### Managerial Work

The effectiveness of managerial work can be judged by the performance of the group being supervised. Managerial work usually does not lend itself to direct measurement in terms of physical units. It falls in the area of unmeasurable managerial work. Although managerial work may not be measurable in the usual way on a Work Measurement report, it is desirable to note the ratio of supervisory personnel to other personnel on board.

### When Supervisor's Time Is Spent in Both Operative and Managerial Work

It is often the case in the Navy that a great deal of a supervisor's time is taken up with both managerial and operative work. For example, a Chief Yeoman may supervise five or ten lower rated yeoman in an office, but still perform operative work of typing letters and reports. The question becomes whether or not to measure his work along with the other yeomen. A good rule of thumb is: if more than twenty-five per cent of the time spent by the individual is on operative work, then that operative work should be included in the Work Measurement report, as operative work. As pointed out above, the portion of the managerial work of the supervisor can be listed as managerial work.

### Summary

It has been indicated above that there are two major types of work: (1) operative, and (2) managerial. Operative work lends itself more readily to direct measurement. Managerial work usually does not lend itself to direct measurement, but its effectiveness can be judged by the performance of the group being supervised.

There is need for flexibility in a work measurement system. It may be impossible or undesirable to measure all of the operative work. Where this is the case, one way of handling the situation is to list the functions performed and the time spent on each of them.

Regardless of the specific variations in different groups, a work measurement report is of little value unless the total number of personnel, the functions they perform, work units turned out (for measurable work) and time available or used to do the work are specified. This means that all operative work (both measurable and unmeasurable) and all managerial work (unmeasurable) will be accounted for in the work measurement report.

Examples Of Areas Of Measurable Work--A Listing of Subfunctions

What then are the measurable work areas of your division? A look at the work being performed is the key to the question. In the case of a Transient Section of the Personnel Department, one might well pick some list of measurable areas such as the following subfunctions:

- Transferring personnel
- Receiving personnel
- Processing correspondence

The measurable areas of Clothing and Small Stores activity might look something like the following:

- Clothing issued to recruits
- Bedding issued to recruits
- Storing in the bulk warehouse (male)
- WAVE sales
- Sales in salesrooms

Now determine areas of measurable work. (A sample worksheet is provided in Appendix C for recording the areas of measurable work you select for your Work Measurement System.)

B. STEP TWO: SELECTING WORK UNITS

One of the most crucial aspects of any work measurement system is the selection of work units. These are the units by which the work is measured; hence they must satisfy certain requirements to make them sound measuring devices.

Requirements for a Good Work Unit

In looking for a work unit, you should try to make it meet the following requirements:

- (1) IS IT COUNTABLE? The work unit must be capable of being counted. It must be readily accessible for counting. Frequently it may be possible to pick a unit that is already being counted such as: orders written, students processed, square feet of floor space maintained, gallons of gas consumed, etc.

- (2) IS IT REPRESENTATIVE OF THE WORK ACCOMPLISHED? The work unit must adequately represent the work effort and work turned out for a function or subfunction. It must be representative in the sense that it is a fair indication of work performed. For example, mileage is not a good work unit on trucks that repair sewers if they are compared to other trucks which haul gravel; because trucks repairing sewers stand still a great deal of the time while workmen repair the sewers. Gravel trucks, however, are almost constantly on the go. Sewers cleaned, therefore, would be a better unit for sewer trucks, and ton-miles of gravel hauled would be better for gravel trucks.
- (3) IS THE QUALITY OF THE WORK UNIT CONSISTENT? As pointed out previously Work Measurement does not measure quality, but the quality of the Work Unit chosen should be standardized for Work Measurement to be meaningful. The work unit must stand for work of a similar quality. This means that over a given period of time the quality of the work will be on a fairly even keel. Quality should be maintained at a relatively constant level.
- (4) IS THE TERMINOLOGY CONSISTENT AND FAMILIAR? Where there is similarity in work among several groups, consistency and use of familiar terminology is important. If different groups are performing similar functions it may be possible to use the same work unit. Typing correspondence, for instance, is common to a number of departments or groups. A potential work unit for all of them may be a piece of correspondence typed. Even though all letters are not of the same length, they will average out so that groups of letters will take uniform amounts of time.
- (5) DOES THE WORK UNIT MEASURE WHAT YOU WANT TO CONTROL? What you want to control is obviously, some phase of your work that enters into the accomplishment of your objectives. This will be some function or functions being performed in your group. The work unit preferably should be an end product of the function or functions you wish to control.

Remember that you want a work unit which will do an economical job of measuring what you want to control. It should strike a happy balance between being

overly refined or too gross. No hard and fast rules can be stated, but work units can be so minute and detailed as to be cumbersome and impractical or they can be so gross that they offer few useful facts. Through experience, it is usually possible to find a work unit which best meets the requirements of a good work unit.

#### Examples of Work Units

Before giving specific examples of work units which might reflect the output of various divisions and departments, a distinction needs to be made between variable work units and fixed work units.

Variable work units are those which represent tangible work products completed, and which accumulate during a reporting period. Examples are patients treated in Medical Services and number of completed Courts Martial cases.

Fixed work units are those which remain relatively constant and which represent stable workloads on which effort is spent period after period. Examples are thousands of square feet of floor space maintained, and miles of railroad track maintained.

In Figure 2 examples of work units are given to point up the fact that a wide variety of work units may be used in work measurement and to suggest potential work units for various divisions and departments in the naval situation. This list is by no means complete nor are the work units necessarily considered ideal. They are suggested to encourage you and your group to apply your practical experience to evaluating these work units in the light of general rules outlined above.

Figure 2

ILLUSTRATIVE WORK UNITS

Division and/or Operation	Work Unit
Transfer Division of Personnel Department	Service School transfer orders written Recruit transfer orders written, etc.
Personnel Accounting Office of Personnel Department	Personnel diary entries Changes processed Men processed Statistical reports completed
Insurance Office	Insurance contacts Check-ins Discharges Benefit sheets Beneficiary and options Waiver applications
Barracks	People berthed Square feet of floor space
Postal Unit	Pieces of mail handled Persons processed at window Address cards typed
Dental Department	Extractions Restoration surfaces Prosthetic appliances Sittings
Medical Department	Calls at sick bay Physical exams given
Legal Department	Cases processes Court martial records completed Final record entried
Service School	Number of students Number of examinations Number of classes supervised
Clothing and Small Stores	Dollar value of sales and issues

Figure 2 (Continued)

<u>Division and/or Operation</u>	<u>Work Unit</u>
Galleys	Rations fed Personnel subsisted
Seamen Guard	Cars per hour through gate Pedestrians per hour through gate Passes issued

Procedure for Selecting  
Work Units

Now that you have some idea of the requirements for a good work unit, specifically how do you go about selecting work units for your division or department?

- (1) The first thing you need to do is make a list of the things your division does. (These are the subfunctions. Subfunctions for the Transfer Division and those for Clothing and Small Stores are illustrated above in Step One.)
- (2) List possible work units.
- (3) Test potential work units against the list of characteristics described above.

In regard to each work unit: IS IT COUNTABLE? IS IT REPRESENTATIVE OF THE WORK ACCOMPLISHED? CAN QUALITY BE HELD RELATIVELY CONSTANT? IS THE TERMINOLOGY CONSISTENT AND FAMILIAR? WILL IT MEASURE WHAT YOU WANT TO CONTROL?

Now determine work units. (A sample worksheet is provided in Appendix C for recording work units you select for your Work Measurement System.)

C. STEP THREE: SETTING UP  
A REPORTING SYSTEM

A proper reporting system should include records for collecting workload (work units completed) and man-hours expended, and reports for transmitting data. Whenever possible present records should be used as sources of basic data on (a) man-hours expended, and (b) work units produced. These basic data should be collected at a convenient time interval when the records are being worked on anyway, such as each week or every two weeks. In order to keep paper work to a minimum, the completed Work Measurement reports should be issued monthly, bi-monthly, or quarterly. These reports usually should be transmitted from the group level to the officer in charge, and from him to his commanding officer or otherwise as directed. Naval Training Centers which have a Management Engineer's Office probably will use that office as the coordinating agent to summarize reports for use by the Center Commander's Office.

The method of computing a simple ratio, showing the relationship of man-hours expended and work units produced, follow. It is illustrated in Figure 3. Examples of forms that may be used in reports for transmitting Work Measurement data are illustrated in Figures 4 and 5.

Computing Performance Rate  
(Using a Single Work Unit)

Assume for the moment that you are in charge of a small office whose function is to issue war bonds. A record card is made out for each war bond issued, and so at the end of the day you go over and count the number of record cards which have accumulated during the day. Suppose that after you have counted the number of record cards which have accumulated for the day, you calculate the man-hours expended during the day in performing the work. You have three people working in the office. Each person works an eight-hour day. You can easily arrive at the fact that twenty-four man-hours were spent producing the work turned out. (Three people at 8 hours equals 24 man-hours.) If your count of the number of record cards accumulated at the end of the day is 120, you can then relate the work performed and the manpower used in performing the work. This can be done by computing a performance rate.

A performance rate is the man-hours expended divided by the work units completed.

See Figure 3 below for an illustration of the performance rate for the work in the war bond office during a typical day. Figure 4 shows a monthly report by this War Bond Office.

