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A GROUP WAGE INCENTIVE SYSTEM FOR PRODUCTION WORKERS AT PEARL HARBOR NAVAL SHIPYARD: TEST AND EVALUATION

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This report describes the implementation and evaluation of a group wage incentive system for production workers in a naval shipyard. The system provided periodic rewards to groups of civil service workers performing above standard. A description of the system and an evaluation of its effects during the first 19 months after implementation are provided. Improvements were found in the areas of performance efficiency, accuracy of labor accounting, and adjustment of staffing levels to changing workload situations. The shop showed a 7.5 percent improvement over baseline performance during the last 11 periods of the 19-period system test. During the first 8 periods, the shop maintained its baseline performance efficiency level in spite of a severe workload reduction. Performance in two shops used for comparison showed substantial decreases in performance efficiency during the same time, although their workload reductions were less severe than that of the test shop. A cost savings analysis revealed a net cost savings in excess of $600,000 due to improvement over baseline performance that occurred during the system test. At current performance levels, shipyard cost savings will approach $2,000,000 during 1985. It was recommended that shipyard managers consider using the incentive system in other production shops and shipyards.

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FOREWORD

The purpose of this research and development, which was supported under a task order from the Pearl Harbor Naval Shipyard (NAVSHIPYDPEARL), was to implement and evaluate a group wage incentive system for civilian production workers at NAVSHIPYD-PEARL. A previous report described the performance measurement and reporting (PMR) system developed to support the incentive system (NPRDC TR 84-55). A subsequent report will provide a more detailed description of the incentive system itself.

Appreciation is extended to Captain D. H. Hines and Captain H. C. Hunter for their support of the project and to the many individuals throughout NAVSHIPYDPEARL who helped develop, implement, and maintain the test system. The efforts of Commander M. E. Morgan, who served as Project Officer during the early stages of the project; Commander A. S. Dowd, who served as Project Officer after implementation; Mr. Ronald Yamagata, who served as Incentive Coordinator; and Mr. Robert Kanemaru, who coordinated the data processing requirements of the project, are particularly appreciated.

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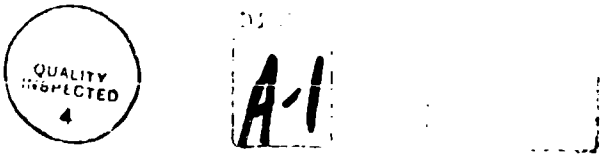

SUMMARY

Problem and Background

The escalating cost of maintaining and repairing the Navy's submarines and surface craft is a serious problem given current efforts to establish a 600-ship Navy. In addition to traditional productivity initiatives involving hardware and technology, attention is now being focused on techniques to increase employee motivation and performance.

At the request of NAVSHIPYDPEARL for assistance in reducing costs, the Navy Personnel Research and Development Center (NAVPERSRANDCEN) analyzed the shipyard's work settings and performance measurement capabilities and recommended that a monetary incentive award system be developed and tested. Such systems have proven to be cost-effective means of improving motivation and performance in a variety of Navy activities.

Purpose

The purpose of this effort was to implement and evaluate a group wage incentive system for production workers and foremen at NAVSHIPYDPEARL. The system was designed to improve performance efficiency without negatively affecting schedule adherence, product quality, or participants' job attitudes.

Approach

The incentive system relied on information provided by a new performance measurement and reporting (PMR) system developed to overcome limitations in the shipyard's existing management information system (MIS). The PMR calculates work group performance efficiency and man-hour savings which are the basis for incentive award calculations. Half of the value of man-hour savings was shared with work group members in the form of incentive awards. Awards were calculated by the PMR every four weeks and were directly proportional to each group's above-standard performance. Foremen were eligible for awards whenever overall shop performance resulted in man-hour savings. The system was tested in one production shop consisting of 480 workers and 23 foremen assigned to 17 work groups.

Results

The incentive system produced a significant increase in the shop's performance efficiency. The shop showed a 7.5 percent improvement over baseline performance during the last 11 periods of the 19-period system test. During the first 8 periods, the shop maintained its baseline performance efficiency level in spite of a severe workload reduction. Performance in two shops used for comparison showed substantial decreases in performance efficiency during the same time, although their workload reductions were less severe than that of the test shop.

As expected, implementation of the system did not hurt schedule adherence or product quality. Furthermore, participants' job attitudes remained stable. Although program participants recognized problems related to system operation, 80% of those expressing an opinion favored continuing the incentive system.

Additional positive outcomes from the system test occurred, including improvements in shop practices, such as labor accounting accuracy, and increased action directed toward resolving productivity problems.

A cost savings analysis revealed a net cost savings in excess of $600,000 due to improvement over baseline performance that occurred during the system test. At current performance levels, shipyard cost savings will approach $2,000,000 during 1985.

Conclusions

1. Group wage incentive systems are effective in increasing performance and result in significant cost savings in Navy industrial settings. They do not negatively affect schedule adherence, product quality, or worker job attitudes.

2. Incentive systems can result in additional benefits to the organization in areas such as labor accounting accuracy.

3. Incentive systems focus attention on performance and highlight organizational problems, insufficient management controls, and impediments to productivity, thereby encouraging efforts to resolve these issues.

