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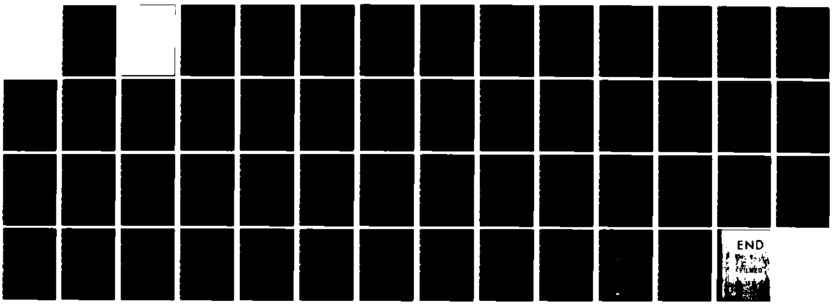

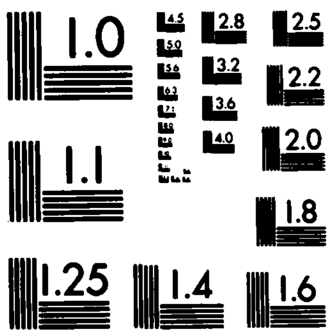
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NPRDC TR 83-35 September 1983

INDIVIDUAL PERFORMANCE MEASUREMENT AND REPORTING IN A NAVY INDUSTRIAL ORGANIZATION

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This report describes the operations performance tracking system (OPTS), an automated individual performance measurement and reporting system designed for industrial employees of naval air rework facilities (NARFs). OPTS extracts and organizes existing management information system data to provide individual performance measures and reports. It was implemented in the Power Plant Division at NARF Alameda and can be used at NARFs elsewhere. The measures provided by OPTS can be used to support productivity improvement techniques such as performance feedback, goal setting, performance appraisal, and incentive awards.

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FOREWORD

This research and development was conducted in support of task area Z1169-PN.01 (Civilian Productivity Enhancement), and was sponsored by the Chief of Naval Material Productivity Management Office and the Naval Air Logistics Command. Additional support was provided under a task order from the Naval Air Rework Facility (NARF), Alameda.

This report describes the operations performance tracking system (OPTS), an individual performance measurement and reporting system designed for use in conjunction with experimental productivity improvement techniques. Results of applying one such technique were described in NPRDC Technical Report TR 83-4.

Appreciation is extended to staff members of NARF Alameda, who provided detailed information about the existing NARF performance measurement system as well as valuable suggestions for design of OPTS, and to systems analysts and programmers of the Navy Regional Data Automation Center, San Francisco, who developed the computer programs.

J. W. RENARD
Commanding Officer

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Technical Director

SUMMARY

Problem

Implementation and evaluation of experimental programs to increase individual productivity in the Power Plant Division (PPD), Naval Air Rework Facility (NARF), Alameda required the development of accurate, objective measures of individual employee performance.

Purpose

The purpose of the present effort was to design and implement an automated individual performance measurement and weekly reporting system that would use information currently available in the NARF's management information system.

Approach

The existing management information system for industrial naval air stations (MIS for INAS) (hereafter referred to as MIS) was examined to determine what performance information was currently being collected and reported. The NARF's MIS collects data appropriate for individual performance measurement but currently does not report this information at the individual level. New programs were designed to extract and organize existing MIS data to provide such information.

Results

The principal result of this effort was an integrated performance measurement and reporting system called the operations performance tracking system (OPTS). This system produces five weekly reports for use by employees and foremen. These reports summarize the work activity of each employee and the shop as a whole and provide measures of individual employee and shop performance.

Performance information provided by OPTS could be used in conjunction with a number of productivity improvement techniques, including performance feedback, goal setting, performance appraisal, and incentive awards. Further, OPTS provides an objective basis for evaluating the effects of these techniques.

Conclusions

1. The OPTS individual performance measurement and reporting system for production workers was implemented successfully in the PPD, NARF Alameda.

2. Because it uses data produced by the standard MIS, OPTS could be adopted by all NARFs.

3. The most serious drawback of OPTS (and MIS) is that employees can manipulate inputs and thus inflate their performance measures. Appropriate controls are required to prevent manipulation if OPTS is to be an effective management tool.

Recommendations

It is recommended that:

1. NARF Alameda implement OPTS performance measurement reports in other areas within the Production Department. OPTS may need to be tailored to fit these somewhat different work environments.

2. Other NARFs implement OPTS on a trial basis in their Production Departments. Any local differences should be considered when transferring OPTS to other NARFs.

3. NARFs consider using the individual performance measures provided by OPTS in conjunction with their productivity improvement efforts (e.g., existing incentive award programs, the Navy's Basic Performance Appraisal Program, or experimental techniques such as goal setting).

4. When implementing new productivity improvement programs, NARFs use the individual performance measures provided by OPTS to evaluate resulting performance changes.

5. Before NARFs adopt OPTS for such purposes, they strengthen the controls in the work assignment and reporting systems to prevent manipulation of the performance measurement information generated by MIS and OPTS.

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INTRODUCTION

Problem and Background

The Navy, along with the rest of the nation, has been concerned with declining productivity. Efforts to improve productivity typically focus on technological innovations (e.g., new equipment and automation) or changes in work methods or plant layouts (e.g., work simplification). One source of productivity improvement that is often overlooked in private industry as well as in the public sector is human performance. Personnel approaches to improving productivity through increased worker motivation include such techniques as feedback, goal setting, and incentives. Dr. Alan Campbell, former chair of the Civil Service Commission, has stated that, because the public sector is heavily service-oriented, as is much of the private sector, people resources are probably a more important focus for improving productivity than are technology and capital investments. Further, the Civil Service Reform Act (CSRA) of 1978 mandated the development of objective performance measures for all government employees.

Accordingly, in mid-1980, the Navy Personnel Research and Development Center (NAVPERSRANDCEN) and the Naval Air Rework Facility (NARF), Alameda agreed to undertake an experimental program to increase productivity at the NARF based on objective performance measures. The techniques to be tried required a measure of individual worker performance to assess the effects of implementating these techniques.

NAVPERSRANDCEN has been developing and testing motivational approaches to increase the productivity of Navy employees since the mid-70s. These approaches have included giving feedback to employees about their performance (Dockstader, Nebeker, & Shumate, 1977) and paying monetary incentives to employees based on their individual performance levels (Shumate, Dockstader, & Nebeker, 1978). An individual performance measurement and reporting system was an essential element in each of these efforts, both as the basis for the experimental approaches themselves and as the source of the data used to evaluate the experimental effects. The trial of goal setting and feedback and incentive awards with Navy industrial workers also required a performance measurement and reporting system.

NARFs are a step ahead in establishing a performance measurement and reporting system appropriate for these research purposes because work measures in the form of operation standards exist and are maintained for a large portion of the jobs in these facilities. Further, employee work activity data are already being gathered systematically. Despite this relatively good performance measurement situation, there was still a problem, however, because the standard management information system for industrial naval air stations (MIS for INAS) used by all NARFs (hereafter referred to as MIS) is intended for purposes other than individual performance measurement. It reports productivity measures at various group levels rather than at the individual employee level. Since the interventions to be tried at the NARF were designed to increase the productivity of individual employees, an individual performance measurement and reporting system had to be developed.

Purpose

The purpose of this effort was to design and implement an automated individual performance measurement and reporting system for NARFs that would use information already available in the existing MIS. The new system was to provide (1) objective individual performance measures for use in conjunction with productivity enhancement techniques (e.g., goal setting and wage incentives) and (2) data necessary to evaluate the effects on performance of implementing such techniques. Productivity, as used in this report, is defined as the ratio of measured work output to measured work input. Other relevant terms and issues are defined and discussed in Appendix A.

APPROACH

Research Site

The mission of the NARFs is to provide major maintenance and repair service for aircraft and their components. In this capacity, the NARFs serve the fleet as well as other customers such as the Air Force. NARF Alameda, one of six NARFs, employs over 5,000 civil service workers, 75 percent of whom are wage grade (or blue collar) employees.

The Power Plant Division (PPD) within NARF Alameda's Production Department was selected for initial research because (1) this division had better standards coverage than did other divisions and (2) its work best fit the criteria for good performance measures (see Appendix A). PPD services various units, including complete aircraft engines and engine components and accessories.

Figure 1 provides a generalized description of the workflow within PPD shops. Briefly, as units enter a shop, they are inspected to determine the level of rework required. They are then repaired or overhauled as necessary, tested, and moved from the shop to other shops, to the Navy supply system, or directly to a customer. For the most part, mechanics in these shops work individually on assigned units.

Existing MIS Performance Measurement System

The existing MIS was examined to determine what data were being collected, how the data were processed and stored, and what reporting capabilities existed. All NARFs use a standard MIS, which consists of several programs and reports that provide NARF managers information relative to labor and finance, work planning, location and status of work, and performance of shops, sections, and branches (the three lowest organizational levels at the NARFs).

Performance measurement within a NARF production department relies on operation standards, which are developed by the NARF's methods and standards analysts for each operation required in reworking a unit. Operation standards are identified by type code, depending on how they are developed: "A" and "D" type standards are developed through work measurement techniques (e.g., time studies or elemental standard data); "B" standards, by using work sampling; and "C" standards, based on estimates of methods and standards analysts. "E," "N," and "Z" type codes designate various categories of work for which no operation standards exist.