Figure 3

Performance Rate For Work Done In A War Bond Office  
During A Typical Day

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Manpower used = man-hours expended = 24

Work units completed = number of record cards = 120

Performance rate =  $\frac{\text{man-hours expended}}{\text{work units completed}} = \frac{24}{120} = 0.2$  man-hours per work unit or 12 minutes per work unit.

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Figure 4

Sample Copy Of A Work Measurement Report Form

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War Bond Office (Monthly Report)

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(1) Subfunction	(2) Description of Work Unit	(3) Man-Hours Expended	(4) Work Units Completed	(5) Performance Rate (3) ÷ (4)
Issuing war bonds	Record card	480	2400	0.2

---

Computing Performance Rates  
(Using Multiple Work Units)

The above example (Figure 4) is an illustration of presenting Work Measurement information in a fairly simple form. It may be possible to find a single work unit to measure the work, but in most situations, it is necessary to use a number of work units. An example of how to report multiple subfunctions is shown in Figure 5.

Figure 5

Sample Copy of Transient Section's Work Measurement System

Naval Station "A" Transient Section Personnel Department (Monthly Report)				
(1)	(2)	(3)	(4)	(5)
Subfunctions	Description of Work Units	Man-Hours Expended	Work Units Completed	Performance Rates (Hrs. per W. Unit) (3) ÷ (4)
Transfers	No. of men transferred	2448	958	2.56 man- hours per work unit or 2 hours 27 min. per work unit
Receipts	No. of men received	944	688	1.37 or 1 hour 22 min.
Correspondence	No. of pieces of correspond- ence	752	4928	0.153 or 9 min.
Measured oper- ative time		4144		
Available Time:			Normal Work Week	40 hrs.
	Operative (measured)	4144	No. of Supervisors	3 men
	Operative (unmeasured)	0	No. of Operative	
	Managerial (unmeasured)		Personnel	29 men
	(160 hours x 3 men)	480		<u>32 men</u>
	Total Available	<u>4624</u>		
Unavailable Time:			Total time = 5120	
	Leave	320	Man-month	160 = 32 men
	Sick List	176		
	Total Unavailable	<u>496</u>		
Total Time		<u>5120</u>		

Reporting Operative  
Man-Hours Expended

Work Measurement is relating the amount of work performed against time taken to do it; consequently the time charged to the work units completed in the performance of a subfunction must be as nearly accurate as possible if the system is to be effective. The problem is to select a system of recording man-hours which is easily recorded and reported, capable of verification, an accurate reflection of actual time spent in doing the work and comparable over a period of time. A Work Measurement system could be said to be no more reliable than its report of man-hours expended and work units completed.

Operative Man-Hours Expended  
Equals Actual Process Time  
Plus Proportionate Allocation  
of All On-Job Time Remaining

The number which is entered in the "Man-Hours Expended" column opposite each subfunction on a transmitting report should indicate as closely as possible the over-all time actually spent in performing the work of that subfunction. See Figure 5 for an illustration. The first subfunction is "transfers," and during the month reported, 2448 man-hours were spent on it. These man-hours equal the actual time it took the yeomen to process the transfers plus a proportionate amount of all the on-the-job time not spent in actually processing work units. Operative man-hours expended do not include leave, time of personnel on the sick list, supervisory time, or watch standing after normal working hours. It is process time plus lag time put in by the personnel who are at work during the day. When a local Work Measurement system is first established, there are two practical ways of keeping the time of man-hours expended on the different subfunctions:

- (1) The supervisor can keep a log of time spent on the subfunctions performed, or
- (2) the yeomen or other workers can keep a log of time spent on each subfunction as they do the work.

These two methods of recording man-hours expended have certain weaknesses, but they appear to be the most practical for most naval situations at the present time. The weakness of having the supervisor keep these logs is that it consumes his time on clerical duties that might well be used for supervision. A possible solution many times may be to delegate this detail to one of the yeomen or responsible seamen. Having people keep their own time, of course, has the weakness that they can allocate time among their different subfunctions in a

manner that is different from reality, in an effort to "look good." If the supervisor suspects this practice, a spot check by keeping his own log for a day or so will disclose such irregularities.

It should be noted that the total of the measurable operative man-hours expended on all subfunctions does not account for the total time of all the personnel attached to the activity. (See Figure 5 above.) Unmeasurable operative and managerial time, time on leave and on the sick list, make up the difference. Unavailable time plus total available time are equal to normal work days' clock time of all the personnel being reported upon. This sum divided by 160 hours (normal working month per person in this case) should equal the number of personnel aboard, doing the work being performed.

#### Military Watch Standing Recorded Separately

As pointed out earlier in this Manual, hours spent in watch standing can be recorded in a number of different ways:

- (a) If watches are not measurable and are performed after normal working hours, the time so spent should be listed separately at the bottom of the report. (See Table 2, page II-30)
- (b) If the watches are stood after the work day hours and output is the same type of work units as that during the normal working day, a separate work measurement report should be kept of these watches.
- (c) If watches are an important part of the normal day's work and can be measured, work units turned out and time to produce them should be included in the regular work measurement report.

#### Three Steps Lead To Action For Improving Management

To summarize Part II, there are three steps to setting up the machinery for a local Work Measurement system:

1. IDENTIFYING POSSIBLE AREAS OF WORK MEASUREMENT, AND DETERMINING SUBFUNCTIONS.
2. SELECTING WORK UNITS.
3. SETTING UP A REPORTING SYSTEM.

It goes almost without saying that Work Measurement reports solve no problems of themselves. Something must be done as a result of the reports. This is the subject of Part III, "Continuous Review of Work Measurement Facts Leading To Programs of Specific Management Improvements."

## PART III

### CONTINUOUS REVIEW OF WORK MEASUREMENT FACTS-LEADING TO PROGRAMS OF SPECIFIC MANAGEMENT IMPROVEMENTS

The real value of a local Work Measurement system comes, of course, from continuous review and analysis of the reports. Part III deals with presenting Work Measurement data in useful form for analysis, and with suggesting methods of improving management of Naval Shore Stations.

#### A. PROCEDURE FOR ANALYZING BASIC DATA

The three steps in Part II of the manual explain the process by which Work Measurement data can be collected. The following steps should be taken to enable better analysis of the data.

##### Step One: Collect Monthly Work Measurement Facts

In order to facilitate the monthly compilation of data, a work sheet is recommended (See Table 1, p. 28). This work sheet is for collection of facts for a four-week period. Man-hours expended and work units completed are recorded weekly. Then, by adding horizontally in the case of each subfunction, man-hours expended for the month are calculated.\* The same thing is done for work units for each subfunction. For example, under subfunction "Ship's Company Transfers" by adding horizontally, a total of 552 man-hours is obtained; for work units, the four week total, added in the same manner, is 298.

The weekly totals of man-hours expended on all subfunctions should equal the monthly summary total of man-hours expended. (For example, 620, 651, 705 and 679 equal 2655.) This permits a check on mathematical accuracy in compiling the man-hours data. The same procedure can be followed for work units, but these totals are not necessary for subsequent calculations; therefore their computation is optional.

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\* Most months, of course, will have slightly more than four weeks in them and work sheets should include all the work days in the month.

TABLE 1:

Work Sheet  
Transfer Division, Personnel Dept.  
Work Measurement Performance Data

Sub-Function	Description of Work Units	First Week		Second Week		Third Week		Fourth Week		Monthly Summary*	
		a.	b.	a.	b.	a.	b.	a.	b.	a.	b.
Ship's Co. Transfers	Ship's Co. T.O.	128	68	145	81	99	54	130	95	552	298
Service Sch. Transfers	Service S. T.O.	140	148	120	130	197	205	100	99	557	582
Recruit Transfers	Recruit T.O.	162	1058	197	1235	190	1056	145	1036	694	4385
Two Weeks Reserve	Transfer Orders	56	57	46	49	71	75	120	133	293	314
Draft Escort	Draft E. Orders	30	25	31	29	35	32	30	24	126	110
Discipline	Disc. O.	30	19	34	31	35	20	30	21	129	91
Shore Patrol	Shore P. T.O.	40	74	40	72	40	71	40	80	160	297
Hospital	Hospital T.O.	34	81	38	85	38	90	34	87	144	343
Total Measured Operative Time		620		651		705		679		2655	

a. Man-Hours Expended  
b. Work Units Completed

T.O. Transfer Orders  
\* Four week month assumed in order to simplify.

### Step Two: Calculate Performance Rates

From Table 1, transfer the monthly summaries to Table 2, p. 30, Columns 1 and 2 respectively. Then calculate performance rates for each subfunction. For example, in Table 2 (subfunction - Ship's Company Transfers), 552 man-hours divided by 298 work units equals 1.85 man-hours per work unit. A similar calculation yields 0.96 for the subfunction, "Service School Transfers." For other individual performance rates, see Column 3.

### Step Three: Choose Temporary Standards

In order to compare this month's performance with subsequent monthly performances, it is necessary to establish a standard performance rate for each subfunction. It should be recognized that this standard is only TEMPORARY. The reason for selecting a temporary standard rate is to provide a base for analyzing the trend in performance.

The temporary standard must be determined on the basis of judgment. If it is believed that there are no unusual circumstances present, the first month performance rate for a subfunction can be taken as representative, and used as a temporary standard. Experience must be relied upon to a large degree in setting temporary standards. It remains for time to validate the temporary standard, or to refute it. For example, in Column 4 of Table 2, all performance rates with a single asterisk (\*) used the first month performance as standard. The double asterisk (\*\*) on the temporary standard (1.30\*\*) for the subfunction of "Discipline" indicates that it is agreed to be a better temporary standard than the first month's performance rate.