4. Implementing and maintaining a credible, cost-effective incentive system requires continued system support and efforts to address factors that limit incentive earnings.

Recommendations

1. Shipyard managers should continue to support the system. They should conduct periodic evaluations of the system to ensure that its objectives continue to be met, to identify problems that may have surfaced, and to change the system when necessary to solve problems or accommodate changes in the test shop.

2. Shipyard managers should continue to solve problems that limit the ability of the test shop to improve its performance and the eligibility of all work groups to earn awards.

3. Shipyard managers should consider expanding the group wage incentive system to other production shops.

4. Naval Sea Systems Command managers should consider transferring the group wage incentive system to other naval shipyards.

5. Managers in other Navy industrial facilities should consider developing incentive systems to improve performance and reduce costs.

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INTRODUCTION

Problem

The demand for productivity improvement throughout the private and public sectors has increased due to sharply rising personnel and material costs, increasing foreign competition, and a declining rate of growth in the general economy. As a result, there is greater interest in developing and assessing new methods to improve productivity. Current objectives to establish a 600-ship Navy while simplifying maintenance procedures and reducing repair costs make productivity improvement equally important in Navy activities.

While many of the Navy's productivity improvement efforts are hardware-related, attention is also being focused on new techniques to improve employee motivation and performance. Monetary incentive award systems, for example, have been effective in increasing productivity through improved worker motivation and efficiency. There is a need to examine the extent to which such systems can contribute to increased productivity given current resource limitations and economic conditions.

Purpose

The purpose of this effort was to implement and evaluate a group wage incentive system for industrial workers at a naval shipyard. The incentive system was intended to improve productivity by financially rewarding work groups whose performance resulted in measurable cost savings. It was designed to motivate workers to improve performance efficiency without negatively affecting schedule adherence, product quality, or participants' job attitudes.

Background

Many different performance-based incentive systems are currently in use in private organizations, ranging from individual systems, such as the piece-rate systems common in manufacturing settings, to organization-wide profit-sharing systems, such as the Scanlon and Rucker plans. Peters and Waterman (1982) found extensive use of both financial and nonfinancial incentive systems in the companies they identified as excellent. In describing the results of a survey of 1500 American and Canadian companies, Rice (1977) reported that 44 percent were using some type of wage incentive system. More recently, Pryor (1984) found among a random sample of 2050 U.S. manufacturing firms that 54 percent were using some form of incentive system. Of these companies, many reported more than one system in use. Bureau of Labor Statistics studies (cited by Fein, 1982) show that, on the average, 26 percent of American workers are covered by incentive plans. The most common systems in use are piece-rate systems in which workers earn a set sum of money for each unit of production completed or those in which workers receive awards based on above-standard performance, usually for completing work in less time than expected.

The public sector has not kept pace with this trend. Although in state and local government the use of such systems has expanded considerably since 1974, they are still fairly rare (Greiner, Hatry, Koss, Millar, & Woodward, 1981). Within the federal government, few agencies use performance-based incentive systems for non-supervisory employees. This difference may be attributable, in part, to the service orientation of many government agencies which makes performance more difficult to measure. In

addition, the non-profit nature of the public sector requires a unique financial management system that may complicate the design of effective incentive systems.

Of greater influence on whether or not these systems are tried and succeed are the beliefs held by some managers about incentives. Some points of resistance are unique to the public sector, while others are common to both public and private settings. The most common beliefs are discussed below.

1. Incentive systems are illegal. Managers in the public sector may question the legality of using wage incentive plans for civil service employees and because of historical patterns may believe that incentive awards can only be granted once a year. Greiner et al. (1981), in reviewing the use of monetary incentive plans in state and local government settings, identified the following current legal and regulatory barriers existing in various locations: statutory prohibitions against the payment of monetary incentives, barriers to the use of incentive programs based on shared savings, appropriation laws prescribing government pay rates, restrictive procedures for granting wage increases or bonus payments, restrictions on pay and reward levels, and requirements for jurisdiction-wide eligibility for awards. The authors point out that although implementing monetary incentive plans may require revisions in a state or local government's laws or regulations, such changes are feasible and often successful.

Within the federal government, the legality of incentive systems has been well established. The Government Employees' Awards Act of 1954 authorizes monetary and honorary awards for ideas, suggestions, inventions, or performance. The National Productivity and Working Life Act of 1975 requires all federal agencies to develop and support productivity improvement programs. In addition, the Civil Service Reform Act of 1975 emphasizes the use of incentives to recognize and reward superior performance throughout the federal government. The most recent revision to Navy policy (Naval Civilian Personnel Instruction 451 dated 29 April 1982) encourages the use of performance-contingent reward systems or PCRSs (referred to as Productivity Incentive Award Plans in OPNAV guidance).

The Manager's Handbook (1981), the Office of Personnel Management's guide for federal supervisors and managers, indicates that the law and regulations provide departments and agencies a great deal of flexibility in using incentive awards. While minimal restrictions exist, the legality of incentive plans based on meeting production standards is specifically supported. Federal and Navy guidance includes the authority for managers to make incentive payments to employees as frequently as earned. Further, a variety of wage incentive plans have been successfully tried in federal government settings (cf. Brengel, Stringer, & Kell, 1980; Nebeker, Neuberger, & Hulton, 1983; Oliver & van Rijn, 1983; Shumate, Dockstader, & Nebeker, 1978; White, Crawford, & Dockstader, in preparation).