To collect performance data in the production shops, MIS draws upon an extensive data file (the master data record or MDR) for the various kinds of units reworked at the NARF to generate a "shop order" for each incoming unit. The shop order lists the specific operations ordinarily required to rework that kind of unit in the order performed (see Figure 2). Each operation line (LINE NO.) indicates the shop responsible for doing the work (SHOP NO.) and the operation standard type code (STD CD) and time allowed

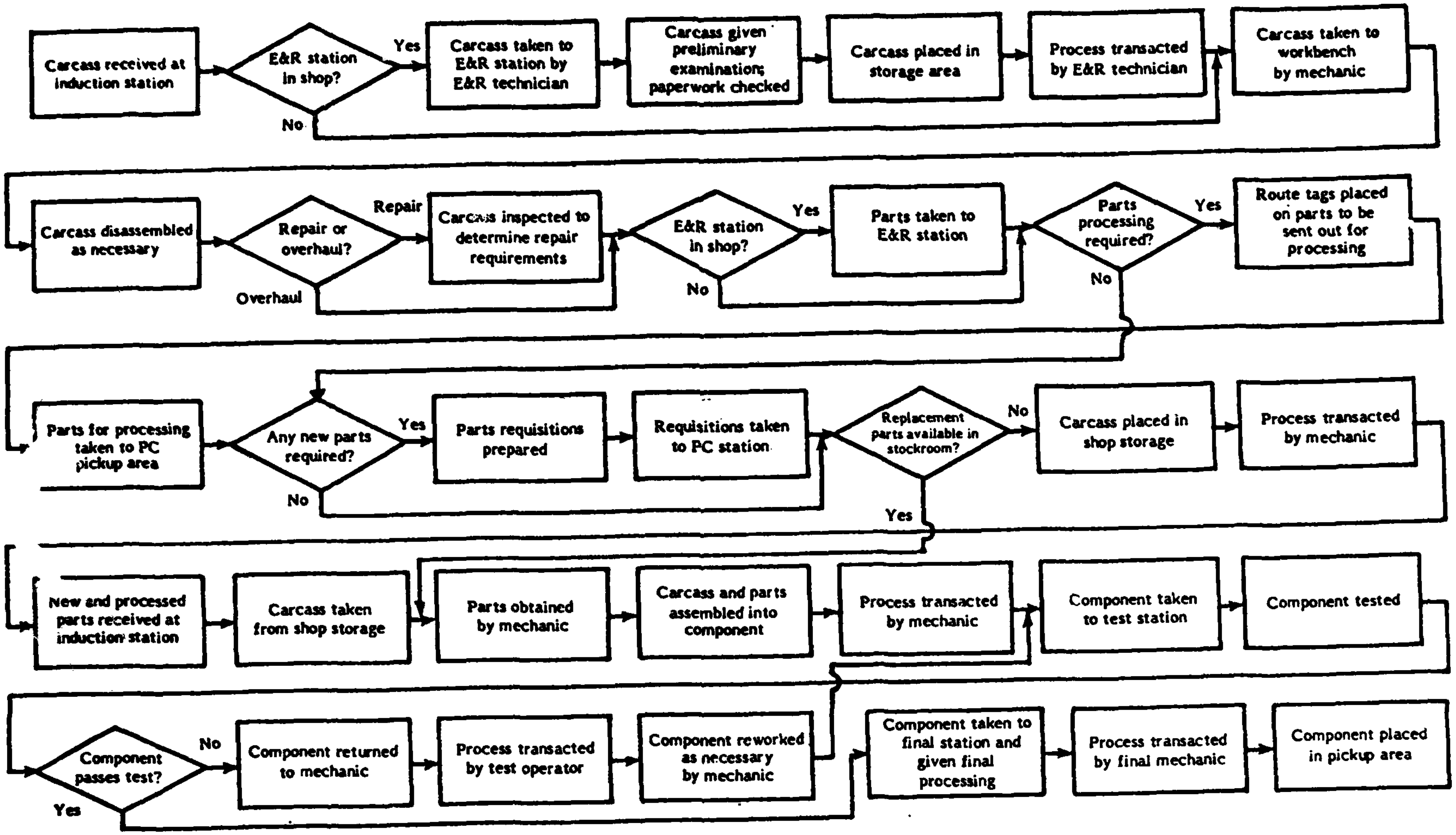

Figure 1. Typical workflow in PPD shops.

LINK NO	PART NAME	RELATED DESCRIPTION	[illegible]	COMPONENT [illegible]	[illegible]
G891468	PRI 4 CASING	COMPRESSOR REAR	22311	305Q10000100	---- ----

PRODUCT STD	CL	DISP CODE	TMS NAME	SEQUENCE	INDUCTED FEDERAL STOCK NUMBER	MODIFIED FEDERAL STOCK NUMBER	QUANTITY
		R	GE100	C477	9V 2848-001597766-SN		1

PROCUREMENT COST	MODEL CODE	MANUFACTURER'S PART NUMBER	PUBLICATION NUMBER	SPARES	BU NO
9000		6019T86G01			205116

LINE NO	SHOP NO	GEO AREA	SHOP CAT CODE	START DAY	COMP DAY	COMP HR	OPERATION CODE	STD CD	OPERATION STANDARD	OPERATION DESCRIPTION	SUPERVISOR INSPECTOR
01	96213	60	XR	028	028	16	0005	C	.01	ROUTE	
02	96215	61	BX	029	029	16	0009	D	.20	CLEAN-C/W 01&02 TBL 3	
03	42610	63	BX	030	030	16	0017	C	.37	NDT-C/W 01&02 TBL 5	
04	96213	60	XX	031	031	16	0021	C	.50	EXAM & REWORK-C/W 01&02 PARA 16	
05	96246	70	XX	032	032	16	0025	C	.30	DEGREAS/MASK ID NO./STRIP AND	
06			EX							BEAD BLAST-C/W 03	
07	96245	59	XX	033	034	12	0029	C	6.40	PLASMA SPRAY-C/W 03	
08	96213	69	XX	034	035	12	0033	D	.86	BOLT CASE HALVES TOGETHER	
09	96242	65	XX	035	036	12	0037	D	2.62	MACHINE-C/W 03	
10	96213	60	XX	036	037	12	0041	C	.50	SEPARAT CASE & EXAM 04	
11	96246	70	BX	037	038	12	0045	C	.09	BAKE & SPRAY WITH WD 40-C/W 04	
12			EX							WARNING&CAUTION-C/W 04 PARA 5	
13	96232	55	XF	039	039	12				STORE	
	TF34-GE-100										
	01	TC 2J-TF34-3							C2	WP 34500	
	03	TFI 330-77-0377							C4	TEI 330-80-0416	

LINK NO	PART NAME	UNIFORM DATA CLASSIFICATION CODE STRUCTURE	COMPONENT IDENTITY NO	PAGE
G891468	CASING	21X0403-3-TTGX	305Q10000100	1-1

Figure 2. Sample shop order.

(OPERATION STANDARD) to complete it. (Operation standard times are shown in decimal hours (e.g., .25 hours equals 15 minutes).) Each shop order carries a unique 7-digit alphanumeric number (LINK NO) that is used to identify both the shop order and the unit to which it applies. Although a particular unit may be reworked more than once during its service life, it is assigned a new shop order and link number each time it comes to the NARF. Each shop order is accompanied by a set of machine-readable, punched cards called job cards encoded with the same link number.

Shop employees use the job cards to provide work progress and timekeeping data inputs to the MIS. The employees insert the job cards into transactors, which are data entry devices wired to a central computer. Ordinarily, a transaction is made whenever work stops on a shop order operation. Work may stop either because the operation has been completed or because of some other reason (e.g., end of the work shift, lack of parts necessary to complete the job, employee is reassigned to another task). Each transaction provides essential performance measurement data, including the identity of the employee making the transaction, the unit's link number, the line number of the operation, the status (completed or incomplete) of the operation, and the time of the transaction. The MIS compares this transaction time to the time the employee last transacted (or to the start time of the work shift, if this is the mechanic's first transaction of the day) to calculate how much time the employee spent on that operation. If the transaction has indicated that the operation is not yet complete, the MIS accumulates in memory the time spent on that operation and, when the operation is finally completed, calculates the total time spent on it. In subsequent processing, the MIS uses the link and line numbers to match the transactor input data with the corresponding operation standard data that were used earlier to produce the shop order.

The MIS calculates a performance efficiency measure by comparing the accumulated earned operation standards to the time it actually took to complete the operations. The standard performance measurement system at NARF (called the MIS feedback system) provides performance measurement reports for shops, sections, and branches within the Production Department. These reports show an "efficiency index" that is the ratio of the total operation standard hours for all operations completed by all workers within the shop (or section or branch) during the week to the total time spent by all workers to complete those operations, multiplied by 100. An efficiency index of 100, therefore, means that the group completed the work in exactly the operation standard time allocated by the organization for those operations. As can be seen in Figure 3, a sample performance summary report, an efficiency index is calculated for each of the various categories of work done in the shop (e.g., aircraft, engines).

The primary shortcoming of the existing NARF performance measurement and reporting system was its lack of an individual performance measure. However, since all transactor inputs are identified with the employee doing the work, the data necessary to develop such a measure were already being collected by the system.

Design and Development of OPTS

The operations performance tracking system (OPTS) was designed to collect and analyze the existing MIS individual work activity and performance data and to provide reports for employees and foremen that summarized this information. Reports were also designed to supply foremen with additional information about shop performance and to provide backup data about specific work being done in the shop.

PERFORMANCE SUMMARY

MIS FOR INAS

RPT SYM 4710V16-1 | REPORT ID 25320R02 | DATE 12-06-80 | ORGANIZATION CODE: 96211

LINE	PROGRAM	EXPENDED HOURS: THIS WEEK: STANDARD CODE A B C D	E	NETWORK	OVERTIME: THIS WEEK	OVERTIME: QUARTER TO DATE	EFFICIENCY: THIS WEEK: STANDARD HRS PROD. CODE A – D	HRS EXP ON STDS PROD. CODE A – D	EFFICIENCY INDEX	EFFICIENCY: QUARTER TO DATE: STANDARD HRS PROD CODE A – D	HRS EXP ON STDS PROD CODE A – D	EFFICIENCY INDEX	PRODUCTION: THIS WEEK: HOURS COMPLETED AS SCHED	HOURS SCHED FOR COMPLETION	[illegible]	PRODUCTION: QUARTER TO DATE: HOURS COMPLETED AS SCHED	HOURS SCHED FOR COMPLETION	[illegible]
	1	2	3	4	5	6	7	8		10	11		13	14		16	17	
A	0 AIRCRAFT																	
B	1 MISSILES																	
C	2 ENGINES	342	8	1	122	815	300	313	961	2394	2569	932	182	316	576	1.25	3533	291
D	3 [illegible]	197	19		82	346	257	199	1267	1198	1151	1041	83	270	307	365	2293	173
E	4 OTHER SUPPORT																	
F	5 MANUFACTURING	4			1	4	5	4	1450	38	47	799						
G																		
H	TOTAL DIRECT [illegible]	545	27	1	206	1165	555	514	1080	3630	3767	964	265	596	452	1398	5616	247
I	INDIRECT		83		20	89												
J	TOTAL [illegible] (LESS LEAVE)	545	111	1	226	1254	555	514	1080	3630	3767	964	265	586	452	1388	5616	247
K																		
L																		