In other words, when setting temporary standards the prescribed procedure is to look at the results of the first reporting period (usually one month or one quarter) and ask the following questions: For the man-hours expended is the total of work units completed in line with what experience tells you reasonably should be produced? If not, what should have been the number of man-hours expended on this number of work units completed? How does this compare to the performance rate of the period in question? Then set a standard based on judgment as the temporary standard.

In choosing temporary standards a number of problems may be encountered. There may be excess personnel on board, so that many of them simply do not have a full day's work to do. Some personnel may be in on-the-job training, doing some work but not equaling the work a well-qualified individual can turn out. Or a standard for one level of operation may not be equally applicable when the workload is greatly increased. The latter may be illustrated by a galley example. Let

TABLE 2:

Transfer Division, Personnel Dept.  
Work Measurement Performance Data

First Month Summary

Sub-Function	Description of Work Units	(1) Man-Hours Expended	(2) Work Units Completed	(3) Performance Rate (Man-Hours Per Work Unit)	(4) Temporary Standards	(5) Standard Man-Hours
Ship's Co Transfers	Ship's Co. Transfer Orders	552	298	1.85	1.85*x 298	552.00
Service School Transfers	Service School Transfer Orders	557	582	0.96	0.96*x 582	557.00
Recruit Transfers	Recruit Transfers for Orders	694	4385	0.16	0.16*x 4385	694.00
Two Week Reserve	Trans. Orders	293	314	0.93	0.93*x 314	293.00
Draft Escort Discipline	Draft E. Orders Disc. Orders	126	110	1.15	1.15* x 110	126.00
Shore Patrol Hospital	S.P. Trans. Orders Hosp. T. Orders	160	297	1.41	1.30** x 91	118.30
		144	343	0.54	0.54* x 297	160.00
		2655	--	0.42	0.42* x 343	144.00
	Measured Operative Time		--	--	--	2644.30

\* Performance rates of First Month deemed representative.

\*\* Agreed to as being more representative than the monthly performance rates.

TABLE 2  
 (Continued)  
 Transfer Division, Personnel Dept.  
 Work Measurement Performance Data

First Month Summary

Available Time:

Operative (measured)	2655
Operative (unmeasured)	0
Managerial (unmeasured)	<u>640</u>
Total Available	3295

Unavailable Time:

Leave	320
Sick List	225
Total Unavailable	<u>545</u>
Total Time	3840

Military Duties 295 hours

Normal Work Week 40 hours

No. of Supervisors	4 men
No. of Operative Personnel	<u>20 men</u>
Total Personnel	24

$$\text{Index of Productive Efficiency} = \frac{2644}{2655} = 99.59\%$$

us say that 5000 rations are being prepared by 30 mess cooks. If it suddenly becomes necessary to prepare 10,000 rations, it may not be true that 60 (twice as many) cooks are needed. Perhaps only a third more cooks are enough. Thus a temporary standard set for 5000 rations will not apply for 10,000 rations. This increase in the workload has been of such a nature that more efficiency is a natural result. That is, rations can be prepared with proportionately fewer people (less time per ration.)

The kinds of problems mentioned above may be met in many types of work. It is assumed that the individual or individuals choosing temporary standards will have enough experience on the job to take these factors into consideration. The temporary standard may be a rough index, but it will provide a useful guide until enough facts can be collected to arrive at a sounder standard.

#### Step Four: Calculate Standard Man-Hours

Standard man-hours can be derived by multiplying temporary standard performance rates by work units completed. For example, under sub-function "Ship's Company transfers" Table 2, p. II-30, multiply the temporary standard performance rate of 1.85 man-hours per work unit by the actual number of work units completed, 298, to obtain 552.00 standard man-hours.

#### Step Five: Calculate Productive Efficiency--An Index of Man-power Utilization

Divide total standard man-hours by total of actual man-hours expended to obtain the per cent that standard man-hours are of actual man-hours, which is an Index of Productive Efficiency, (See Table 2.) Standard man-hours of 2644 are divided by actual man-hours of 2655 to obtain an Index of Productive Efficiency of 99.59 per cent.

#### Step Six: Set Standards Based on Performance Data to be in Effect as Long as Applicable to Present Conditions

After performance rates for individual subfunctions have been plotted long enough to establish a definite trend, effort should be made to check temporary standards and establish more realistic standards, subject to review from time to time. (Appendix A, pages II-42-49, illustrates methods for this procedure.)

## B. SUGGESTIONS FOR APPLYING WORK MEASUREMENT DATA

Following the analysis of the data, the immediate benefit of a local Work Measurement system comes from applying the data. What application you make of the data depends upon the objectives in the establishment of the system. In addition to the summary of uses of Work Measurement presented in Part I, suggestions are given here. Generally, the objectives and uses can be classified under the following management functions: (a) control or follow-up and (b) forecasting or planning.

### Control and Follow-up

There are many ways Work Measurement data can be used in controlling activities and following up on what is going on in an organization. Some of the more obvious and commonly applicable are as follows:

#### (1) Analysis of each subfunction

For the immediate supervisor an analysis of the individual subfunctions will be most meaningful. It was this kind of analysis which led the officer-in-charge of the Tabulating Machine Unit activity in the case described in Part I of the manual to see that operators on the machines have slack periods at the very time they could be used to help out on making monthly reports.

#### (a) Helps Iron Out Peaks and Valleys in Work Load

Data on the number of work units turned out over a long period of time will show peaks and valleys in work load and if they indicate seasonal or some other regular variations, such data are helpful in planning and scheduling work. On an hourly basis such data could be used in scheduling number of personnel needed for the Seamen Guard.

#### (b) Aids in Allocating Work Within an Organization

Likewise, watching the proportion of the work load that is performed by different subfunctions will enable the supervisor to have better balance in his work load. For example, in the case of the Transfer Division if the people processing Recruit Transfer Orders are overloaded, an analysis of the other subfunctions will indicate how to reallocate the work.

(c) Provides an Automatic Check

Also, the regular Work Measurement report is an automatic check on certain subfunctions. For example, in the case of the Service School mentioned in Part I, the Training Officer has an automatic report on how much "In-service Training" each school is doing.

(d) Helps Support Requests for Personnel

One of the problems that is becoming more and more important is supporting personnel allowances. The local Work Measurement data represent a significant forward step in putting such justification on a factual plane rather than on opinion. First of all, the Work Measurement report is a continuous time and duty study of the jobs in an activity. A mere list of these duties is often enlightening and adds strength to any personnel allowance. When the work units are also given, a basis is provided for discussion regarding their worth in terms of the time expended. Since the local command has determined its own subfunctions and work units, the Work Measurement report should reflect in a true and favorable manner what the organization contributes to running the Navy.

For example in the case of the Transfer Division again, (See Table 2, p. II-30) during the first month there were 2655 hours of available measured time and 545 hours of unavailable time. By considering the problem in smaller segments such as subfunctions, it makes it easier to justify or support the work being done. Likewise the unavailable time consisting of leave and sick list time should cause little disagreement as it is relatively easy to judge if it is reasonable when considered as a separate item. Therefore, it only remains to divide total man-hours of 3840 by 160 (hours per month per man) to arrive at the on board count of 24 personnel, and so account for the personnel allowance needed to do the operative work represented by the production time.

(e) Graphic Presentation Aids

If the officer concerned wishes, he may keep a graph on the subfunctions most important to him, showing the trend of any one or all of the following--(1) man-hours expended. (2) work units completed, or (3) performance rate in man-hours. Figure 6 is an example.