2. Money is not a motivator. Managers in the public and private sectors may believe that money has limited effect in motivating employees. This view is tied to the humanistic management philosophy, especially the theories of Maslow (1954) and Herzberg (1968), developed in response to Taylor's scientific management approach. Maslow proposed that human needs are organized in a hierarchy and that once lower level needs (e.g., for survival or security) are satisfied, they no longer motivate behavior. This suggests that money, which allows humans to meet survival and security needs, loses its motivating potential when these needs are met. Since workers' base salaries typically meet their survival needs, additional earnings in the form of incentives are not believed to

further motivate performance. Herzberg's two-factor theory of satisfaction and motivation proposed that employee satisfaction and motivation are dependent on factors intrinsic to the work, such as recognition and responsibility, while dissatisfaction is linked to extrinsic factors such as company policies and wages. Herzberg suggested that improved worker motivation and performance will result from intrinsic aspects of the job rather than from extrinsic rewards for superior performance.

More recent theorists suggest, however, that money in the form of incentive awards can motivate employees toward increased productivity. In a meta-analysis of the relative effectiveness of four methods of motivating employee performance (participation, goal setting, job enrichment, and incentive pay), Locke, Feren, McCaleb, Shaw, and Denny (1980) found that money was the most successful. The authors conclude that "money is the crucial incentive because, as a medium of exchange, it is the most instrumental; it can be used to purchase numerous other values" (p. 379) and to satisfy higher order needs.

Katzell and Yankelovich (1975), in a review of studies designed to enhance job satisfaction and productivity, concluded that "of all the factors that help create highly motivated/highly satisfied workers, the principal one appears to be that effective performance be recognized and rewarded--in whatever terms are meaningful to the individual, be it financial or psychological or both" (p. 26). Clearly, while monetary rewards are not the only method of increasing productivity, they remain one of the most effective tools available.

3. Incentives are double payment for work. Managers (and some employees) may resist incentive systems on the grounds that workers are already paid to be productive. Providing incentive awards to employees for doing their job is seen as double payment for the same work. However, employees' wages are compensation for meeting a satisfactory performance level. Incentive programs provide managers the opportunity to recognize and financially reward superior performers.

As previously discussed, employees whose superior performance results in benefits to the federal government above the satisfactory performance level of competent, experienced personnel in similar jobs ought to be fairly compensated for this performance. Incentive awards programs provide one means of accomplishing this.

4. Incentives are bribery. Managers, supervisors, and employees may believe incentive systems are simply complicated means of bribing workers. There are two definitions of a bribe in Webster's New Collegiate Dictionary (1965). The first is: "Money or favor bestowed on or promised to a person in a position of trust to pervert his judgment or corrupt his conduct." The second is: "Something that serves to induce or influence." The negative connotations of the first, more common definition do not apply to incentive systems. Although incentive systems are designed to induce or influence behavior, the influence is of a positive nature, providing compensation for work that exceeds expected levels of performance.

5. Extrinsic rewards decrease intrinsic motivation and performance. Managers may believe that extrinsic rewards (e.g., money) reduce employees' intrinsic motivation to work. Deci (1975) concluded that the use of performance-based extrinsic rewards reduces the intrinsic motivation provided by the job itself, perhaps, he suggests, because the rewards make employees feel less in control of their own behavior. Other research in this area has produced mixed results. Guzzo (1979) and Cooper (1984) cite a number of methodological limitations in research testing Deci's ideas. Studies supporting

Deci's work typically use student subjects working at artificial tasks that are not representative of real work settings and provide rewards appropriate to those artificial tasks. Those conducted in more realistic settings using more typical work rewards frequently do not support the theory (Guzzo, 1979). Guzzo concludes that extrinsic rewards decrease intrinsic motivation only when "the reward is (a) salient, (b) sufficient in magnitude to induce attributions of behavioral causality, (c) not perceived as a success symbol, and (d) not conducive to the expectation of future rewards for similar performance" (p. 78). PCRSs, by design, build the expectation among workers that similar performance in the future will result in comparable rewards. Thus, they should not result in decreased intrinsic motivation.

The distinction between intrinsic and extrinsic rewards has also been questioned (Cooper, 1984; Guzzo, 1979). In real work settings, extrinsic rewards such as incentives can also be seen as symbols of success, which are intrinsic rewards.

In summary, it would appear that both intrinsic and extrinsic rewards can enhance employees' productivity. The ideal situation would consist of a job that is intrinsically-motivating to the employee and that provides the opportunity to earn extrinsic rewards for superior performance.

6. Incentive standards cannot be changed. Several objections may be raised regarding incentive levels and work standards. Since work standards establish what a "fair day's work" is, managers are often unwilling to establish an incentive level other than 100 percent of standard. For example, when performance averages 70 percent of standard, managers, nonetheless, are reluctant to set the incentive level below 100 percent as they fear they will be "giving away the store." This is a legitimate concern. On the other hand, incentives will not motivate performance if they are seen as unobtainable. Establishing a lower, obtainable incentive level increases the motivating potential of the incentive and rewards employees for performance improvement rather than absolute performance levels. Shumate, Dockstader, and Nebeker (1983) recommend setting the incentive level so that approximately 30 percent of the workforce is performing at or above the reward level prior to introduction of the reward system. Thus, the top performers will be motivated to improve their performance to earn more bonus money and other workers will have reason to believe they can also earn incentives with improved performance.