LINE	PERIOD	HOURS EXPENDED VS ALLOCATED HOURS: AIRCRAFT	MISSILES	ENGINES	COMPONENTS	OTHER SUPPORT	MANUFACTURING		TOTAL DIRECT	TOTAL INDIRECT	TOTAL AVAILABLE	TOTAL LEAVE	[illegible]	LEAVE: ANNUAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
M	WEEKLY HRS EXPENDED			350	216		4		569	83	652	17	669	1	2	16	36				36
N	WEEKLY HRS ALLOCATED									59	59		59								
O	QTR HRS EXP TO DATE			2917	1315	3	50		4186	672	4858	686	5544	291	68	115	27	280			100
P	QTR HRS ALLOCATED TO DATE									519	519		519								

LINE	PERIOD	INDIRECT (LESS LEAVE): SUPERVISION	[illegible]	[illegible]	TRAINING: APPR	TRAINING: NON APPR	TIME ALLOWED	DELAY	BACK ROBBING	CANNIB	CLEAN UP	SHOP GENERAL	IN HOUSE CALIB	PLANT MAINT	[illegible]	[illegible]	ALL OTHER	[illegible]	LABOR DISTRIBUTION			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Q	WEEKLY HRS EXPENDED	63					11					4					4		DIRECT LABOR	----	873	862
R	WEEKLY HRS ALLOCATED	41					6				5	4		1			2		INDIRECT LABOR	1000	127	138
S	QTR HRS EXP TO DATE	433				74	17			9		124					16					
T	QTR HRS ALLOCATED TO DATE	356					56		4		48	35		5			14		TOTAL AVAILABLE (LESS LEAVE)	[illegible]		

NAVAL FORM [illegible] S/N 0102-LF-[illegible]

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Figure 3. Sample performance summary report from MIS.

The system was a collaborative effort by personnel from NAVPERSRANDCEN, NARF Alameda, and the Naval Regional Data Automation Center (NARDAC), San Francisco. System programming, testing, implementation, and maintenance were provided by NARDAC.

RESULTS AND DISCUSSION

OPTS consists of 16 programs, 4 permanent files, 2 weekly tape files, and 5 weekly feedback reports. Figure 4 provides a flow diagram for OPTS, showing inputs and outputs. All reports and tapes are generated weekly. The reports were designed primarily for use by foremen and employees in conjunction with various productivity improvement programs, while the tapes provide individual worker activity and performance data essential to evaluating the effectiveness of these programs. OPTS can accept manual inputs such as employee identification codes (to assure confidentiality of individual employee reports), efficiency goals, and corrections to erroneous data. Although it was designed for use in PPD at NARF Alameda, it can be easily adapted to other divisions within NARF Alameda or to another NARF.[1]

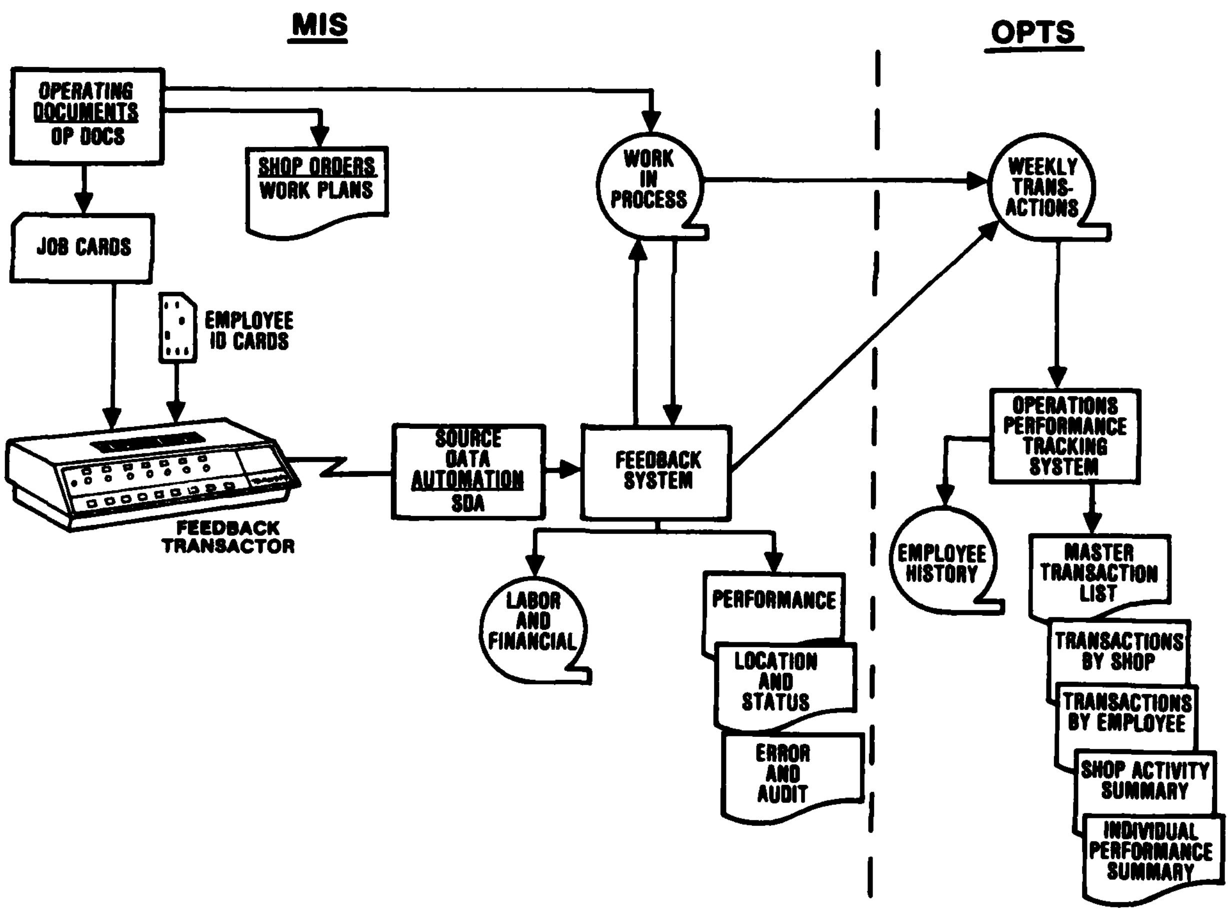

Figure 4. OPTS flow diagram.

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[1]OPTS is currently being used by the PPD at NARF North Island.

Overview of System

OPTS collects all transactor inputs made by or for each employee during the reporting week (Monday through Saturday) and classifies these into various categories of work (direct labor on shop order operations, indirect labor such as shop cleanup or training, leave usage, etc.). Weekly OPTS reports show the hours expended in these work categories. Direct labor hours are further analyzed to determine the type of work done, the operation standard hours for the work, and the completion status of each operation at the end of the week.

Only hours expended and standard hours "earned" on operations that are completed by the end of the week are counted toward performance for that week. As with MIS, hours spent on operations that are not completed by the end of the week are held until the work is finished. At that time, these carryover hours (hours spent in some previous week on operations completed during the current reporting week) are counted toward performance. This direct labor hour analysis separates out only those hours expended on completed operations for comparison to earned hours on the same operations. When more than one employee has worked on a particular operation, the standard hours for that operation are shared among all employees who have transacted that operation line. Operation standard hours are credited in such cases by prorating the standard hours on the basis of (1) the hours each employee expended on that operation and (2) each employee's performance efficiency in the past 4 weeks. In this way, employees earn hours based both on their input to the task and on how well they usually perform.

OPTS provides two complementary measures of individual performance on direct labor tasks. Although both are based on performance against standards, they cover different kinds of work that may be done by employees.

1. Efficiency percentage. This measure is analogous to the efficiency index for organizational units reported by MIS. It indicates an employee's performance on those operations whose work measures best satisfy the criteria for good performance measurement (see Appendix A). Specifically, performance efficiency covers only direct original work (as opposed to rework required to correct flawed work) and operations completed during the reporting week. Further, it is restricted to those operations having A, B, C, or D operation standard types (i.e., operations having standard time associated with them). Fortunately, such operations encompass the majority of the work performed by most employees. Efficiency percentage is calculated as follows:

$$\frac{\text{Total Operation Standard Hours Earned on Original, Completed Operations with A to D Standard Types}}{\text{Total Hours Expended on Original, Completed Operations with A to D Standard Types}} \times 100$$

2. Realization percentage. This measure is based on all direct work completed, including rework and certain operations having no standard time available to be earned. Such operations are those with E, Z, or N standard type codes, as well as previously completed operations. A previously completed operation is one on which time has been expended during the reporting week but that had been reported as completed during a previous reporting week. In this case, no standard time remains to be earned because it

has already been credited to the employee(s) who completed the operation previously. Realization percentage is calculated as follows:

$$\frac{\text{Total Operation Standard Hours Earned on All Completed Tasks}}{\text{Total Hours Expended on All Completed Tasks}} \times 100$$

Since the denominator of this calculation includes any hours expended on operations that have no corresponding standard hours in the numerator, an employee's realization percentage is apt to be lower than his or her efficiency percentage. The efficiency percentage compares earned hours to expended hours only on those operations with associated operation standards; thus, it is a more precise measure of performance than is realization percentage. On the other hand, realization is a broader measure that considers a greater range of potential work activity. For some employees, then (e.g., those who do a considerable amount of rework), realization percentage may be the more useful of the two performance measures. In general, using both measures should provide a comprehensive picture of how an employee is performing on direct labor work.

OPTS Reports

Of the five weekly OPTS reports, two provide new information about the work activity and performance of individual employees and shops respectively; and three, detailed backup information that supports the entries on the two primary reports. This backup information is also summarized on two computer tapes that are generated weekly for program evaluation purposes. OPTS reports are discussed below; samples and field descriptions are provided in Appendix B.

1. Employee Performance Report. This report is produced and distributed to provide individual performance feedback to employees. Each employee and his or her foreman receive a report that summarizes how that employee spent his or her time during the current reporting week, the week prior to that, and the past 4 weeks. It includes the number of hours spent on indirect tasks, on overtime, and in various leave categories, and efficiency and realization performance measures for work completed during each of the three time periods reported. Presenting information for three time periods helps foremen and employees to monitor performance changes.

2. Shop Activity Summary Report. This report, which is distributed to the shop foreman, provides information about work activity and performance of the shop as a whole during the current reporting week. It provides for the shop the same types of information shown for an individual on the Employee Performance Report, including overall efficiency and realization percentages for the shop. It also presents additional indicators to describe the work that was done in the shop that week. It shows the total time spent and operation standard hours earned on special categories of work (such as handwritten shop orders prepared to describe and account for work lacking MIS-generated shop orders).