Figure 6

Analysis of Recruit Transfer Orders  
Work Measurement Performance Data

A. MAN-HOURS EXPENDED

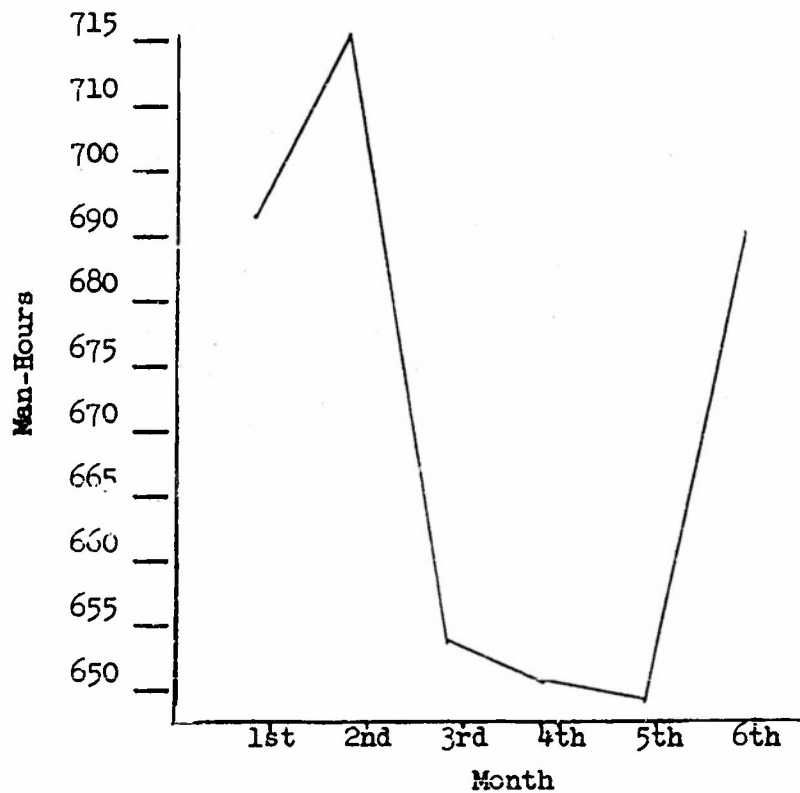
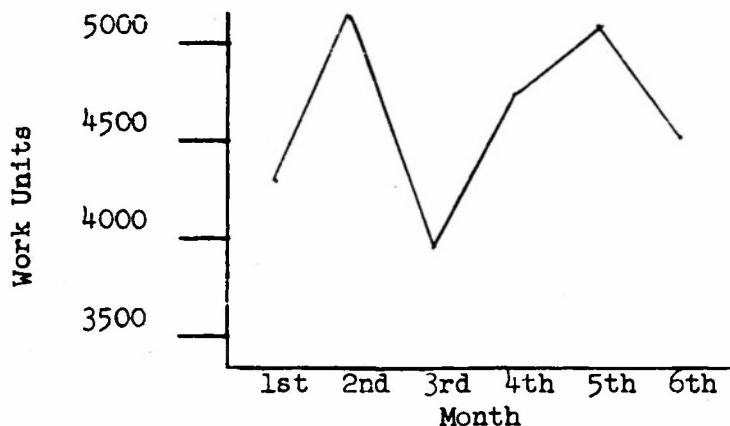


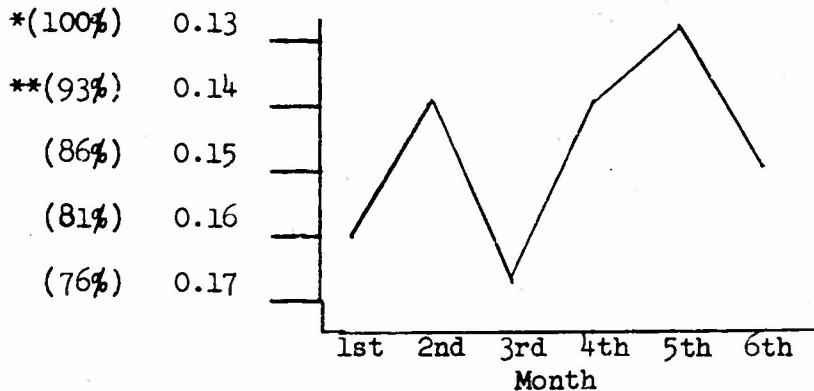
Figure 6 (Continued)

Analysis of Recruit Transfer Orders  
Work Measurement Performance Data

B. WORK UNITS COMPLETED



C. PERFORMANCE RATES



\* Performance Rate of 0.13 is the Performance Standard, thus it is 100% for comparative purposes. (See Table III on page II-46, Appendix A for explanation of establishment of standards.)

\*\* 0.13 divided by 0.14 equals 93%.

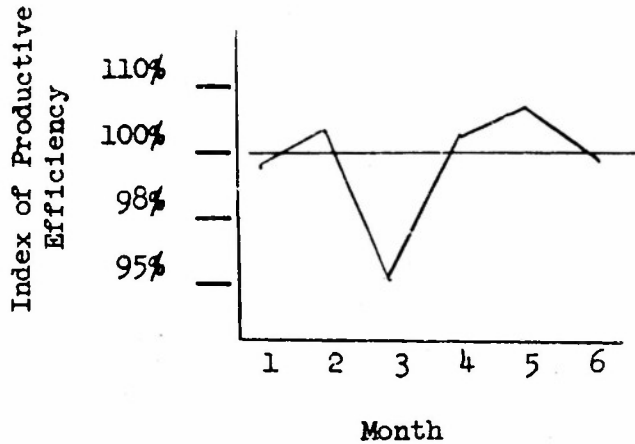
(2) Analyzing Index of  
Productive Efficiency

This index answers the need for an over-all measure. It answers the question: "Over-all, how does the performance of my group compare to the standard?" The per cent of Standard Man-hours is calculated by dividing the total Standard Man-hours by the total of actual Man-hours it should have taken to do the same number of work units. This percentage then gives an indication of how effectively an organization is performing its work load. It is an index of Man-power Utilization, or Productive Efficiency. It may well be that the commanding officer will not have time to analyze each Work Measurement report in detail, but by watching the trend of this percentage over a period of time, he can get a rough estimate of effectiveness. Likewise, such a trend can be compared to that of other organizations, even those which perform different functions. For example, if the Transfer Division's Index of Productive Efficiency is staying above the 100 per cent line (see Figure 7), this can be compared with what is happening to the Index of Productive Efficiency, say, in the Legal Department. The comparison is between how one organization makes out in meeting its standard and how other organizations do in meeting their standards. The rate of improvement, of course, may not be the same in each organization, due to the fact that some groups may be aiming at a higher standard than others. Any reaction to the rates of improvement between organizations should be based on a thorough analysis of how their standards were set. The Index of Productive Efficiency, however, should only serve as a warning signal. It is necessary to look at the individual subfunctions for the explanation of "why" the change from standard. Only in this way can the trouble-areas be pinpointed.

Figure 7 below is an example of how the trend of the Index of Productive Efficiency could be plotted.

Figure 7

Transfer Division, Personnel Dept.  
Work Measurement Performance Data  
Index of Productive Efficiency



Forecasting and Planning

Work Measurement facts can be used to forecast the number of personnel needed to perform an anticipated work load. A typical sort of problem can be illustrated in the case of a Transfer Division of a Personnel Department. Next month there will be a 25 per cent decrease in recruits and a 50 per cent increase in Service School trainees. How many personnel are needed to handle this workload? By considering work measurement data available one can arrive at a reasonably close approximation of the number of personnel necessary to do the work. (Specific details for working through this problem are illustrated in Appendix B, pages II-51 to II-53.)

C. GETTING HELP IN SETTING UP AND  
USING WORK MEASUREMENT

A work measurement program is set up with the most ease when staff assistance is available to coordinate the program throughout the base and to give individual help or assistance to personnel. At larger stations, the Management Engineer is a logical person for this job. He generally has specialized knowledge that can be helpful in solving problems which will arise in regard to work measurement, and he frequently has facilities for doing some of the detail work involved in making work measurement reports. At smaller stations, the commanding officer can appoint a qualified individual to coordinate the program. He too can be expected to help solve specific problems and render assistance to individuals.

Staff assistance can be used in every phase of a work measurement program. The staff member may be of help in identifying areas for measurement, selecting work units, and setting up a reporting system. A staff member's contribution can be even greater in a program of continuous review and specific management improvements. By doing some of the detailed work on reports he can relieve individuals of unnecessary work. By coordinating the program for the entire base, he can direct the total effort toward an efficiency producing uniformity in reporting procedures and assure an understandable communication system both to and from the commanding officer. This staff member can do the important job of presenting an over-all picture of the work measurement program to the commanding officer in a rapid and economical manner. In short, he can help make a work measurement program a useful tool for management improvement rather than a burdensome additional task from which no good is derived.

#### D. REVIEW OF PROGRESS

Following the policy of many progressive businesses, many officers in supervisory capacities hold regular weekly or bi-weekly meetings with their supervisory personnel to review Work Measurement data and plan for improvements. A regular periodic review of the data suggested in the sections above should lead to a discussion of specific management problems--with the people who can do something about them- the local officers, petty officers, and civilian supervisors.

A logical development from such meetings may well be the establishment of regular group meetings with the people concerned. Some of these meetings may be devoted to discussions of problems and possible solutions. Such group discussions should be aimed at uncovering the problems and difficulties that are keeping the activity from having good utilization of man-power. Corrective action and improvements should then be based on these findings. Specific projects to correct or improve the trouble should be undertaken. When the list of specific projects is long, it may be necessary to assign priorities to them, in order to know what can be done and in what order. Such projects could well be assigned to a special staff group that may be available at the station. Such a group is the Management Engineer's Office. However, most Naval Shore Stations do not have this staff available on their personnel allowances, and must request outside help from the bureau concerned.

Besides improvement projects, it may be advisable to institute a program of training, aimed at equipping officers and other supervisors with the understanding of management techniques necessary for the solution of the specific difficulties and problems being experienced by the activity.

Such a training program may well consist of conferences on techniques of work simplification, organizational problems, or difficulties in communication of ideas and coordination of effort. All these conferences should strive to improve the method of attacking the management problem as one involving many factors and forces--the correct solution to which may well be not what is right or logical, but what will work best in the particular situation.

#### E. CONCLUSION

The suggestions for the proper constant review and follow-up on Work Measurement reports are but a skeleton outline of the management principles, techniques, and methods of approach that need to be applied to the daily situations that arise in running a naval shore station. Proper treatment of these subjects is beyond the scope of this manual. The more basic information an officer has on these subjects, the easier it makes his job and the better the results are apt to be. With this in mind, Appendix D has been added as a short list of reference materials which it is considered would be most helpful in these fields. Besides the immediate objective of affording the basic information for setting up a local Work Measurement system, it is the indirect objective of the manual to suggest a program of action to improve the management of naval shore stations.