Once performance has improved, managers may be tempted to tighten the standard, but by doing so risk undercutting the benefits of the incentive system. Workers will feel cheated if they must work harder without receiving anything for their efforts. An alternative to this ratcheting of standards under such conditions is to use a buy-back or buy-out procedure (Fein, 1982). This procedure provides for a one-time bonus to workers based on the amount by which work standards or the incentive level are made more difficult. The costs of the payments are recovered by one year's production at the new performance standard.

7. Implementing an incentive system is too difficult. Managers may reject the suggestion of introducing a wage incentive system because they believe it is too difficult. Further, such systems may be perceived as a threat to managers' control. Those with experience in designing and implementing such systems know that it is not an easy process. Major changes in organizations and management practices are often needed to successfully implement incentive systems (Goodman, 1982). At a minimum, a high degree of commitment to the program is necessary before and after implementation, commitment involving more than verbal support. It requires a willingness to do what is necessary

for effective implementation and maintenance, such as dedicating personnel and funds to these tasks. Ideally, commitment should exist at all levels of the organization and should be voluntary. It is difficult to implement changes in organizations when either top management or those expected to implement the change are unsupportive.

A project coordinator should be named to oversee implementation, maintenance, and evaluation of the system. This individual needs to have a position of power and the credibility to deal with representatives of other departments to accomplish needed actions. Assigning an individual with a thorough understanding of the organization and experience in dealing with others will help to maximize the chances for success.

Implementation and maintenance are not trivial tasks and should not merely be added as adjunct duties to an existing position. Depending on the size of the project being undertaken, one or more full-time project coordinators may be needed. Goodman also stresses the need for formalization of all aspects of new programs. Documentation of the incentive system is particularly critical when top management or project coordinators change, providing the basis for a smooth transition.

Turney and Cohen (1982) present a plan for adopting and implementing monetary incentives within the Navy. Five key conditions are identified as critical for successful implementation: (1) a mature technology (indicating an incentive plan that has been proven effective), (2) sufficient personnel and guidance above the field activity level to support and implement the technology, (3) strong local and headquarters support, (4) adequate personnel and financial resources, and (5) a favorable organizational climate. Much of this plan applies to non-Navy organizations as well.

The long-term success of such programs requires continual maintenance and adaptation to changes. Once implemented, incentive systems do not run themselves. Periodic evaluations are needed to determine the extent to which the program's objectives are being met, to identify problems that have surfaced, and to change the system when necessary to solve problems or accommodate changes in the work site.

The implementation and maintenance requirements can be eased somewhat by automating the performance tracking and award calculation portions of the incentive system. While such automated systems increase the time required to design and implement incentive plans, they greatly reduce the administrative burden of the system. In addition, they can provide valuable information for use in monitoring and evaluating the system's effectiveness.

Despite these requirements for successful implementation of incentive systems, economic analyses of the effects of trial systems show that the costs of implementing and maintaining incentive systems are outweighed by the benefits to the organization (cf. Bretton, Dockstader, Nebeker, & Shumate, 1978; Nebeker et al., 1983; White et al., in preparation). Further, concurrent positive outcomes (for instance, in the area of quality of work life) often accompany net cost savings.

8. Employees will oppose the system. Managers may anticipate opposition to such systems from employees or their representatives. Employees' opposition is often rooted in misconceptions about incentive plans and fears about the outcomes of such systems. Employees may think wage incentive programs are piece-rate systems and may assume they will result in a sweatshop atmosphere. Workers may have fears that management will tighten standards when performance improves or discontinue the incentive program

when a desired performance level has been achieved. They may question the objectivity of performance measures and award calculations and complain of inequities in the system. Finally, a frequent fear associated with incentive programs concerns employees' job security. Workers are reluctant to improve their productivity for a few extra dollars if they believe the long-term result will be unemployment. These fears may be justified and can lead to employee efforts to sabotage incentive systems, for instance, by restricting output or by attempting to "cheat" the system.

The resolution of these issues is the responsibility of management and depends largely on the relationship between employees and management within the organization. In situations where employees have little trust in management, implementing an incentive system will be very difficult. Goodman (1982) cites trust between employees and management and, if applicable, between union and management as a prime factor in the successful implementation and long-term viability of all types of change programs. A relationship based on open, honest communication between workers and managers will ease many of the employees' concerns about wage incentive systems. Goodman does not recommend beginning productivity improvement programs in environments lacking this trust.

The effectiveness of such programs in building up a level of trust where it does not exist has yet to be determined. It is feasible that employee-management relationships might improve when employees experience a positive program developed by management. As a general rule, program sponsors should provide participants with sufficient training about the system to assure an adequate understanding and should address concerns that employees raise following implementation.