3. Shop Activity Report by Employee. This report is distributed weekly to the shop foreman to supplement the two primary reports. It shows (a) all labor transactions made by or for each employee in the shop during the current reporting week, including indirect labor and leave, and (b) any carryover transactions when previously uncompleted operations are finally completed. (Carryover transactions, as defined earlier, are those made in some previous week on operations completed during the current reporting week.) It provides detailed information about each transaction. For direct labor transactions, it

provides the link number, the operation line number, the date of the transaction, the hours expended (and, on completed operations, the hours earned), the operation standard type, and other information identifying the kind of work done. For indirect labor transactions, a 7-digit number identifying the labor charge category replaces the link number, and no shop order information appears.

4. Shop Activity Report by Link. This report also goes to the shop foreman. It displays essentially the same information shown on the Shop Activity Report by Employee, but it lists the shop's transactions for the current reporting week in link and labor charge number order. Because it shows all operation line transactions made in the shop on each link number being worked that week, it can provide useful information about work progress. It can also be used to identify cases in which more than one employee has transacted the same operation line, thereby sharing the operation standard hours for that line.

5. Master Link Activity Report. This report shows all transactions made during the current reporting week in all shops and shifts for which OPTS data are collected. Due to its size, a single copy of this weekly report is generated and kept in some central location for use by any foreman. This report is similar to the two shop activity reports just described in that it provides detailed information about each transaction. The transactions are sorted into link number order to show all activity on each unit, regardless of the shop doing the work. This master report is intended to help foremen investigate cases in which employees in different shops or shifts have transacted the same operation line.

In combination, foremen can use the five OPTS reports to understand the work being done in their shops and the performance of their employees. The Employee Performance Report and the Shop Activity Summary Report are designed as primary sources of individual and shop performance information. The remaining three are provided as backup for use as needed by foremen in researching pertinent data. All entries in the three backup reports carry employee number and shop and shift designators, as well as the link and operation line number transacted, to allow tracing information between the reports. For example, if a foreman or employee felt that the employee's efficiency percentage was unexpectedly low one week, the foreman could easily use the backup reports to investigate the situation. After referring to the Employee Performance Report that showed the low efficiency percentage and the Shop Activity Report by Employee that showed the transactions made by the employee that week, he would compare the operation standard hours earned to the hours spent to determine which operation lines accounted for the employee's low performance efficiency. Other information on these lines' transaction records (e.g., the transaction date) may provide clues to help the foreman and employee, both of whom would probably be familiar with the week's work activity, to understand what had happened.

If there was reason to suspect that the standard time shown as earned by the employee on a particular operation line was less than the full standard time allowed for that operation, the foreman would then look up that link and line number in the Shop Activity Report by Link. As mentioned above, this report would show if some other employee had also transacted the same operation line and thereby earned or "shared" part of the operation standard time. If this other sharing employee was in the same shop and shift, his or her transaction record for this operation line would appear right before or after the original employee's transaction record. If there had been a sharing employee in a different shop or shift, an asterisk would appear in the multishop/shift indicator column of the original employee's transaction record. In this latter case, the foreman would then look up the link and line number in the Master Link Activity Report to find the record of the other transaction and learn where and by whom it was made.

Similarly, if the Shop Activity Summary Report showed a large increase in hours spent on indirect work, the foreman could examine the Shop Activity Report by Link or by Employee to determine which employees account for these expenditures as well as the specific indirect categories used.

Trial Implementation at NARF Alameda

Since OPTS was developed to provide individual performance information for use by NARF in experimental productivity improvement programs, training was conducted so that the intended users would understand the new reports. Considerable time was spent in familiarizing the foremen with the purposes and formats of the reports, since they were to receive and use all of them, and their help was sought in checking data and suggesting improvements to the reports before OPTS was implemented.

Structured group training sessions were held with foremen and their production support personnel to present the rationale for OPTS and the principles behind its development. Additional group and individual training sessions were held with foremen to review the information on the new reports and discuss how to use them. The initial reports generated by OPTS during the system test were used to help foremen familiarize themselves with the system and to identify any problems in report formats or data.

Employees did not begin receiving individual Employee Performance Reports until foremen were comfortable with the new reporting system (approximately 3 months after initial report distribution). At this time, a performance feedback and goal-setting program using the performance measurement information provided by OPTS was implemented in several PPD shops. Employees received training about their new Employee Performance Reports and were provided with documentation similar to that shown in Appendix B. For a complete description and evaluation of this program, see Crawford, White, and Magnusson (1983).

To evaluate the utility of the OPTS reports, interviews and questionnaires were administered to shop foremen and participating employees. Shop foremen reported that the individual performance reports provided a reasonable measure of the performance of most of their employees. These reports were seen as one of the most useful aspects of the total productivity improvement effort at NARF Alameda. The majority of employees interviewed (69%) reported that the efficiency measure provided by OPTS was a good or usually good measure of their own job performance. Those who were less confident of the accuracy of the efficiency measure reported problems with transacting, with inacccurate operation standard hours on specific jobs assigned to them, or with the shop orders prescribing the work to be done. A problem of particular concern was that employees and foremen alike mentioned the potential for manipulation of the performance measurement system. Various methods were described by which employees could claim work they had not done or could earn operation standard hours in excess of those they actually deserved for their work. The existing work assignment and reporting systems lacked sufficient controls to prevent such manipulation. (A more complete discussion of these problems can be found in Crawford et al., 1983.) Since OPTS is basically an extension of the MIS used by the NARFs, both measurement systems face these same problems. Individual performance measures, as provided by OPTS, make these problems more apparent to employees and foremen alike and emphasize the need for management controls.

Potential Applications

OPTS provides useful performance management information not previously available to employees and their supervisors. This information can be used to support a number of productivity improvement techniques, including performance feedback, goal setting, performance appraisal, and incentive awards. These techniques are discussed below.

1. Performance Feedback. Goal-setting theory (Locke, 1968) suggests that the conscious intentions of an individual (his or her goals) will determine behavior. Further, one postulate of the theory states that individuals will set goals spontaneously if they receive feedback about their performance relative to a performance standard. Previous research has demonstrated the motivational properties of performance feedback, particularly when this feedback includes information about one's performance relative to others or to an objective standard (Dockstader, Nebeker, & Shumate, 1977). OPTS was designed to provide individual performance feedback on a weekly basis. An employee's productive efficiency percentage shows his or her performance relative to established operation standards. Weekly feedback allows individuals to monitor their work performance in a timely manner.

2. Goal Setting. Goal theory encompasses a number of hypotheses about the motivational aspects of goals, including the following:

a. Specific goals increase performance more than do generalized goals.
b. Difficult (but attainable) goals result in higher performance than do easy goals.

Both of these hypotheses have been supported in a number of research studies (Latham & Yukl, 1975). Using an employee's performance efficiency from OPTS as a basis for setting performance goals, the first hypothesis suggests that a goal of 120 percent would do more to increase performance than would simply encouraging employees to do their best. Further, the second hypothesis suggests that a goal of 120 percent would produce better performance than would one of 100 percent, which, in general, is the accepted goal for NARF employees. A detailed evaluation of the use of feedback and goal setting based upon the performance measures provided by OPTS is provided in Crawford et al. (1983).

3. Performance Appraisal. CSRA (1978) requires all federal agencies to establish a performance appraisal system to permit accurate evaluation of job performance based on objective job-related criteria. The Department of the Navy has developed the Basic Performance Appraisal Program (BPAP) (SECNAVINST 12430.1 of 19 January 1981) to meet the CSRA requirement. BPAP requires that performance elements and standards be developed to cover those major components of a position for which the employee is held responsible. OPTS provides objective measures of one element of NARF employees' job performance; namely, productivity. It most likely represents the major component of most production positions. NARFs can go far toward meeting the BPAP requirements by incorporating performance efficiency from OPTS in their performance appraisal systems for production workers.

4. Incentive Awards. Incentive award programs, in which employees receive monetary or nonmonetary rewards for superior performance, have been quite effective in increasing performance in a number of settings (Belcher, 1974). OPTS provides a performance measure on which rewards (e.g., training, promotions, recognition, or a monetary award) could be based. One type of incentive system, a performance contingent reward system (PCRS) (Shumate, Dockstader, & Nebeker, 1978), provides rewards directly linked to work-related behavior. In developing a PCRS, it is critical to define the desired

work behavior clearly and to link the reward directly to the behavior. Using the OPTS performance efficiency percentage makes it possible to satisfy both of these requirements. For example, employees working above the standard rate of 100 percent efficiency could receive wage incentives based on their increased productivity. Ideally, the amount of the reward would be directly proportional to the extent to which the standard rate was exceeded. The results of implementing such a PCRS using the performance measures provided by OPTS in four PPD shops at NARF Alameda are currently being evaluated.

5. Program Evaluation. When organizations experiment with productivity improvement techniques such as those just outlined, accurate, objective measures are needed to assess the degree of success or failure of those efforts. Unfortunately, most such experimentation is not subject to rigorous evaluation because of the lack of such performance data. Evaluation requirements also extend to other organizational changes such as the introduction of new managerial practices or advanced technology. The information contained in the OPTS reports and tapes makes it possible to assess changes in employee and shop performance and in other work indicators. In fact, OPTS data provided the primary measures for the evaluation of the experimental feedback and goal-setting and performance contingent reward programs studied at NARF Alameda.

CONCLUSIONS

1. The OPTS individual performance measurement and reporting system for production workers was implemented successfully in PPD, NARF Alameda.

2. Because OPTS uses data produced by the standard MIS used by NARFs, it could be adopted by all NARFs.

3. The most serious drawback of OPTS (and MIS) is that employees could manipulate inputs and thus inflate their performance measures. Appropriate controls are required to prevent manipulation if OPTS is to be an effective management tool.

RECOMMENDATIONS

It is recommended that:

1. NARF Alameda implement the OPTS performance measurement reports in other areas within the Production Department. OPTS may need to be tailored to fit these somewhat different work environments.

2. Other NARFs implement OPTS on a trial basis in their Production Departments. Any local differences should be considered when transferring OPTS to other NARFs.

3. NARFs consider using the individual performance measures provided by OPTS in conjunction with their productivity improvement efforts (e.g., existing incentive award programs, the Navy's BPAP, or experimental techniques such as goal setting).

4. When implementing new productivity improvement programs, NARFs use the individual performance measures provided by OPTS for evaluating resulting performance changes.