APPENDIX A

Setting Standards Based on Performance Data

## APPENDIX A

### SETTING STANDARDS BASED ON PERFORMANCE DATA

After performance rates for individual subfunctions have been plotted long enough to establish a definite trend, effort should be made to check temporary standards and establish more realistic standards based on the performance data.

What standards are set should be the decision of the controlling authority---the department head to whom the work measurement report is submitted---subject to the concurrence and approval of the commanding officer. The latter may delegate this function to a subordinate who would assist in securing a satisfactory joint agreement among the interested parties.

A number of factors should be considered in setting a standard; the most important of these are---

- (a) An evaluation of what is a fair day's work.
- (b) An evaluation of what standard will result in improving the performance of the group or activity being measured.

If the standard selected is simply the mean or median of the past six months, it may well be found to fail to lead to improved performance. This conclusion is based on the assumption that the introduction of a Work Measurement system will lead to discovery of areas that can and will be improved. This improvement will be gradual and cumulative and result in improving the performance rate, so that the performance of the last month will be better than the first month's performance. Thus the mean or median will be less than the current performance of the last month. Accepting such a standard would actually be discouraging effective manpower utilization. For this reason, it is advisable to set a standard that will provide a reasonable improvement in performance for the group to work toward.

The setting of satisfactory standards can be done in a number of ways. One of the easiest, and yet acceptable, methods will be illustrated in some detail below.

### Suggested Methods

Table I shows the sixth month summary of work measurement performance data in the Transfer Division of the Personnel Department. It should be noted that temporary standards which were chosen at the end of the first month (process of choosing temporary standards is illustrated in Table 2, page II-30) are still being used for the sixth month report.

With the collection of data for six months the temporary standards can be replaced with standards based on performance rates for the entire six month period.

Table II provides a summary of performance rates in each subfunction for the first six months of work measurement. (To keep the illustration simple, monthly work measurement reports for the second through the fifth months are not shown.)

The performance rates in Table II can now be put in an array from lowest to highest. This is illustrated in the upper position of Table III.

Then the standard can be set in each subfunction. This may be done by computing the midpoint between the median and the best month's performance. Taking ship's Co. Transfers in Table III, the median (middle value) for the six months is 1.83. The best performance rate is 1.75. The difference between these two is 0.08. This divided by two yields 0.04. Adding 0.04 to 1.75 yields 1.79 which can be considered the standard performance rate for the Ship's Co. Transfer subfunction.

When using this method, one caution must be taken. If the best performance rate (in this case 1.75) was the result of circumstances not likely to be repeated and thus yields a figure way out of line with other performance rates, then it should be discarded and a more reasonable value used, for example, the next best performance rate.

It must be remembered that this is a somewhat rough method for selecting performance standards. The ease with which it can be understood and computed recommends it for general use, but it is still not a substitute for using good common sense in checking on its reasonableness.

Using the standard performance rates shown in row five of Table III, standard manhours have been computed for the seventh month of work measurement. This is illustrated in Table IV. The performance standards used in this table can be used until further data suggests that the standards be changed.

(Note: In situations where expert staff assistance is available, and such a step is desirable, a more complicated technique of computing these standards may be used. The standards can be set at one standard

Table I

TRANSFER DIVISION, PERSONNEL DEPT.  
 WORK MEASUREMENT PERFORMANCE DATA  
 SIXTH MONTH SUMMARY

	1	2	3	4	5
	Performance Rate				
Sub-Function	Man-Hours Expended	Work Units Completed	(Man-Hours Per Work Unit)	Temporary Standards	Standard Man-Hours
Ship's Co. Transfers	599	310	1.93	1.85 x 310	573.50
Service School Transfers	544	549	.99	.96 x 549	527.04
Recruit Transfers	688	4587	.15	.16 x 4587	733.92
Two Week Reserve	276	303	.91	.93 x 303	281.79
Draft Escort	122	109	1.12	1.15 x 109	125.35
Discipline	128	93	1.38	1.30 x 93	120.90
Shore Patrol	160	281	.57	.54 x 281	151.74
Hospital	133	333	.40	.42 x 333	139.86
Measured Operative Time	2650				2654.10
Available Time:				Military Duties	270 hours
Operative (measured)	2650			Normal Work Week	40 hours
Operative (unmeasured)	0			No. of Supervisors	4 men
Managerial (unmeasured)	640			No. of Operative Personnel	19 men
Total Available	3290			Total Personnel	23
Unavailable Time:					
Leave	230				
Sick List	160				
Total Unavailable	390				
Total Time	3680				
				Index of Productive Efficiency =	$\frac{2654}{2650} = 100.15\%$

Table II

TRANSFER DIVISION, PERSONNEL DEPT.  
 WORK MEASUREMENT PERFORMANCE DATA  
 MONTHLY PERFORMANCE RATES

Sub-Function	Description of Work Units	First Month	Second Month	Third Month	Fourth Month	Fifth Month	Sixth Month
Ship's Co. Transfers	Ship's Co. Transfer Orders	1.85	1.75	1.88	1.81	1.81	1.93
Service School Transfers	Service School Transfer Orders	.96	.97	.97	.92	.99	.99
Recruit Transfers	Recruit Transfer Orders	.16	.14	.17	.14	.13	.15
Two Weeks Reserve	Trans. Orders	.93	.97	.94	.95	.97	.91
Draft Escort	Draft E. Orders	1.15	1.19	1.18	1.27	1.16	1.12
Discipline	Disc. Orders	1.41	1.39	1.40	1.32	1.39	1.38
Shore Patrol	S.P. Trans. Orders	.54	.50	.58	.49	.51	.57
Hospital	Hosp. T. Orders	.42	.45	.44	.41	.40	.40

Table III

TRANSFER DIVISION, PERSONNEL DEPT.  
 WORK MEASUREMENT PERFORMANCE DATA,  
 ARRAY OF MONTHLY PERFORMANCE RATES AND DERIVED STANDARD RATES

Row No.	SUB-FUNCTION									
	Ship's Co. Transfers	Service School Transfers	Recruit Transfers	Two Week Reserve	Draft Escort	Discipline	Shore Patrol	Hospital		
	1.75	0.92	0.13	0.91	1.12	1.32	0.49	0.40		
	1.81	.96	.14	.93	1.15	1.38	.50	.40		
	1.81	.97	.14	.94	1.16	1.39	.51	.41		
	1.85	.97	.15	.95	1.18	1.39	.54	.42		
	1.88	.99	.16	.97	1.19	1.40	.57	.44		
	1.93	.99	.17	.97	1.27	1.41	.58	.45		
1	1.83	.97	.14	.94	1.17	1.39	.52	.41		
2	1.75	.92	.13	.91	1.12	1.32	.49	.40		
3	0.08	.05	.01	.03	0.05	0.07	.03	.01		
4	0.04	.03	--	.02	0.03	0.04	.02	--		
5	1.79	.95	.13	.93	1.15	1.36	.51	.40		

LEGEND

1. Row 1 - Median
2. Row 2 - Best Performance Rate
3. Row 3 - Difference of Rows 1 and 2
4. Row 4 - Half of Above Difference
5. Row 5 - Best Performance Rate plus Half of Difference = Standard Rate

Table IV

TRANSFER DIVISION, PERSONNEL DEPT.  
 WORK MEASUREMENT PERFORMANCE DATA  
 SEVENTH MONTH SUMMARY, USING STANDARD RATES GATHERED FROM SIX MONTHS EXPERIENCE

Sub-Function	Description of Work Units	Man-Hours Expended	Work Units Completed	Performance Rate				
				(Man-Hours Per Work Unit)	Standards	Performance Standards	Standard Man-Hours	Man-Hours
Ship's Co. Transfers	Ship's Co. Transfer Orders	559	311	1.80	1.79 x 311		556.69	
Service School Transfers	Service School Transfer Orders	521	560	.93	.95 x 560		532.00	
Recruit Transfers	Recruit Transfer Orders	720	5071	.14	.13 x 5071		659.23	
Two Weeks Reserve	Trans. Orders	299	315	.95	.93 x 315		292.95	
Draft Escort	Draft E. Orders	131	111	1.18	1.15 x 111		127.65	
Discipline	Disc. Orders	135	113	1.19	1.36 x 113		153.68	
Shore Patrol	S.P. Trans. Orders	160	314	.51	.51 x 314		160.14	
Hospital	Hosp. T. Orders	140	311	.45	.40 x 311		124.40	
Measured Operative Time		2665					2606.74	
Available Time:								240 hours
Operative (measured)		2665						
Operative (unmeasured)		0						40 hours
Managerial (unmeasured)		640						
Total Available		3305						
Unavailable Time:								
Leave		240						
Sick Call		145						
Total Unavailable		385						
Total Time		3690						
								Index of Productive Efficiency = $\frac{2607}{2665} = 97.82\%$

deviation below the arithmetic mean. Using the performance rates summarized in the upper part of Table III, this technique is illustrated in Table V.)

#### Recompute Initial Work Measurement Data

After new standards are set, it is usually desirable to recalculate basic work measurement data. In the case illustrated above, standard man-hours (Column 5 of the monthly report, Table I or Table IV) and the Index of Productive Efficiency should be recomputed for the first six month's data. This will convert the Index of Productive Efficiency to the new base.