9. Incentive systems overlap with existing programs. Finally, managers may believe that PCRSs duplicate their organization's existing incentive award program. This may, in part, be true. However, the federal government's incentive systems typically use poorly defined criteria for award payment and limit awards to once a year. Frequently, in existing programs, subjective judgments about employees are more important than quantitative measures of output or effectiveness. Further, use of current programs is limited, largely due to supervisors' beliefs that preparing and processing award requests is too difficult and time-consuming. While recent revisions in incentive award policy within the federal government have been designed to delegate authority and responsibility for approving awards to the lowest practical level and to minimize the documentation requirements, supervisors are often still reluctant to initiate awards.

Award systems that are not fully used by supervisors and managers are largely ineffective. At best, organizations may reward their best performer or a small number of outstanding employees. The rest of the workforce, which usually includes some very good performers, fails to benefit from the system.

Automated PCRSs provide managers with a simple, routine tool for rewarding their superior performers. Such systems do not require complicated documentation or lengthy approval processes. They also provide the opportunity to recognize and reward a greater portion of the workforce in a more timely fashion and on a more continuous basis. Existing award programs can be used in tandem with PCRSs to reward employees for performance in areas other than those covered by the PCRS (e.g., safety record or performance on special projects).

Since 1977, NAVPERSRANDCEN has been involved in a research program to test the effectiveness of performance-based incentive systems. This program has focused on

developing and implementing PCRSs for a variety of Navy civilian workers (Shumate, Dockstader, & Nebeker, 1981).

A PCRS attempts to tie financial rewards to objective measures of performance. Initial tests of these systems resulted in substantial performance improvements by linking rewards to the individual performance efficiency of key entry operators, small purchase buyers, and aircraft engine mechanics (Nebeker et al., 1983; Shumate et al., 1978; White et al., in preparation). These efforts have two important features in common: All are based on individual employee performance and all link incentive awards to efficiency measures. The present effort represents a departure from the previous work of NAVPERSRANDCEN because the PCRS is designed to link incentive awards to group performance efficiency measures. In addition, it covers a greater number of employees than any previous system developed by NAVPERSRANDCEN.

APPROACH

The NAVSHIPYDPEARL requested the assistance of NAVPERSRANDCEN in developing an incentive system for production employees at the shipyard. Following an analysis of the shipyard work environment and its performance measurement capabilities, NAVPERSRANDCEN recommended that a PCRS be developed based on measures of performance efficiency. Shipyard workers have a substantial degree of control over their performance efficiency and the basics required for developing accurate measures in this area were available. Inclusion of all of a shop's work ensures that incentive awards are paid only for actual, overall improvements. Further, since historical efficiency information was available, assessing cost savings from improved performance efficiency would be fairly straightforward.

An analysis of typical production work settings in the shipyard revealed that an individual PCRS was inappropriate. Shop employees work together on large operations in the repair and overhaul processes. These employee work groups, called work gangs, typically consist of 8 to 25 wage grade workers supervised by one foreman. Each work gang is responsible for a different portion of a shop's work. Existing performance efficiency measures used by the shipyard focused on these work groups rather than on individual employees. Thus, it was recommended that a PCRS be developed and tested based on measures of work gang performance efficiency.

Objectives of the Performance-contingent Reward System

The goals of the shipyard PCRS were to:

1. Achieve measurable productivity increases without detrimental effects on schedule adherence, product quality, or participants' job attitudes.

2. Recognize and financially reward both foremen and production employees whose performance contributed to man-hour and cost savings.

3. Pay for itself through cost savings.

4. Be fair and acceptable to both shipyard management and program participants.

5. Be consistent with existing incentive award policies and guidance.

Research Site

The group incentive awards system was developed for use in the Inside Machine Shop (Shop 31) at NAVSHIPYDPEARL. The mission of naval shipyards is to perform overhaul, repair, construction, and conversion work for Navy surface craft and submarines. NAVSHIPYDPEARL employs approximately 7000 civil service workers, 4500 of whom are assigned to the production department. Shop 31 is one of 17 shops in the production department at NAVSHIPYDPEARL and employs approximately 480 wage grade employees, 23 first level supervisors, and 7 general foremen on three shifts. Each supervisor is responsible for a work gang consisting of 12 to 25 employees who specialize in one portion of the shop's work. Shop 31 performs the shipyard's light and heavy machine work, hydraulic repairs, and associated equipment testing.

Shop 31 is organized into 17 work centers, each responsible for a particular type of work. Production shops receive work requirements from the planning department on job order (JO) key operation (KEYOP) documents that provide detailed descriptions of the work to be performed, man-hour allowances for the work, and schedule information. Typically, a JO KEYOP shows several job operations, called line items, required to complete the work package. Each line item is assigned to a particular work center and carries an associated man-hour allowance for accomplishing the work. Foremen account for their employees' time by listing the line items worked on the employees' daily time cards. If an employee works on overhead jobs or takes leave, this information is also entered on the time card.

Shop 31 was selected for the initial test of a group wage incentive system for several reasons:

1. Shop characteristics. Shop 31 is the lead shop on many of the shipyard's work packages, indicating that it is on the critical path and has the major responsibility for completing the work. Thus, the shop's performance can have a major impact on overall shipyard performance. In addition, the potential for accurate performance measurement was greater in Shop 31 than in other production shops due to its more stable work environment, resulting from the recurring nature of the shop's work and the more controlled nature of inside work.