5. Before NARFs adopt OPTS for such purposes, they strengthen the controls in the work assignment and reporting systems to prevent manipulation of the performance measurement information generated by MIS and OPTS.

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APPENDIX A

PRODUCTIVITY MEASUREMENT ISSUES

PRODUCTIVITY MEASUREMENT ISSUES

1. Productivity. Productivity, as used herein, is defined as the ratio of measured work output to measured resource input. Special emphasis needs to be given to the word "measured." The ratio is typically expressed as:

$$\text{Productivity} = \frac{\text{Work Output}}{\text{Resource Input}}$$

Productivity increases when greater work output occurs with the same or less resource input or when the same or greater work output occurs with a decrease in resource input. Resource input is usually measured in terms of labor hours required to produce the associated work output. If the output units are uniform, they can be measured as a simple count of units produced (e.g., tons of steel produced or number of cars completed). If output units are not uniform and cannot easily be counted (as in a repair or overhaul facility), work measurement techniques are used to develop standard measures of work output.

2. Work Measurement. Work measurement refers to a variety of methods used to establish relatively objective criteria (e.g., standards) to measure a fair day's work. These methods include time and motion study, elemental standard data (e.g., methods time measurement), and work sampling. Typically, work measurement includes the following four steps:

a. Job analysis (JAN). Job analysis consists of a variety of methods (e.g., observation, work sampling, critical incidents, or questionnaires) used to determine job requirements. These requirements, in turn, help to identify the skills, abilities, and knowledge needed to perform the job.

b. Methods improvement. During JAN, opportunities inevitably arise for improving the way work is performed. Improvements may be in the form of simplifying, combining, or eliminating certain procedures. The objective of methods improvement is to determine and establish those work procedures that provide the best product or service for the least cost.

c. Job description. A job description literally specifies the tasks and behaviors required to produce a product or service. The description should follow directly from JAN and incorporate procedural changes identified through methods improvement. An important element of the job description is the requirement to specify a standardized method for performing and reporting work. If work measurement systems are to provide a major justification for personnel actions, as required by CSRA (1978), it is imperative that common procedures be followed within work units.

d. Performance standards. The transition from work measurement to performance measurement begins after JAN, when jobs and employees are brought together through the development and implementation of performance standards. A performance or operation standard has been defined as the time needed for a normally skilled employee, following a prescribed method, working at an average pace, to complete a defined task or operation at an acceptable level of accuracy (Presgrave, 1971). (The standard usually includes an allowance to cover such things as rest breaks and normal fatigue.) Basically, a performance standard represents how long it should take an employee to perform a given task or specified unit of work. From an organizational perspective, a performance standard represents what an individual is expected to do on a daily basis to warrant a "fair day's pay."

3. Performance Measurement. The basic concern in the selection of performance measures is that they reflect the valued objectives of the organization. The organization must decide what is required of the employee, through the four steps covered above, and develop measures suitable for obtaining the relevant performance information. While the organization must make the final decision regarding what constitutes "good" performance measures, the following characteristics of such measures are desirable for productivity improvement efforts.

a. Definable/Objective. Performance must be clearly defined in terms of specific, countable, observable acts or events.

b. Sensitive. If performance is to be enhanced, measures of performance must reflect, or be sensitive to, changes in individual or group effort that determine performance levels.

c. Complete/Comprehensive. All acts or events important for determining performance need to be either measured or controlled. A rule of thumb is that at least 80 percent of the work should be measured. To achieve this, more than one aspect of job performance is typically measured.

d. Timely. The time span for measurement should be as short as feasible. Smaller time spans usually mean smaller units of behavior, actions, or events and more accurate measures.

e. Reliable. Performance measures should reflect actual performance; that is, equal levels of effort should result in consistent levels of measured performance.

f. Accessible. Performance measures should not be so difficult to obtain that the potential benefits would be negated by the costs of obtaining the information.

These six criteria can be satisfied in industrial activities such as a NARF by comparing the time an employee takes to complete tasks to the standard time allowed for those tasks. Thus, work output (the numerator of a productivity ratio) is measured in terms of performance standards, while resource input (the denominator) is measured in labor hours.

4. Performance Reporting Systems. Once the basic data for calculating performance measures have been identified (e.g., time taken to complete tasks and operation standard times for those tasks), a means must be developed to obtain, manipulate, report, and store performance information. Because of the volume and complexity of performance measurement data in large organizations, these tasks cannot be considered trivial. Many organizations face these issues by incorporating performance measurement and reporting in their management information systems (MISs). A MIS is an integrated system "for providing information to support the operations, management, and decision-making functions in an organization" (Davis, 1974, p. 5). Most often, these systems rely on computer hardware and software. A MIS processes raw data obtained through some data collection system to provide information valuable to the organization. Davis states that, "Information is data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective decisions" (p. 32). The focus of a MIS is to provide useful information in a format that meets users' needs. As

with all MIS reports, performance measurement reports are most likely to be accepted and used by the recipients if they satisfy certain criteria.

a. Appropriate content. The information provided by performance measurement reports should be both accurate and consistent over time. A performance reporting system based on measures developed, as previously discussed, will satisfy the criteria of accuracy and consistency. In addition, performance reports should provide the information that managers and other users would like to have. At the same time, though, the indices presented should be job-relevant and nonredundant. A related consideration is that the reports should provide information that is comprehensive. While a single measure of an employee's performance may be useful to a manager, a variety of indices of performance and work activity may give a more complete picture of the employee's job-related behavior. The time, effort, and cost required to supply performance measurement information should not be wasted on trivial or inappropriate measures, or on those already available. Finally, the level of aggregation of the information presented on reports should be appropriate to their intended purposes. This means that the aggregation level should be chosen to provide the right amount of detail. A manager may need performance information for each unit supervised. A first-level supervisor, therefore, may need performance measurement information for each employee.

b. Appropriate format and language. The format or layout of the information on the report page is another factor that influences user acceptance of reports. Information should be organized logically and presented in a way that is easy for users to read. (Some guidelines for preparing report layouts are provided in Hartman, Matthes, and Proeme, 1968.) Finally, the information provided and the titles and headings used on the reports should be in a form and language easily understandable to the users. They "should conform to the terms and practices of the industry to the greatest extent possible; that is, the system must talk in the [users'] language, not vice versa" (Walsh, 1968, p. 45).

c. Timeliness. To be of value, reports must provide timely information. Data input to the reporting system should be as current as possible. Computer generation of reports speeds data analysis, but this advantage is wasted if report distribution lags. Reports that reach managers too late to support required decisions or actions are worthless. The organization must accept responsibility for timely distribution of reports.

5. Uses of a Performance Reporting System. The primary purpose of a performance reporting system is to help the organization manage performance. Managers can use accurate and timely information about the performance of their own organizational units to assess the effectiveness of their current managerial practices. This information can also help an organization to plan its workload and labor requirements more accurately and to aid in staffing decisions, budget estimations, and resource allocations. Performance measurement data can be used by management in evaluating the effectiveness of new practices and programs.

When performance measurement is further refined to provide information about individual performance, additional benefits are accorded employees and supervisors. With regular and timely feedback, employees and their supervisors have an opportunity to monitor their performance. Research and experience have repeatedly shown that "where performance is measured, performance improves" (McConkie, 1979). Measures based on work standards provide further information about an employee's work relative to average or expected performance. Job performance data can be used by an individual or the supervisor to identify areas of strength or weakness, to assess career opportunities (e.g., promotion, transfer), to identify employee development needs (e.g., training, counselling), and as the basis for performance-based rewards (e.g., pay increases, cash awards). Further, individual performance measures can play an essential role in motivational productivity enhancement techniques such as goal setting and performance incentives.

APPENDIX B

SAMPLES OF OPTS REPORTS AND FIELD DESCRIPTIONS

EMPLOYEE PERFORMANCE REPORT

This report shows information about your performance for the current reporting week, the previous week, and the last 4 weeks.

The top half of the report, labelled WEEKLY ACTIVITY, Columns 1-10, shows how you spent your time during the current, previous, and last 4-week periods. The bottom half of the report, labelled OVERALL PERFORMANCE, Columns 11-20, shows information about how you performed during these periods.

Column	Title	Description
WEEKLY ACTIVITY		
DIRECT HOURS EXPENDED (Columns 1-3)		
1	ON COMP TASK	Hours you spent on tasks completed during that period.
2	ON PREV COMP TASK	Hours you spent on tasks that had been completed previously.
3	ON UNCOMP TASK	Hours you spent on tasks not yet completed at the end of that period (See Note 1).
ADDITIONAL HOURS (Columns 4-10)		
4	O/T HRS	Hours you worked overtime.
5	PREM HRS	Hours you worked on premium pay.
6	TOTAL INDIRECT HOURS	Total hours you spent on indirect charge categories.
7	ANNUAL LEAVE	Hours of annual leave you took.
8	SICK LEAVE	Hours of sick leave you took.
9	OTHER LEAVE	Hours of other leave you took (for example, leave without pay or holiday leave).
10	ERROR & UNACCTD HOURS	Hours including overtime you were expected to be at work that were not covered by transactions. This may be caused, for example, by not transacting during the last 15 minutes of your shift, or

Column	Title	Description
		by having uncorrected transaction errors such as "LINK NOT ON WIP," or by your foreman not transacting leave for you. A minus sign shows that more than the expected number of hours were accounted for, probably because a correction was processed late.

OVERALL PERFORMANCE

ALL DIRECT HOURS AGAINST COMPLETED TASKS (Columns 11-14)

11	ORIGINAL A-D	Hours you spent at any time on original (non-reprocess) A, B, C, or D standard tasks that were completed during that period (See Note 2).
12	ORIGINAL OTHER	Hours you spent at any time on original non-A-D standard tasks that were completed during that period.
13	REPROCESS A-D	Hours you spent at any time on reprocess A-D standard tasks that were completed during that period (See Note 2).
14	REPROCESS OTHER	Hours you spent at any time on reprocess non A-D standard tasks that were completed during that period.

EARNED HOURS FOR COMPLETED TASKS (Columns 15-16)

15	ORIGINAL	Standard hours you earned on original A-D standard tasks completed during that period (See Note 2).
16	REPROCESS	Standard hours you earned on reprocess A-D standard tasks completed during that period (See Note 2).