#### Limitation in the Setting of Performance Standards

A standard set for one level of operation may not be equally applicable when the workload is greatly increased. This has been previously illustrated by a galley example when temporary standards were discussed. If 5000 rations are being prepared by 30 mess cooks it may not be the case that twice as many cooks are necessary to prepare 10,000 rations. The increase in the workload may permit greater efficiency. Therefore, the increase in workload will permit rations to be prepared with proportionately fewer people (less time per ration). In this case, the performance standard would not remain constant throughout the entire range of possible work load. In the above example, it should reflect better efficiency at higher levels of operation. It is vital that the individuals determining performance standards have sufficient background to recognize and compensate for this factor.

Table V

TRANSFER DIVISION, PERSONNEL DEPT.  
 WORK MEASUREMENT PERFORMANCE DATA  
 Standard Rates

(Set at One Standard Deviation Below the Arithmetic Mean)

Standard Performance Rates can be set one standard deviation below the arithmetic mean. This will yield comparable results to the method utilized in the above example in Appendix A. For example, when the standard deviation is computed by using the formula for ungrouped data, Standard

Deviation =  $\sqrt{\frac{\sum d^2}{N}}$ , the following results are obtained.

Subfunction	Arithmetic Mean of Performance Rates	Standard Deviation	Standard Rates*
Ship's Co. Transfers	1.84	.06	1.78
Service School Transfers	.97	.02	.95
Recruit Transfers	.15	.01	.14
Two Weeks Reserve	.95	.02	.93
Draft Escort	1.18	.05	1.13
Discipline	1.38	.03	1.35
Shore Patrol	.53	.03	.50
Hospital	.42	.02	.40

\* Column 2 - 3 = 4

APPENDIX B

Using Work Measurement for Forecasting

## APPENDIX B

### USING WORK MEASUREMENT FOR FORECASTING

In Part III, page II-38, it was indicated that work measurement can be used to forecast the number of personnel needed to perform an anticipated work load. Again using the Transfer Division of the Personnel Department, the process of forecasting will be illustrated below. (Data shown in Table IV, page II-47, will be used in the example.)

#### Forecasting Example

During the next month (and for the rest of the new fiscal year) a 25 per cent decrease in recruits and a 50 per cent increase in Service School Trainees is projected. Basically, the problem is one of determining how many personnel will be needed to do the work for the new population.

Table A illustrates the forecasting process. An estimate is made of the number of work units which will have to be completed under the projected conditions. For example, it is estimated that the number of Ship's Company Transfer Orders will remain at the past monthly average. The work load of Service School Transfer Orders is assumed on the basis of past experience to be in direct proportion to the number of Service School Trainees. Therefore, a 50 per cent increase in Service School Trainees can reasonably be estimated to result in a 50 per cent increase in Service School Transfer Orders over the past monthly average. In this manner, the new forecasted work load is built up for each subfunction.

Estimated work units are multiplied by the proper standard performance rates to get the standard manhours necessary to do the work. The forecast for the subfunction of Ship's Company Transfer Orders, for instance, is 300 times the Standard Performance Rate of 1.79. This equals 537 Standard Man-Hours. Likewise the forecast for the second subfunction is 870 work units. Multiplied by the standard performance rate of .95, the result is 826.50 standard man-hours. Forecasted Standard Man-Hours are obtained in a similar fashion for each of the other subfunctions.

The sum of these estimated standard man-hours for the month being forecast, may be divided by 160 (assumed number of man-hours in one month) to arrive at the estimate of the number of personnel needed to perform the forecasted operative work load. In the case of the Transfer Division, the forecast is for 17 personnel. It is necessary to add to

Table A

TRANSFER DIVISION, PERSONNEL DEPT.  
 FORECAST FOR NEW FISCAL YEAR ON MONTHLY BASIS ASSUMING  
 25% DECREASE IN RECRUITS AND A 50% INCREASE  
 IN SERVICE SCHOOL TRAINEES  
 (160 hours = man-month)

Description of Work Units	Estimated Work Units for Month Forecast	Standard Performance Rates	Est. Standard Man-Hours for Month Forecast
Ship's Co. Transfer Orders	300	1.79	537.00
Service School Transfer Orders	870	.95	826.50
Recruit Transfer Orders	3800	.13	494.00
Two Week Reserve Transfer Orders	300	.93	279.00
Draft Escort Orders	100	1.15	115.00
Discipline Orders	90	1.36	122.40
Shore Patrol Orders	315	.51	160.65
Hospital Orders	350	.40	140.00
			<u>2674.55</u> ÷ 160* = 16.72

\* 160 - Assumed Average Man-Hours per Man Each Month

Estimated No. of Personnel for Measurable Operative Time	17
Add No. of Personnel Unavailable Time (14.5%)**	3
Total No. of Operative Personnel Needed	<u>20</u>
Add No. of Supervisory Personnel Needed (21%)***	4
Total Number of Personnel Needed	<u>24</u>

\*\* Per Cent of Unavailable Time to Total Available Time

\*\*\* Per Cent of Supervisory Personnel to Operative Personnel

this figure the number of personnel needed due to the elements of leave time and time that must be anticipated lost due to being on the sick list. To account for this unavailable time, a ratio of unavailable man-hours over man-hours spent in operative work is computed. As a general rule, this ratio would be based on average figures for these categories over a period of time long enough to be considered sufficient to reflect the normal situation. The unavailable time of 385 man-hours is divided by operative work time of 2665 man-hours. This gives 14.5 per cent of the total man-hours available. Thus unavailable time accounts for an additional 3 people. (Seventeen men times 14.5% = 2.46 or 3). Adding 3 people to the 17 men needed to perform the operative work brings to 20 the total number of operative personnel needed.

In making a forecast, it is also necessary to allow for the number of supervisory personnel needed. The number of supervisory personnel needed may be estimated by using the ratio of number of supervisory personnel to total operative personnel, based on past experience. Taking the seventh month figures as typical the percentage of supervisory personnel to operative personnel is 21%. Now if 21 per cent of the total available time is spent in supervision, this supervisory time accounts for an additional 4 people (21% of 20 = 4.2 or 4). Adding these 4 people to the 20 operative people needed gives a total of 24 people. This is the forecast of total personnel needed under the projected conditions.

#### Caution In Forecasting

A forecast in any area is always a prediction of what will happen. It can never be known ahead of time that a thing is bound to happen and that nothing can prevent it. Thus one is faced with the possibility that his forecast can go wrong. Some forecasts are more likely to be wrong than others, so it is wise to make the kind of forecast which has the best chance of being right. The weather man, for example, seems to have a better forecast most of the time if he studies present weather facts than if he reads an almanac and makes a guess.

This has a bearing on forecasting personnel needs for a new work load. A forecast may go wrong. Among other things, the work load may be changed or the standards used may not be accurate. Forecasting personnel needs is like other forecasting. Since it can go wrong there is a real need to make a forecast which has the best chance of being right. A guess can be right, but a forecast based on the best facts available will be right much more frequently. Work measurement facts are the best ones available for accurate forecasting.

**APPENDIX C**

**Sample Work Sheets**

OBJECTIVES WORK SHEET (SAMPLE)

WRITE IN HERE THE OBJECTIVES YOU SELECT FOR YOUR WORK MEASUREMENT SYSTEM. (Refer to page II-12.)

WORK SHEET FOR AREAS OF MEASURABLE WORK (SAMPLE)

LIST HERE THE AREAS OF MEASURABLE WORK IN YOUR ORGANIZATION. (Refer to page II-16.)

WORK UNITS WORK SHEET (SAMPLE)

WRITE IN HERE THE WORK UNITS YOU SELECT FOR YOUR WORK MEASUREMENT SYSTEM. (Refer to page II-20.)

Discussion Questions:

1. Will it be costly to collect the work unit data--in comparison to anticipated results?
2. Are there other work units that may not be as ideal, but more practical to collect and apply?

APPENDIX D

Selected References on Management

## APPENDIX D

### SELECTED REFERENCES ON MANAGEMENT

The field of management has grown to the point where there is a well-developed and extensive body of literature supporting it. (It is interesting here to note that the principles of management have ancient origins, some of them having been taken from the field of military organization.) To cite all of the helpful references on management would be an impractical undertaking for the purposes of this manual. A few selected references are given here, however, to encourage naval personnel to look into them and become more aware of the possibilities of improved management.

#### BOOKS:

Noel, John V., Jr., Commander, U.S.N. The Division Officer's Guide. Annapolis: U.S. Naval Institute, 1952.

Chapter III on "Organization," presents a very readable section on the basic principles of organization as especially applied to the naval situation. Chapter IV on "Administration," does a good job of explaining such concepts as control, delegation of responsibility, planning of work, and personnel assignment.

Beishline, John Robert. Military Management for National Defense. New York: Prentice-Hall, Inc., 1950.

This book deals with the fundamentals of management as applied to the military situation.

Brown, Alvin. The Armor of Organization. New York: Hibbert Printing Co., 1953.

A study by a civilian authority on organization, with an attempt to bring competent outside point of view to the problem of military organization with respect to the public interest in national security. Goes into the problem of organizational policy.

Davis, Ralph C. The Fundamentals of Top Management. New York: Harper and Brothers, 1951.

A very complete presentation of the basic factors and principles in management, including a fundamental statement of business objectives, policies, and general methods that govern the solutions of basic business problems. One value of this book is that it is a good reference bibliography.

Hittle, J.D. The Military Staff, Its History and Development. Harrisburg: The Military Service Publishing Company, 1944.

A well-prepared account of the staff organization and functions of the Armies of France, Germany, Great Britain, and the United States, together with interesting historical background.