2. Availability of performance measurement inputs. Many performance measures consist of a ratio of work output to labor input. Man-hour standards are frequently used to measure work output in industrial settings. The shipyard planning department provides a man-hour allowance, or standard, for each line item required to complete a given KEYOP. Labor input is generally measured in terms of man-hour expenditures. The shipyard's time accounting procedures track the man-hours expended against each task. Both the man-hours allowed for a job (from the KEYOP document) and the man-hour expenditures required to complete the work (from employees' time cards) are routinely collected by the shipyard's management information system (MIS). Thus, the measures of a work gang's work output and labor input required to compute a performance efficiency ratio were available for work groups in Shop 31. Further, these measures were part of the MIS's performance tracking system used by the shipyard.

3. Control over performance. An important attribute of a sensitive performance measure is that it is controlled by the workers. Work gangs in Shop 31 could influence their performance efficiency, for example, through changes in work effort or work strategies.

4. Potential for improvement. Shop 31, as well as other production shops at the shipyard, historically over-expended the man-hour allowances issued by the planning department for their work. Thus, there was substantial room for productivity improvement in Shop 31.

5. Management support. Finally, key Shop 31 managers supported the idea of trying a group wage incentive system.

Performance Measurement Issues

As discussed above, the basic inputs required for measuring performance were available for Shop 31. A more thorough examination of the performance measurement (PM) application of the shipyard's MIS, however, revealed several factors that limited the accuracy of the monthly performance measures.

The first factor involved the way in which man-hour allowances are awarded to work gangs when more than one gang works on a task. The shipyard's MIS awards both the entire man-hour allowance and all of the labor expenditures to the foreman whose work gang accounts for the largest portion of the total hours charged to the job. In the case of equal charges from two work gangs, the total man-hours allowed and expended are awarded to the foreman whose gang submits the first labor charge against the job. As a result, neither work gang's performance efficiency is accurate.

The second limiting factor involves the time frame for performance measurement. Each line item is entered into the performance measurement calculations when it reaches its scheduled completion date. Labor charges are accepted against line items, however, until the closure date (20 days after the scheduled completion date). Thus, the performance calculations made when jobs first enter the system overestimate work gang performance in cases where additional charges are subsequently made. Furthermore, there are several situations when labor charges are made against a job after closing (e.g., when it is reopened for additional work). Thus, the efficiency calculations are sometimes inflated.

A third limitation results from the variability of the man-hour allowance estimates provided by the planning department. Some line items have allowances that are easily met, while others have allowances that are difficult or impossible to meet. Calculating and reporting performance measures based on a short performance period results in measures that reflect imprecision in allowances rather than actual performance changes.

Also, the PM system calculates and reports performance weekly and monthly. Thus, performance measures are based on the relatively few line items that are completed during each period and sometimes vary dramatically from period to period. Longer performance periods assure that work gang performance is based on an adequate mix of "easy" and "hard" jobs that more accurately reflects performance.

Finally, the reports generated by the shipyard's existing MIS did not provide the capability of auditing input information (man-hour allowances and expenditures) for accuracy and consistency, nor did the system contain adequate procedures to correct inputs.

New Performance Measurement System

These limitations pointed to the need for a revised performance measurement and reporting system at the shipyard. Such a system could also be used to automatically

calculate and track earnings under the proposed group incentive system. To meet this need, personnel from NAVSHIPYDPEARL worked together with NAVPERSRANDCEN representatives to design and develop a new performance measurement and reporting (PMR) system. This system was designed to resolve the existing performance measurement deficiencies and to limit the need for additional reporting requirements. It uses existing inputs (man-hour expenditures from employee time card charges and man-hour allowances from the planning department) to calculate and track more accurate work gang performance measures (Riedel, Crawford, Morell, & Kanemaru, 1984).

When more than one work gang works on a task, the PMR system prorates man-hour allowances among all work gangs that charged to the task based on their proportion of the total expended hours. The computation of each work gang's performance efficiency, therefore, includes both the man-hours spent on the task and its share of the man-hour allowances for the work. Thus, all work gangs are held accountable for their work on such tasks.

In order to pick up as many charges against each task as possible, the PMR system computes performance measures based on line items that closed in the previous 12 weeks (referred to as the performance period). Since performance measures are calculated every 4 weeks, performance on each task affects work gang performance for 3 months. While all labor charges probably would not be accounted for during the first of these months, by the third month a more complete accounting of charges would be expected.

Using a 12-week period for performance computations has other advantages. It helps to compensate for the variability in the accuracy of the man-hour allowances provided by the planning department since a balance of "easy" and "hard" jobs would be expected over this length of time. This time period also affords some assurance that enough jobs will close to provide a reasonable estimate of each work gang's true performance and to limit the erratic nature of measures based on shorter time periods and fewer closed jobs.

Finally, the PMR system reports performance measures every 4 weeks based on all jobs completed during the previous 12 weeks, providing more timely feedback to shop managers. If feedback were to be provided only at the end of each 12-week performance period, it would be neither fast (occurring up to 12 weeks after job completion) nor frequent (occurring only 4 times yearly). The PMR system provides feedback within 4 weeks of job completion and 13 times yearly.