Column	Title	Description
PERFORMANCE (Columns 17-20)		
17	EFFCNCY %	This percentage shows how efficiently you worked during that period. The standard hours you earned on A-D standard original tasks completed during that period are divided by the hours you spent on those tasks: $$\text{Efficiency } \% = \frac{\text{Column } 15}{\text{Column } 11}$$
18	% OF EFFCNCY GOAL	This percentage shows how well you did that period in reaching your Efficiency Goal: $$\% \text{ of Goal} = \frac{\text{Column } 17}{\text{Efficiency Goal}}$$
19	RLZTN %	This percentage shows your performance when reprocessing tasks and tasks with no standards are included along with original tasks with A-D standards: $$\text{Realization } \% = \frac{\text{Columns } 15 + 16}{\text{Columns } 11+12+13+14+2}$$
20	% OF RLZTN GOAL	This percentage shows how well you did that period in reaching your Realization Goal: $$\% \text{ of Rlztn Goal} = \frac{\text{Column } 19}{\text{Realization Goal}}$$

NOTE 1: Standard hours are earned only for completed tasks. You may sometimes work on tasks that you do not complete that week. Time spent on such tasks appears in Column 3 as direct hours expended on uncompleted tasks. When such a task is completed during a later week, the time you spent earlier is called "Carryover."

Because performance is based on all hours expended on completed tasks, both the carryover hours and any hours spent on the task during the week it was completed are considered to be direct hours expended on completed tasks. For example, suppose you had transacted a stop two weeks ago after working one hour on original work with a C standard. This one hour would show up in Column 3, direct hours expended on uncompleted tasks, for that week, but <u>not</u> in Column 1 since the task was not completed. Suppose that, during the current week, you worked two more hours and completed that line. The carryover hour from two weeks ago would go into the expended hours number in Column 11 for the current week, along with the two hours you spent to complete the task. Of course, these same two hours also go into Column 1 as direct hours expended on completed tasks for the current week. Likewise, the total standard awarded for completing the line would go into Column 15 for the current week.

NOTE 2: So that you can get credit for work on completed handwrite and added line tasks with E standards, these tasks are changed to C standards for this report. Therefore, the expended and earned hours for these tasks are included in the report columns that refer to A-D standard tasks (Columns 11, 13, 15, and 16).

FILE LABEL AWGM6R01

ENCODED EMPLOYEE NO 82357 SHOP 06413 SHIFT 1

WEEKLY ACTIVITY

	DIRECT-HOURS-EXPENDED ON COMP TASK	ON PREV-COMP TASK	ON UNCOMP TASK	O/T HRS	PREM HRS	TOTAL INDIRCT HOURS	----LEAVE---HOURS---- ANNUAL	SICK	OTHER	ERROR & UNACCTD HOURS
CURRENT WK	33.3		5.4			.3				1.0
PREV WEEK	24.6		15.5							
LAST 4 WKS	79.5		36.9			2.6		32	8.0	1.0

OVERALL PERFORMANCE

	ALL-DIRECT-HRS-AGAINST-COMP-TASKS ORIGINAL A-D	ORIGINAL OTHER	REPROCESS A-D	REPROCESS OTHER	EARNED-HOURS FOR COMPLETED--TASKS ORIGINAL	REPROCESS	EFFCNCY %	% OF GOAL	RLZTN %	% OF GOAL
CURRENT WK	48.7				49.5		101.6		101.6	
PREV WEEK	21.0	3.6			20.1		96.0		82.0	
LAST 4 WKS	91.4	3.6			87.0		95.2		91.6	

SHOP ACTIVITY SUMMARY REPORT (SHOP-SUM)

This report summarizes the weekly labor transactions for each shop and shift. It gives information about the performance of the shop and the nature of the work.

Column	Title	Description
DIRECT HOURS EXPENDED (Columns 1-6)		
1	ON COMP TASKS	Hours expended on lines completed in the current week.
2	ON PREV-COMP TASKS	Hours expended on lines that had been completed in a previous week.
3	ON UNCOMP TASKS	Hours expended on lines not yet completed at the end of the current week.
4	TOTAL THIS WEEK	Total of Columns 1-3.
5	ON PREVIOUS CARRY-OVER	Hours expended in previous weeks on tasks completed in the current week.
6	TOTAL ON COMPLETIONS	Total of Column 1 and Column 5.
7	STD HOURS EARNED	Total standard hours awarded for all tasks completed in current week.
8	INDIRECT EXPENDED HOURS	Total hours expended against indirect charge categories.
LEAVE HOURS (Columns 9-11)		
9	ANNUAL	Hours of annual leave taken.
10	SICK	Hours of sick leave taken.
11	OTHER	Hours of other leave taken (for example, holiday leave or leave without pay).
12	ERROR & UNACCTD HOURS	Hours, including overtime, that employees were expected to be at work that were not covered by transactions. This may be caused, for example, when employees do not transact during the last 15 minutes of their shift, or by having

Column	Title	Description
		uncorrected transaction errors such as "LINK NOT ON WIP." A minus sign shows that more than the expected number of hours were accounted for, probably because a correction was processed late.

EXPENDED HOURS AGAINST TASKS COMPLETED THIS WEEK (Columns 13-16)

13	ADDED LINES	Hours expended on added lines.
14	VOIDED LINES	Hours expended on previously voided lines.
15	HAND WRITES	Hours expended on non-reprocessing handwritten shop orders.
16	REPROC	Hours expended on reprocess handwritten shop orders.

HOURS SPENT IN SPECIAL CATEGORIES

17	O/T	Overtime hours.
18	PREMIUM	Hours on premium pay.

EARNED HOURS AGAINST TASKS COMPLETED THIS WEEK (Columns 19-22)

19	ADDED LINES	Standard hours earned on added lines.
20	VOIDED LINES	Standard hours earned on previously voided lines.
21	HAND WRITES	Standard hours earned on non-reprocessing handwritten shop orders.
22	REPROC	Standard hours earned on reprocess handwritten shop orders.

Column	Title	Description
23	EFFCY %	Efficiency % shows how efficient the shop as a whole was on A, B, C, and D standard original work (plus added lines and non-reprocessing handwritten shop orders with A-E standards) completed in the current week. Standard hours earned on this work are divided by the hours expended on this work. (Note that hours expended on this work do not include any expended hours on transactions shown on the Shop Employee, Shop-Link, and Master Reports with E, Z, or N standards.)

$$\text{Efficiency} = \frac{\text{Column 7} - \text{Column 22}}{\text{Column 6} - \text{Column 16} - \text{Expended Hours Against E, Z, N, Standards}}$$

Column	Title	Description
24	RLZTN %	Realization % shows how efficient the shop as a whole was on all direct work completed by the end of the current week. Standard hours earned on original and reprocessing work completed this week (Column 7) are divided by hours expended on all work completed this week (Column 6 + Column 2).

$$\text{Realization} = \frac{\text{Column 7}}{\text{Column 6} + \text{Column 2}}$$

Column	Title	Description
25	INDIRECT HOURS BY CATEGORY	Hours transacted against each indirect category listed below.

Indirect Categories

AA/MA	Supervision
MC	Experimental
NA	Training, Apprentice
NB/NC	Training,Non-Apprentice
QA	Time Allowed
MB	Delay
ME	Backrobbing
MF	Cannibalization
MG	Cleanup
MJ	Shop General
KA/KK	Plant Maintenance
KB/KC	Tool Maintenance
KD	Minor Equipment
Other	All Other Indirect Categories

OPTS SHOP ACTIVITY SUMMARY REPORT

WEEK-ENDING-DATE 031983 PAGE 1
WEEK ENDING WORK DAY 109

FILE LABEL AWGL4R02

SHOP 96413 SHIFT 1 TOTALS

DIRECT HOURS EXPENDED												
ON COMP TASK	ON PREV-COMP TASK	ON UNCOMP TASK	TOTAL THIS WEEK	ON PREVIOUS CARRYOVER	TOTAL ON COMPLETIONS	STD HOURS EARNED	INDIRECT EXPENDED HOURS	LEAVE HOURS ANNUAL	LEAVE HOURS SICK	LEAVE HOURS OTHER	ERROR & UNACCTD HOURS
516.6	36.7	180.5	735.8	128.8	647.3	626.8	72.4	40	74		37.6

EXPENDED HOURS AGAINST					
ADDED LINES	VOIDED LINES	HAND WRITES	REPROC	O-T	PREM
23.9		36.8	44.3		

EARNED HOURS AGAINST					
ADDED LINES	VOIDED LINES	HAND WRITES	REPROC	EFFCY %	RLZTN %
30.7		31.9	14.9	105.6	91.6

INDIRECT HOURS BY CATEGORY

AA/MA 40.0 QA 9.1 MB 1.2 MG 6.1 OTHER 16.0

DETAILED SHOP ACTIVITY REPORT BY EMPLOYEE (SHOP-EMPLOYEE)

This report shows all labor transactions for the current week by each employee in the shop and shift. It provides detailed documentation to back up the Employee Performance Report.

Column	Title	Description
1	EMPL NO	Five digit number identifying the employee making the transaction.
2	LINK NO	A seven digit number that shows one of three things depending on the type of transaction: (1) the link number from the shop order, (2) the job order number, or (3) the indirect charge category.
3	HR	Handwrite/Reprocess Indicator: R = Reprocess handwritten shop order H = Non-reprocess handwritten shop order Blank = All others
4	LN NO	The line number identifying each operation or task on a shop order.
5	BWD	Base Work Day shows the work day on which the transaction was made.
6	AV	Added/Voided Line Indicator: A = Added line V = Previously voided line Blank = All others
7	WTC	Work Transaction Code identifies the specific type of transaction: e.g., 500 = Work stop 600 = Work complete 570 = Labor adjustment 520 = Batch stop 620 = Batch complete 670 = Manual labor correction-complete 700 = Rework stop
8	COI	Carryover Indicator identifies a line worked but not completed in a previous week that has been completed in the current week. The original transaction showing the hours

Column	Title	Description
		expended on the line in a previous week carries over to the week in which the line is completed. COI also gives other information about a line's completion status. C = Carryover transaction made in a previous week against a line completed in the current week. P = Transaction made this week against a line that had been completed in a previous week. U = Transaction made this week against a line not yet completed at the end of the current week. Blank = Transaction made in the current week against task completed in the current week.
DIRECT HOURS EXPENDED		
9	ON COMP TASK	Hours expended on a line completed in the current week.
10	ON PREV-COMP TASK	Hours expended in the current week on a line that had been completed in a previous week.
11	ON UNCOMP TASK	Hours expended on a line not yet completed at the end of the current week.
12	STD HOURS ERND	Standard hours earned for the line if it was completed by the end of the current week.
13	STD TYPE	One letter code showing how the operation standard was determined. A = Engineered time studies B = Work sampling and reference materials C = Estimate by M&S D = Industry accepted data E = Direct labor with no standard hours N = No standard hours in lieu of summary line Z = Waiting for M&S input of standards for an added line

So that employees can get credit for work on handwrites and added lines with E standards, upon completion, these standards are changed to and printed on this report as C standards.