Jucius, Michael J. Personnel Management. Chicago: Richard D. Irwin, Inc., 1951.

A complete and readable text on personnel management. Naval personnel should be particularly interested in the presentation in Chapter IV of the meaning and importance of "Organization Structure."

Nelson, O.L., Major General, U.S.A. National Security and the General Staff. Washington, D.C.: Infantry Journal Press, May 1946.

A list of developments of the General Staff concept with reference to the U.S. Army. Shows historically the changes in policy and organization that have taken place.

#### PAMPHLETS AND MANUALS:

Factory Management and Maintenance. Manual of Work Simplification, New York: McGraw-Hill Book Company, 1947, 127 pp.

Defines work simplification and describes its application.

Methods Improvement Program: What It Is and How It Works. Bureau of Supplies and Accounts (Code M)

The following pamphlets are available from the U.S. Government Printing Office, Division of Public Documents, Washington 25, D.C.

Work Simplification Program, Supervisor's Guide to Process Chart.  
Catalog No. Pr 32.102:W89/2, price 10¢.

Work Simplification Program, Supervisor's Guide to Work Count. Catalog  
No. Pr 32.102: W89/3, price 10¢.

Work Simplification Program, Supervisor's Guide to Work Distribution.  
Catalog No. Pr 32.102: W89, price 10¢.

U.S. Bureau of the Budget, Process Charting: Its Use in Procedural  
Analysis, Management Bulletin, November, 1945, 20 pp.

Collects in one place what seems to be the most significant  
material on the subject, and summarizes actual experience  
from private industry and government.

PERTINENT MAGAZINES:

Management Review (monthly). American Management Association, 330 W.  
42nd St., New York City.

Modern Management (monthly) and Advanced Management (quarterly). Society  
for the Advancement of Management, 64 William St., New York City.

The Office (monthly). Office Publications Co., 270 Madison Ave., New  
York City.

Personnel (bi-monthly). The American Management Association, 330 W.  
42nd St., New York City.

Public Administration Review (quarterly). American Society of Public  
Administration, 1313 E. 60th St., Chicago, Illinois.

CASES:

Functions of the Naval Administrator. A Training Program for U.S. Naval  
Reserve Officers Prepared by Harbridge House, Inc.

This is a series of cases designed to help the officer increase his  
skill and understanding in recognizing, evaluating and dealing success-  
fully with the administrative problems which confront him. There is an  
illustrated pamphlet, phonograph recording, and instructor's guide for  
each of the cases in the series.

These cases are available for loan from the Training Aids Section  
in each Naval District.

APPENDIX E

Glossary of Work Measurement Terms

## APPENDIX E

### GLOSSARY OF WORK MEASUREMENT TERMS

Function - a general type of work distinguished by the specialized skill or knowledge required for its accomplishment. Example: Public Works.

Subfunction - a group of related processes or divisions of work within a single work function. For example, WAVES Sales might be a subfunction of Clothing and Small Stores; Correspondence might be a subfunction of the administrative section of the Personnel Department.

Work Unit - a tangible and countable expression of work turned out. For instance: transfer orders written; men processed; tons moved; rations fed.

- a. Variable Work Unit - is one which represents a tangible work product completed. Such work units accumulate during a reporting period. Examples are patients treated in Medical Services and numbers of completed Courts Martial cases.
- b. Fixed Work Unit - is one which remains constant. Such work units represent stable workloads on which effort is spent period after period. Examples are thousands of square feet of floor space maintained, and miles of railroad track maintained.
- c. Work Units Completed - the number of work units accomplished during the reporting period.

Man-Hours Expended (on measured operative work) - the actual process time required to turn out the total number of work units in a given subfunction plus a proportionate amount of the on-the-job time not spent in turning out work units.

Performance Rate - the number of man-hours expended (on measurable operative work) divided by the number of work units completed. The performance rate gives the number of man-hours spent per work unit.

Performance rate equals ...

$$\frac{\text{Man-hours expended}}{\text{Work units completed}} = \frac{100 \text{ man-hours}}{50 \text{ reports completed}} = 2 \text{ man-hours per report completed}$$

Managerial Work - is the effort of planning, organizing and controlling the work of others. It includes supervisory work. Military management is considered by some authorities to include:

- (a) Administrative management--planning, organizing and controlling activities by organizational groups.
- (b) Operative management--planning, organizing and controlling activities by projects.

Operative Work - is effort devoted to turning out projects. For example, a project may be a batch of Ship's Co. orders being processed. In contrast to administrative work, it is likely to be more of a production function which results in output that can be measured. (Operative work exists at all skilled and professional levels; thus it should not be thought of as a purely low level task.)

Measurable Work - effort for which the output can be specified in terms of work units completed and the time required to complete them. Most operative work falls in this category.

Unmeasurable Work - effort which it is difficult or impossible to specify in terms of work units completed and the time required to complete them. Examples of work which frequently falls in this category are administrative and watch-standing tasks.

Available Time - Man-hours spent on measurable operative work, unmeasurable operative work, and unmeasurable managerial work.

Unavailable Time - Man-hours spent on leave or on the sick list.

Total Time - Available time plus unavailable time.

Temporary Standard - a performance rate which is chosen or accepted for a short time as representative for a given subfunction. It is chosen on the basis of judgment based on past experience. It is used as a basis of comparison until a more valid standard can be established.

Standard - a performance rate which is determined after work in a subfunction has been measured for a period of time. It is based on quantitative data and an evaluation of what constitutes an acceptable standard.

Standard Man-Hours - is the number of man-hours that it would take to complete a given amount of work units if the work were done at the standard performance rate. It is calculated by multiplying the "work units completed" by the standard performance rate or by the temporary-standard performance rate. Standard man-hours are used to compare to actual man-hours expended on a given number of work units.

Standard Operative Time - is the total standard man-hours.

Index of Productive Efficiency - is total standard man-hours divided by time.

**ATTACHMENT III**

**Command Management Check List  
(Form II)**

ATTACHMENT III

COMMAND MANAGEMENT CHECK LIST  
(Form II)

Instructions: Circle the number or letter which best describes your reaction to each item in the list using the following scale:

- 1 = No problem (statement suggests an area which is not a problem to you.)
- 2 = Slight problem (statement suggests an area which is a small, relatively unimportant problem to you.)
- 3 = Typical problem (statement suggests an area which represents an everyday problem; one which is not pressing but one which you would like to solve in due time.)
- 4 = Fairly important problem (statement suggests an area which represents a rather significant problem to you; one which you would like to solve as soon as possible.)
- 5 = Important problem (statement suggests a critical problem in need of immediate solution.)
- X = Not applicable (statement is not or would not be applicable to you.)

Example: 1 2 3 ④ 5 X Learning the policies of the station.  
X ① 2 3 4 5 Overstaffed.

TEAR OFF THIS PAGE AND REFER TO THE SCALE ABOVE AS YOU GO THROUGH THE LIST OF ITEMS

- X 1 2 3 4 5 Visualizing the total organization on the station.
- X 1 2 3 4 5 Few chances to participate in developing policies and decisions.
- X 1 2 3 4 5 Back-log of work.
- X 1 2 3 4 5 Extra duties required of uniformed personnel.
- X 1 2 3 4 5 Finding a good measure for work accomplished.
  
- 5 4 3 2 1 X Learning the policies of the station.
- 5 4 3 2 1 X Must take personnel "Bureau" sends you.
- 5 4 3 2 1 X Too many people reporting to one superior.
- 5 4 3 2 1 X Need for additional training.
- 5 4 3 2 1 X Locating management problems.
  
- X 1 2 3 4 5 Personnel allowances not reflecting needs.
- X 1 2 3 4 5 How to increase efficiency.
- X 1 2 3 4 5 Short of personnel allowance.
- X 1 2 3 4 5 Getting information and "know how" on management techniques.
- X 1 2 3 4 5 Difference between shore and shipboard organization.
  
- 5 4 3 2 1 X Making best use of personnel sent to you for duty.
- 5 4 3 2 1 X Lack of sufficient personnel.
- 5 4 3 2 1 X Turnover of personnel.
- 5 4 3 2 1 X Determining the number of people necessary to do the work.
- 5 4 3 2 1 X Lack of sufficient administrative training for junior officers.

- X 1 2 3 4 5 Knowing what goes on in all offices of a large organization.
- X 1 2 3 4 5 How to get officers to understand each other's problems.
- X 1 2 3 4 5 Uneven flow of work.
- X 1 2 3 4 5 Overstaffed.
- X 1 2 3 4 5 Changing outmoded procedures.
  
- 5 4 3 2 1 X How to write job or billet descriptions.
- 5 4 3 2 1 X Spreading your efforts too thinly.
- 5 4 3 2 1 X Justifying personnel.
- 5 4 3 2 1 X Giving training.
- 5 4 3 2 1 X Lack of proper indoctrination in a new shore billet.
  
- X 1 2 3 4 5 Being understood by superiors.
- X 1 2 3 4 5 Overlooking the feelings and problems of those on lower levels.
- X 1 2 3 4 5 Too much routine paper work.
- X 1 2 3 4 5 Finding time for work planning.
- X 1 2 3 4 5 Unqualified personnel.
  