The PMR system computes performance measures based on all jobs (KEYOPS) that close during the performance period. This, in effect, limits the incentive to cross-charge (i.e., charge time expended on one job to another job) in order to artificially inflate performance measures. If only a portion of the shop's jobs were included, foremen might be tempted to cross-charge to other jobs so that they could accrue earnings on those jobs eligible for awards.

The PMR system generates new reports in the areas of time accounting and performance measurement. The time accounting reports provide feedback to supervisors on the accuracy of time card charges submitted for their employees and can be used as the basis for making corrections to these charges. The performance measurement reports provide performance factors (PFs) based on all line items of KEYOPS that have closed during the previous 12 weeks, as follows:

$$PF = \frac{\text{Total Man-hours Allowed}}{\text{Total Man-hours Expended}}.$$

These reports also show man-hour savings (MS) as an additional measure of performance:

MS = Total Man-hours Allowed - Total Man-hours Expended.

Thus, when a work gang completes work in less time than the planning department allowed for that work, man-hours have been saved. Performance factors and man-hour savings are computed and reported at the line item, KEYOP, work gang, and shop level on various PMR reports. In addition, these measures are reported for each of the three 4-week periods that comprise the 12-week performance period.

Because Shop 31 historically spent many more man-hours to complete its work than were allowed by the planning department, few work gangs would save man-hours and earn incentives at typical performance levels. (Incentive systems do not motivate employees to improve performance unless they believe it's possible to earn awards.)

Thus, shipyard managers decided to adjust all performance measures upward by 10 percent for the purposes of subsequent award calculations. (Specifically, this adjustment reduced all man-hour expenditures by 10 percent prior to calculation of performance measures and incentive awards.)

Incentive System Design

Two separate but similar group wage incentive systems were designed to recognize and reward Shop 31 employees and foremen whose performance contributed to man-hour and cost savings. These systems were developed consistent with existing incentive award policies. This section provides a summary of the systems implemented in Shop 31 at NAVSHIPYDPEARL. A more complete description is available in Riedel, Crawford, Cooper, and Nebeker (in preparation).

Employee Incentive System

Shop 31's incentive system is a group-based system in which all employees whose time is charged to a particular foreman comprise the group or work gang. Since employees' time is often charged to more than one foreman, the system was designed to accommodate employee membership in multiple work gangs. This feature is particularly important to backshift workers (employees on second and third shifts) whose time is charged to the various day shift supervisors responsible for their work. Employees are eligible for incentive awards whenever any gang they are a part of saves man-hours. Thus, they can earn incentive awards based on their contribution to more than one work gang.

When a foreman's group performance results in man-hour savings (i.e., when man-hour allowances exceed adjusted man-hour expenditures for line items of KEYOPS that closed during the performance period), the shipyard saves money. Incentive awards are based on these savings and are calculated proportional to the number of man-hours saved. The more hours saved by a work gang the more incentive earnings it receives.

While the incentive system is based on a 12-week performance period, incentives are calculated and paid every 4 weeks to ensure timeliness of awards. Thus, one-third of the work gang's 12-week man-hour savings are paid out at the end of each 4-week incentive period. Incentive awards under this system are in addition to employees' regular wages. Negative monthly man-hour savings are not subtracted from employees' wages and are not carried forward to subsequent months.

Work gang members earn incentive awards in proportion to their contribution to the group. Each employee's "workshare" provides the basis for distribution of man-hour savings among group members. Thus, employees who account for a greater portion of the hours worked by the work gang during the 4-week incentive period earn a larger portion of the group's saved hours. Employees who work in more than one gang during an incentive period have a workshare for each gang and are eligible to earn incentives from each gang that saves man-hours. The sum of an employee's saved hours from each work gang goes into his or her monthly award calculations.

The value of an employee's saved hours is based on the individual's accelerated hourly wage rate. The acceleration rate (30% was used at NAVSHIPYDPEARL) covers shipyard costs for leave and other employee benefits. Based on the 50 percent sharing rate used during the system test, the shipyard retains half the value of each saved hour. (In reality, the actual value of a saved hour is probably greater than the accelerated hourly rate since the customer charge for a direct labor hour is over two times the average hourly wage rate.) Thus, an employee's incentive rate, the amount he or she receives in incentive earnings for each saved hour, is equal to half of his or her accelerated hourly wage rate. Multiplying this incentive rate by the employee's monthly saved hours provides the total incentive earnings for that incentive period.

Foreman Incentive System

Foremen in Shop 31 are also eligible to earn incentive awards based on a separate but similar system. Since the primary responsibility of a shop supervisor is to coordinate with other foremen to complete the shop's work efficiently and on schedule, all of the foremen in the shop can be viewed as constituting one group. Therefore, the major part of the foreman incentive award calculation is based on overall shop performance during each 12-week performance period. Foremen are eligible to earn incentive awards only when the performance of the entire shop results in positive monthly man-hour savings for the period (i.e., an adjusted PF greater than 100%). For each percentage point above an adjusted shop PF of 100 percent, every foreman in the shop earns an incentive award of $14. This amount is based on the number of saved hours each percent increase generates, the distribution of a portion of these saved hours among all foremen, and an incentive rate equal to the average accelerated hourly wage for foremen. Thus, if the shop's adjusted PF is 104 percent, each foreman earns $56 for that period.