Column	Title	Description
INDIRECT EXPENDED		
14	CAT	Two letter code identifying the category of indirect charge (see attached code sheet).
15	HRS	Hours expended against the indirect category.
LEAVE HOURS		
16	AL	Hours of annual leave taken.
17	SL	Hours of sick leave taken.
18	OTH	Hours of other leave taken (for example, military leave or holiday leave).
19	ERROR & UNACCTD HOURS	Hours, including overtime, that the employee was expected to be at work but that were not covered by transactions or for which transaction errors were not corrected. This amount is shown only on the total line for each employee.
20	O/T PREM BOTH	Indicator shows if the transaction was any of the following: O = Transaction on overtime P = Transaction on premium pay B = Transaction on both overtime and premium pay Blank = None of the above
21	INFO ERROR CODE	Informational error code indicating a transaction error. For example: 26 = Link/line number on WIP, not on Mini 41 = Line number invalid for WIP 44 = Transaction against previously completed line 45 = Transaction against voided line Blank = No error

Indirect Categories

AA/MA	Supervision
MC	Experimental
NA	Training, Apprentice
NB/NC	Training, Non-Apprentice
QA	Time Allowed
MB	Delay
ME	Backrobbing
MF	Cannibalization
MG	Cleanup
MJ	Shop General
KA/KK	Plant Maintenance
KB/KC	Tool Maintenance
KD	Minor Equipment
Other	All Other Indirect Categories

OPTS DETAILED SHOP ACTIVITY REPORT (BY EMPLOYEE)

WEEK ENDING DATE 112782
WEEK ENDING WORK DAY 036

FILE LABEL AWGL4R01

SHOP 96422 SHIFT 1

								DIRECT-HOURS-EXPENDED												
EMPL NO	LINK NO	H R	LN NO	BWD	A V	WTC	C O I	ON COMP TASK	ON PREV-COMP TASK	ON UNCOMP TASK	STD HOURS EARNED	STD TYPE	INDIRECT EXPENDED CAT	HRS	LEAVE-HOURS AL	SL	OTH	ERROR & UNACCTD HOURS	O/T PREM BOTH	INFO ERROR CODE
91590	C335525		7	034		600		.7			.5	D								
91590	C335525		9	034		500				.6		D								
91590	C355390		5	034		600		.9			.5	C								
91590	C355391		5	034		600		.6			.5	C								
91590	C355392		5	034		600		1.2			.5	C								
91590	C392820		8	034		600		1.8			2.2	D								
91590	C392820		12	035		500				1.8		D								
91590	TOTALS *EXCL. CARRYOVER*							14.1		5.9	12.5				16		8.0			
91590	TOTALS ** CARRYOVER ***							2.1			2.1									
92260	9602211			036		560									4					
92260	9642211			036		560									8					
92260	9642213			036		560											8.0			
92260	C008997		15	012		500	C	.7			.8	A								
92260	C008997		15	034		600		2.8			3.2	A								
92260	C066862		15	013		500	C	2.0			2.1	D								
92260	C066862		15	012		500	C	1.5			1.6	D								
92260	C066862		15	035		600		4.3			4.5	D								
92260	C066862		15	013		500	C	1.6			1.7	D								
92260	C066864		14	035		600		.2			.8	D								
92260	C116825		6	034		500				1.1		D								
92260	C136247		15	020		500	C	.3			.2	D								
92260	C136247		15	020		500	C	.6			.6	D								
92260	C136247		15	020		500	C	.9			.8	D								
92260	C184142		15	016		500	C	4.6			2.9	D								
92260	C184142		15	022		500	C	1.2			.7	D								
92260	C223565		6	035		500				2.5		D								
92260	C246624		13	034		500				2.6		D								
92260	C361595		6	035		500				1.1		D								
92260	C381653		8	036		600		4.0			2.5	D								
92260	C392820		8	034		500		1.4			1.7	D								
92260	TOTALS *EXCL. CARRYOVER*							12.7		7.3	12.7				12		8.0			
92260	TOTALS ** CARRYOVER ***							13.4			11.4									
92308	9642211			036		560									8					
92308	9642213			036		560											8.0			

DETAILED SHOP ACTIVITY REPORT BY LINK (SHOP-LINK)

This report shows all labor transactions for the current week by each shop and shift. These transactions are sorted into link number order.

Column	Title	Description
1	LINK NO	A seven digit number that shows one of three things depending on the type of transaction: (1) the link number from the shop order, (2) the job order number, or (3) the indirect charge category.
2	QCI	Quality Control Indicator: 1 = Critical defect 2 = Major defect 3 = Minor defect 0 = None
3	LINK STAT	Code identifying the status of the link: 0 = Not inducted 1 = Inducted - work not started 2 = Inducted - work started 3 = Completed 4 = Cancelled 5 = Voided
4	PRG	Identifies the Program or type of direct labor work being done: 0 = Aircraft 1 = Missiles 2 = Engine 3 = Components 4 = Other support 5 = Manufacturing
5	HR	Handwrite/Reprocess Indicator: R = Reprocess handwritten shop order H = Non-reprocess handwritten shop order Blank = All others
6	PRI	Priority of the work being done (1-4)
7	LN NO	The line number identifying each operation or task on a shop order.

Column	Title	Description
8	COI	Carryover Indicator identities a line worked but not completed in a previous week that has been completed in the current week. The original transaction showing the hours expended on the line in a previous week carries over to the week in which the line is completed. COI also gives other information about a line's completion status C = Carryover transaction made in a previous week against a line completed in the current week. P = Transaction made in the current week against a line that had been completed in a previous week. U = Transaction against a line not yet completed at the end of the current week. Blank = Transaction made in the current week.
9	SCHEDULED COMP DATE NARF	Scheduled work day of completion based on expected induction date.
10	SCHEDULED COMP DATE SHOP	Scheduled work day of completion based on actual induction date.
11	BASE WORK DAY	Base Work Day shows the work day on which the transaction was made.
12	AV	Added/Voided Line Indicator: A = Added line V = Previously voided line Blank = All others
13	TRADE CODE	Currently has multiple uses within NARF.
14	LINE STAT	Number indicating status of the line at the end of the current week: 1 = Voided 2 = Active - no work started 3 = Active - work started 5 = Completed 7 = Completed because of a labor transaction in a subsequent shop.
15	STD HOURS	The operation standard hour content of the line.

Column	Title	Description
16	STD TYP	One letter code showing how the standard was determined: A = Engineered time studies B = Work sampling and reference materials C = Estimate by M&S D = Industry accepted data E = Direct labor with no standard hours N = No standard hours in lieu of summary line Z = Waiting for M&S input of standard hours for an added line
17	QTY BEING PROC	Quantity of items being processed for line.
18	ENCODED EMPL NO	Five digit number identifying the employee making the transaction.
19	SCHEDULED HOURS EXPENDED PRIOR	Hours expended prior to shop scheduled start date.
20	SCHEDULED HOURS EXPENDED WITHIN	Hours expended within shop schedule.
21	SCHEDULED HOURS EXPENDED AFTER	Hours expended after shop scheduled completion date.
22	STD HOURS EARNED	Standard hours awarded for completing the line.
23	INFO ERROR CODE	Informational error code indicating a transaction error. For example: 26 = Link/line number on WIP, not on Mini 41 = Line number invalid for WIP 44 = Transaction against previously completed line 45 = Transaction against voided line Blank = No error
24	MSI	Multi shop/shift indicator: an asterisk shows that more than one shop or shift worked on this line.

FILE LABEL AWGK6R01

SHOP 96424 SHIFT 1

LINK NO	QCI	LINK STAT	PRG	HR	PRI	LN NO	COI	SCHEDULED COMP-DATE NARF	SCHEDULED COMP-DATE SHOP	BASE WORK DAY	AV	TRADE CODE	LINE STAT	STD HOURS	STD TYP	QTY BEING PROC	ENCODED EMPL NO	SCHEDULED HOURS-EXPENDED PRIOR	WITHIN	AFTER	STD HOURS EARNED	INFO ERROR CODE	MSI
C319952	0	2	3		4	4		027	036	036			5	.3	D	1	91757	.3			.3	00	
C319952	0	2	3		4	7		027	037	036			5	1.0	C	1	91757	1.1			1.0	00	
C319952	0	2	3		4	9		027	037	036			5	.5	C	1	91757	.5			.5	00	
C325630	0	2	2		4	12		029	035	035	A		5	.3	C	1	78605	1.1			.3	00	
C325634	0	2	2		4	4		029	037	036			5	1.0	A	1	78605	1.4			1.0	00	
C325634	0	2	2		4	12		029	035	036	A		5	.3	C	1	78605	.4			.3	00	
C325687	0	2	2		4	6		035	038	036			5	.3	C	1	92743	1.2			.3	00	
C325809	0	2	2		4	6	P	031	032	035			5	1.1	D	1	88278	1.0				44	
C325809	0	2	2		4	7		031	033	035			5	1.6	D	1	88278	1.5			1.6	00	
C325809	0	2	2		4	14	U	031	033	035			2	2.8	C	1	88278	.5				00	
C335009	0	2	2		4	6		036	035	034			5	.9	D	1	53124	1.1			.9	00	
C335009	0	2	2		4	7		036	036	034			5	.1	D	1	53124	.1			.1	00	
C335281	0	2	2		4	2	U	046	047	035			5		Z	1	92544	.7				00	
C335281	0	2	2		4	3		046	047	035			5	.5	C	1	92544	.5			.5	00	
C335281	0	2	2		4	8		046	052	036			5	7.5	C	1	92544	2.1			2.1	00	
C335281	0	2	2		4	8		046	052	035			5	7.5	C	1	92544	3.3			3.2	00	
C335281	0	2	2		4	8		046	052	036			5	7.5	C	1	92544	2.3			2.2	00	
C335495	0	2	2		4	12	U	039	036	034			2	4.0	C	1	91757	8.0				00	
C335532	0	2	2		4	10		033	037	034			5	.3	C	1	78605	1.3			.3	00	
C335532	0	2	2		4	11		033	037	034			5	1.3	D	1	78605	2.0			1.3	00	
C336941	0	2	3		3	7		034	035	034			5	.8	C	1	92544	.9			.8	00	
C336941	0	2	3		3	15		034	038	034			5	.5	C	1	92544	.4			.5	00	
C336977	0	2	3		3	7		035	035	034			5	.8	C	1	92544	.9			.8	00	
C336977	0	2	3		3	15		035	038	034			5	.5	C	1	92544	.4			.5	00	
C337219	0	2	3		3	14		032	031	034			5	2.8	A	1	88278	2.6			2.8	00	
C337833	0	2	3		3	6		028	034	034			5	1.0	A	1	92743	.8			.1	00	
C337833	0	2	3		3	6		028	034	036			5	1.0	A	1	92743	.5			.1	00	
C337833	0	2	3		3	6		028	034	036			5	1.0	A	1	92743	.6			.1	00	
C337833	0	2	3		3	6		028	034	036			5	1.0	A	1	92743	4.0			.7	00	

MASTER LINK ACTIVITY REPORT (MASTER)

This report shows all labor transactions for the current week by all shops included in the OPTS system. These transactions are sorted into link number order.