- 5 4 3 2 1 X Less control over military personnel on shore stations than at sea.
- 5 4 3 2 1 X Getting enlisted personnel to understand importance of their duties.
- 5 4 3 2 1 X Trying to satisfy more than one boss.
- 5 4 3 2 1 X Lack of teamwork among department heads.
- 5 4 3 2 1 X Fluctuating work loads.

- X 1 2 3 4 5 Personnel doing sloppy work.
- X 1 2 3 4 5 Confused lines of authority and responsibility.
- X 1 2 3 4 5 Being understood by subordinates.
- X 1 2 3 4 5 Getting the work out on time.
- X 1 2 3 4 5 Duplication of work.
  
- 5 4 3 2 1 X Low morale.
- 5 4 3 2 1 X Few on-the-job satisfactions.
- 5 4 3 2 1 X Delegating work to others.
- 5 4 3 2 1 X Explaining the mission to all hands.
- 5 4 3 2 1 X Conflicting directives from different bureaus and administrative offices.

LIST AND RATE ANY ADDITIONAL PROBLEMS:

- X 1 2 3 4 5 \_\_\_\_\_
- X 1 2 3 4 5 \_\_\_\_\_
- X 1 2 3 4 5 \_\_\_\_\_
- X 1 2 3 4 5 \_\_\_\_\_
- X 1 2 3 4 5 \_\_\_\_\_

**ATTACHMENT IV**

**Statistical Method for Determining  
Performance Rates and Standards**

## ATTACHMENT IV

### STATISTICAL METHOD FOR DETERMINING PERFORMANCE RATES AND STANDARDS

The statistical method of determining performance rates and standards described in this Attachment is designed to provide a system of allocating time that personnel spend on different subfunctions without keeping the actual time spent on each subfunction. From these data, then, standards can be set. This system should be a natural evolution from the system that is described in the "Local Command Work Measurement Manual." It should not be used until the system in the manual is understood and accepted, because it adds another concept that must be understood by the personnel. Time did not permit testing this method in the field, but it offers a further refinement for officers interested in devising a method of automatically accounting for man-hours and setting performance standards statistically.

#### Basic Concepts

The following considerations are important in the statistical development of time standards:

1. This method of determining performance rate standards applies chiefly to office production in staff departments.
2. The standard performance rates are relative, rather than absolute. It is not necessary that we have specific standards for each and every activity in the department.

It is merely necessary that countable work units be selected for the principal activities of the department that lead directly to an accomplishment of its service objectives.

3. Support activities within the department, or assigned duties not related directly to its principal service objectives, should not be included in work load standards.
  - a. They should be related to the principal departmental functions by standard ratios. If these ratios can be established by work measurement, so much the better.

- b. Such support or collateral activities of the department must be included in any estimates of man-power requirements and any determination of tables of organization for the department.
4. The work that is measured must be representative and repetitive. It is not necessary that it be carried on continuously at a uniform rate. It should occur a number of times within the normal reporting period. Otherwise, there is some question as to whether the work is representative.
5. Other considerations will be found in the Ohio State Work Measurement Manual, and other publications on the subject.

Basic Data Needed for the De-termination of Performance Standards

Little basic data are needed to set such office production standards. No extensive, detailed reporting of production is required. Neither the employee nor his supervisor is required to keep a record of time spent on various assigned projects. Neither of them is required to estimate the distribution of time over the various activities that have been carried on. The only data needed for each work unit can be obtained by simple count and a cumulative record of work completed during the period. These data are:

1. Work load on hand at the beginning of the period. (This is the same as (3) below. It is obtained by simple count at the end of the preceding period.)
2. New work received during the period. (This is obtained in the case of clerical work by simple count and tally when the work is received.)
3. Unfinished bank of work at the end of the period. (See (1) above.)
4. Work completed during the period. (Simple count and tally as completed.)

A daily production report should be obtained if at all possible. The work should be reported in a form that will facilitate consolidation into a weekly report; the weekly report into a monthly report, etc.

### Basic Computations

The following are the basic computations necessary to calculate the total process float time per unit:

1. Work on hand at beginning of period.
2. New work received during period.
3. Unfinished work at end of period.
4. Work completed during period.
5. Work put into production = (work at beginning) + (new work) - (unfinished work at end.)
6. Average bank ahead =  $\frac{(\text{work at beginning}) + (\text{unfinished work at end})}{2}$
7. Waiting time in bank per unit =  $\frac{\text{average bank ahead}}{\text{work completed during the period}}$
8. Work in production = (work put into production) - (work completed).
9. Total work load at end = (work on hand at beginning + new work received) - (work completed during period.)
10. Average total work load =  $\frac{(\text{work on hand at beginning}) + (\text{total work at end})}{2}$
11. Total float time per unit =  $\frac{\text{average total work load}}{\text{work completed during period}}$
12. Total process float time per unit = (total float time per unit) - (waiting time in bank per unit).

### Computation of Unit Process Time for Representative Work Units

The following tabulation illustrates the method of computing unit process times for units representing the principal activities of a hypothetical staff department "X" in one of its branches "Y". The period covered is one week. The production data are taken from daily reports.

Table I

BRANCH "Y", STAFF DEPARTMENT "X" \*

Week Ending

	Collected Data				Computed Data							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Activity A	50	10	12	46	48	31.0	0.675	2	14	32	0.696	0.021
Activity B	20	315	14	317	321	17.0	0.054	4	18	19	0.060	0.006
Activity C	26	251	37	237	240	31.5	0.133	3	40	33	0.139	0.006
Activity D	27	140	12	152	155	19.5	0.128	3	15	21	0.138	0.010
Activity E	5	8	7	4	6	6	1.500	2	9	7	1.749	0.249
Activity F	7	29	4	31	32	5.5	0.177	1	5	6	0.193	0.006
Activity G**	8	82	(3)	83	(87)	(5.5)	(0.064)	0	4	6	0.070	(0.006)
Activity H	5	40	6	38	39	5.5	0.145	1	7	6	0.158	0.013

\* Figures in parentheses represent the data indicated by corresponding numbers of the definitions of the basic computations listed in the section above.

\*\* It is evident that the time required to process one piece of Work Unit G through the Branch is very little. The actual average work load of Unit G, during the week, could be picked up from the daily work reports of individuals in the Branch. An average of the unit process time, for a work-in-process float between zero and one work unit has been used, nevertheless, because exact accuracy in determining the weekly work-in-process float time is not necessary.

The following tabulation illustrates the method of determining the man-hours of working time that should be charged against each activity of the Branch for the week under consideration. It should be noted that a week is not sufficient to establish a standard. We must have a sufficient number of weeks to establish a norm. It should be noted also that the computations in Table I and Table II are not necessary, after the standard has been established, except to recheck the standard from time to time. Very little data need be collected regularly and very few computations must be made after the system is in operation.

The following information must be available before the computation of man-hours charged per work unit can be made:

Total operative personnel of the branch-----20 people  
 Standard work week-----40 hrs/wk.  
 Gross man-hours of capacity-----800 man-hrs.  
 Ratio of time authorized for this branch for  
 special projects and support activities, as  
 determined by time-and-duty or other special  
 studies, is 0.10-----80 man-hrs.  
 Time available for principal activities of the  
 branch-----720 man-hrs.

The determination of the allocation of available man-hours is as follows:

Table II

COMPUTATION OF TIME CHARGES BY ACTIVITIES AND  
 WORK UNITS BRANCH "Y", STAFF DEPARTMENT "X"

Activity	(4) Work Units Completed	(12) Process Float Times, Wks.	(13) Weighted Production	(14) Ratio	(15) Prorated Time	(16) Man-hrs. Per Unit
A	46	0.021	0.966	0.125	90.000	1.957
B	317	0.006	1.905	0.247	177.840	0.561
C	237	0.006	1.422	0.18	133.200	0.562
D	152	0.010	1.520	0.197	141.840	0.933
E	4	0.249	0.996	0.125	90.000	22.500
F	31	0.006	0.186	0.024	17.280	0.557
G	86	0.003	0.258	0.033	23.760	0.276
H	38	0.013	0.494	0.064	46.080	1.213
Totals			7.747	1.000	720.000	

Determination of the  
Performance Standard

The determination of a performance standard for each activity, in terms of its typical work unit, requires the determination first of the standard work-in-process float time for the unit. This can not be done fairly and with reasonable accuracy until a sufficient record of experience has been accumulated. The best repeated performance can be used, or the technique of standard deviation can be applied. An average work-in-process float time cannot be used, since it chains performance to mediocrity.

Table III

SELECTION OF STANDARD W.P. FLOAT TIME FOR  
ACTIVITY B, BRANCH Y, DEPARTMENT X

Week	Waiting Time in Bank	Total Float Time/Unit	Process Float Time/Unit	Selected Standard Time/Unit
1	0.054	0.059	0.005	
2	0.054	0.060	0.006	
3	0.058	0.065	0.007	
Av.	0.0553	0.0613	0.0060	
4	0.056	0.061	0.005	
5	0.061	0.067	0.006	
6	0.053	0.058	0.005	
Av.	0.0567	0.0620	0.0053	
<u>Selected Average Process Float Time</u>				<u>0.005</u>

It is now possible to adjust the average man-hours charged per work unit B to conform to the standard work-in-process float time. We shall assume that the average for the six-weeks period is the same as that shown for B in Table II, 0.561 man-hrs/unit. Then:

Adjusted man-hours allowed per work unit are  $(0.005/0.006) \times 0.561$  or, 0.468 man-hrs/unit. This is the standard performance rate.