Column	Title	Description
1	LINK NO	A seven digit number that shows one of three things depending on the type of transaction: (1) the link number from the shop order, (2) the job order number, or (3) the indirect charge category.
2	QCI	Quality Control Indicator: 1 = Critical defect 2 = Major defect 3 = Minor defect 0 = None
3	LINK STAT	Code identifying the status of the link: 0 = Not inducted 1 = Inducted - work not started 2 = Inducted - work started 3 = Completed 4 = Cancelled 5 = Voided
4	PRG	Identifies the Program or type of direct labor work being done: 0 = Aircraft 1 = Missiles 2 = Engines 3 = Components 4 = Other support 5 = Manufacturing
5	HR	Handwrite/Reprocess Indicator: R = Reprocess handwritten shop order H = Non-reprocess handwritten shop order Blank = All others
6	PRI	Priority of the work being done (1-4).
7	LN NO	The line number identifying each operation or task on a shop order.

Column	Title	Description
8	COI	Carryover Indicator identifies a line worked but not completed in a previous week that has been completed in the current week. The original transaction showing the hours expended on the line in a previous week carries over to the week in which the line is completed. COI also gives other information about a line's completion status. C = Carryover transaction made in a previous week against a line completed in the current week. P = Transaction made in the current week against a line that had been completed in a previous week. U = Transaction against a line not yet completed at the end of the current week. Blank = Transaction made in the current week against a line completed by the end of the current week.
9	MU	Matched/Unmatched Indicator shows whether the transaction's link number is matched on the Work In Process file. M = Matched U = Unmatched
10	SCHEDULED COMP DATE NARF	Scheduled work day of completion based on expected induction date.
11	SCHEDULED COMP DATE SHOP	Scheduled work day of completion based on actual induction date.
12	BWD	Base Work Day shows the work day on which the transaction was made.
13	ASD	Actual Start Date shows the work day of the first transaction against the line.

Column	Title	Description
14	AV	Added/Voided Line Indicator: A = Added line V = Previously voided line Blank = All others
15	EXPND HRS	Hours expended against the line for this transaction.
16	LINE STAT	Number indicating status of the line at the end of the current week: 1 = Voided 2 = Active - no work started 3 = Active - work started 5 = Completed 7 = Completed because of a labor transaction in a subsequent shop.'
17	STD HOURS	The operation standard hour content of the line.
18	STD TYP	One letter code showing how the standard was determined: A = Engineered time studies B = Work sampling and reference materials C = Estimate by M&S D = Industry accepted data E = Direct labor with no standard hours N = No standards in lieu of summary line Z = Waiting for M&S input of standard hours for an added line
19	QTY BEING PROC	Quantity of items being processed for line.
20	EMPL NO	Five digit number identifying the employee making the transaction.
21	SCHEDULED HOURS EXPENDED PRIOR	Hours expended prior to shop scheduled start date.
22	SCHEDULED HOURS EXPENDED WITHIN	Hours expended within shop schedule.

Column	Title	Description
23	SCHEDULED HOURS EXPENDED AFTER	Hours expended after shop scheduled completion date.
24	STD HOURS	Standard hours awarded for completing the line.
25	WORK SHOP	Five digit number identifying the shop where the employee did the work.
26	WORK S	Shift in which the employee did the work: 1 = Day shift 2 = Swing shift 3 = Graveyard shift
27	ER CD	Informational error code indicating a transaction error. For example: 26 = Link/line number on WIP, not on Mini 41 = Line number invalid for WIP 44 = Transaction against previously completed line 45 = Transaction against voided line Blank = No error
28	MSI	Multi shop/shift indicator: an asterisk shows that more than one shop or shift worked on this line.

ADPCN ANGLMR01 PREPARED 81/08/30 16:27 OPTS MASTER LINK ACTIVITY REPORT PAGE

AS OF WEEK ENDING DATE 08/29/81 WEEK ENDING WORK DAY 225

LINK NO	Q C I	LINK STAT	P R G	P R I	LN NO	C O I	M U	SCHEDULED COMP-DATE NARF	SHOP	BWD	ASD	A V	EXPND HOURS	LINE STAT	STD HOURS	STD TYP	QTY BEING PROC	EMPL NO	SCHEDULED HOURS-EXPENDED PRIOR	WITHIN	AFTER	STD HOURS EARNED	WORK SHOP/S	ER CD	M S I
G456791	0	3	3	3	18	C	M	181	174	198	174	A	8.0	7	19.9	D	1	47011			8.0	6.1	96333 1		
G456791	0	3	3	3	18	C	M	181	174	197	174	A	6.3	7	19.9	D	1	47011			6.3	4.8	96333 1		
G456791	TOTALS												26.3		19.9						26.3	19.9			
G456897	0	3	3	3	7		M	174	193	221	193		1.0	5	4.0	D	1	11521			1.0	4.0	96332 1		
G456897	TOTALS												1.0		4.0						1.0	4.0			
G456898	0	3	3	3	7		M	175	231	223	231		1.0	5	1.0	C	1	08842	1.0			1.0	96333 1		
G456898	0	3	3	3	7		M	175	231	223	231			5	1.0	C	1	08842					96333 1		
G456898	0	3	3	3	9		M	175	232	223	232			5	.2	C	1	08842					96333 1		
G456898	0	3	3	3	9		M	175	232	223	232		.2	5	.2	C	1	08842	.2			.2	96333 1		
G456898	0	3	3	3	11		M	175	233	223	233		.6	5	.7	A	1	11521	.6			.7	96332 1		
G456898	TOTALS												1.8		1.9				1.8			1.9			
G457737	0	3	3	3	2		M	163	230	223	230		1.6	5	1.4	A	6	28790	1.6			1.5	96321 1		
G457737	0	3	3	3	4		M	163	230	223	230		.7	5	.6	A	6	28790	.7			.6	96321 1		
G457737	0	3	3	3	5		M	163	230	223	230		.3	5	.3	A	6	28790	.3			.3	96321 1		
G457737	TOTALS												2.5		2.3				2.5			2.4			
G458124	0	3	3	4	15		M	174	172	223	172			5	.8	C	1	17550					96245 1		
G458124	0	3	3	4	15		M	174	172	223	172		.8	5	.8	C	1	17550			.8	.8	96245 1		
G458124	0	3	3	4	15		M	174	172	223	172			5	.8	C	1	17550					96245 1		
G458124	TOTALS												.8		.8						.8	.8			
G458126	0	2	3	4	15		M	175	172	225	172		.8	5	.8	C	1	17550			.8	.8	96245 1		
G458126	TOTALS												.8		.8						.8	.8			
G458128	0	3	3	4	15		M	176	172	223	172		.8	5	.8	C	1	17550			.8	.8	96245 1		
G458128	0	3	3	4	15		M	176	172	223	172			5	.8	C	1	17550					96245 1		
G458128	0	3	3	4	15		M	176	172	223	172			5	.8	C	1	17550					96245 1		
G458128	TOTALS												.8		.8						.8	.8			
G458132	0	2	3	4	15		M	178	172	225	172		.9	5	.8	C	1	17550			.9	.8	96245 1		
G458132	TOTALS												.9		.8						.9	.8			
G458213	0	2	3	3	9		M	165	161	222	161		.1	5	.1	C	1	47857			.1	.1	96324 1		
G458213	TOTALS												.1		.1						.1	.1			
G458251	0	2	3	3	9	U	M	166	161	225	161		.1	3	.1	C	1	47857			.1		96324 1		
G458251	0	2	3	3	12		U			222			1.7			E		60430		1.7			96324 1	41	
G458251	TOTALS												1.8		.1					1.7	.1				
G458257	0	3	3	3	4	C	M	166	152	161	152		.5	7	.7	C	1	20089			.5	.7	96324 1		
G458257	0	3	3	3	9		M	166	161	222	161		.1	5	.1	C	1	47857			.1	.1	96324 1		
G458257	TOTALS												.5		.8						.5	.8			
G458269	0	3	3	3	9		M	167	161	222	161		.1	5	.1	C	1	47857			.1	.1	96324 1		
G458269	TOTALS												.1		.1						.1	.1			
G458271	0	2	3	3	11		M	167	160	223	160	A	.5	5	2.7	A	1	19726			.5	.7	96324 1		*

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Commander, Naval Military Personnel Command (NMPC-013C)
Commander, Naval Sea Systems Command (073)
Commander, Long Beach Naval Shipyard (Code 110)
Commander, Mare Island Naval Shipyard (Code 115)
Commanding Officer, Naval Air Rework Facility, Alameda (Code 900) (10)
Commanding Officer, Naval Air Rework Facility, Cherry Point
Commanding Officer, Naval Air Rework Facility, Jacksonville
Commanding Officer, Naval Air Rework Facility, Norfolk
Commanding Officer, Naval Air Rework Facility, North Island
Commanding Officer, Naval Air Rework Facility, Pensacola
Commanding Officer, Naval Intelligence Support Center
Manpower and Personnel Division, Air Force Human Resources Laboratory, Brooks Air Force Base
Technical Library, Air Force Human Resources Laboratory, Brooks Air Force Base
Logistics and Technical Training Division, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base
Commander, Army Research Institute for the Behavioral and Social Sciences, Alexandria
Office of Personnel Management, Washington, D.C.
Office of Personnel Management, Western Region
Provost, Naval Postgraduate School
Library, Navy War College
Library, National War College
Defense Technical Information Center (DDA)

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