Additionally, foreman awards are based on the performance of each foreman's work gang during the performance period. The basic rate of $14 per percentage point is modified to reflect the work gang's adjusted performance. A foreman is capable of earning up to 25 percent above or below the basic rate depending on the performance of the work gang. For example, if the shop's PF is 104 percent and a particular foreman's PF is 110 percent, he would earn $68 instead of the basic $56. Since foreman awards are not automatically calculated and tracked by the PMR system, a table of foreman awards was prepared (see Appendix A). This table is used to determine each foreman's monthly incentive award based on the shop PF and his work gang's PF, both of which are provided by the new PMR system.

Finally, an additional one-time incentive was offered to foremen when they first were eligible for awards to encourage them to work together to bring the shop PF up to 100 percent. All Shop 31 foremen received a one-time award of $125 when the adjusted shop PF first exceeded 100 percent. This amount was based on the hours saved when the shop moved from its baseline performance of approximately 90 percent to the incentive

standard of 100 percent. This one-time award was in addition to the award calculations just described.

Automated Incentive Awards Calculations

To ease the administrative burden of the wage incentive system on shipyard personnel, the bulk of the awards calculations and accounting was automated. An additional component of the new PMR system was developed to compute and track individual incentive earnings and awards. (This portion of the PMR system is also described in Riedel, Crawford, Cooper, & Nebeker, in preparation). This component uses the information on work gang performance and employees' workshares to compute monthly incentive earnings. In addition, it maintains an incentive award balance for each employee that reflects earnings and awards to date. Because it is not cost-effective to process payments for less than $25, this system also monitors such unpaid balances until the employee has accrued sufficient incentive earnings to be paid. This component of the PMR system also generates several reports that show important elements used in incentive award calculations. Some of these reports provide accounting information to track current and past incentive award earnings and payments, while others are used for awards approval and processing.

Implementation and Administration of the Incentive System

Before beginning the test of the group wage incentive system in Shop 31, several steps were taken to provide the proper support system for the program. A shipyard instruction was issued to promulgate policy related to the program, to set the program timetable, and to identify responsibilities during the test period and the subsequent evaluation period. It also established the PMR report distribution and the award approval and payment process to be used. A 9-month test period, beginning July 1983, was established by this instruction. A Project Officer (a Navy commander) was assigned to oversee the program and a Shop Incentive Coordinator (a general foreman in Shop 31) was named to manage the day-to-day operation of the system. An agreement to implement the incentive system was also negotiated with the local union (the Metal Trades Council). Finally, a Productivity Improvement Awards Plan documenting the Shop 31 incentive system was submitted to the Chief of Naval Material (MAT 01M) to gain authority for implementation.

Prior to implementation, training was conducted to assure that all shop employees, supervisors, and managers understood the program. At that time, supervisors also received a review of time card charge procedures and a description of the new PMR system and its reports. Since participation in the incentive system was voluntary, employees were asked to sign a participation form at the conclusion of their training sessions.

Following training, the 9-month system test of the Shop 31 wage incentive system began. The new PMR system reports, including those that provided incentive awards information, were produced and distributed at the end of every 4-week incentive period. The Shop Incentive Coordinator reviewed these each month and made any required corrections. Final PMR reports were then produced and distributed to reflect these corrections. At that time, the award request report was signed by the Shop Incentive Coordinator and forwarded for approval. (A sample award request report showing required approval is provided in Appendix B.) This process was repeated each month until the test was scheduled to conclude in February 1984. The incentive system was not

discontinued at this time; based on the preliminary evaluation results, shipyard managers decided to continue the system.

Data Collection and Evaluation Measures

Since the objectives of the incentive system were to improve the shop's performance efficiency without negatively affecting schedule adherence, product quality, or employees' job attitudes, the primary evaluation measures focused on these areas. In addition, efforts were made to assess program participants' opinions and perceptions of the incentive system itself. Each of these evaluation areas is discussed below.

Performance Efficiency

Work gang and shop-level performance efficiency (PF) and man-hour savings (MS) data from the new PMR system were collected for evaluation purposes. A baseline consisting of seven 4-week periods and an incentive test comprised of nine 4-week incentive periods were planned for the evaluation of changes in these measures. Since many other potential change-producing events may have occurred at the same time the incentive system was introduced in Shop 31, changes in performance efficiency could not be safely attributed to the incentive system. To attempt to compensate for this, Shop 38, the Outside Machine Shop, and Shop 56, the Pipe Shop, served as nonequivalent control or comparison groups (Campbell & Stanley, 1963). Shop 38 performs work similar to Shop 31 on board ships and submarines rather than inside the shop area. Shop 56 provides the pipe fitting services for the shipyard's work.

Since the PMR system developed to support the Shop 31 incentive system did not provide comparable data for Shop 38 or 56, another source of performance data had to be identified. The shipyard MIS produces various performance reports that could be used for this purpose. The PM-302A report provides weekly data on the allowances and expenditures for closed work within each shop in the production department. Although these data reflect the same performance measurement problems previously discussed, aggregating data at the shop level and calculating a moving 12-week PF helped to limit these problems. Also, since the primary function of data from these shops was to provide typical shipyard performance trends, the absolute PF level was not the critical factor. Performance data (12-week PFs) from the PM-302A reports were collected for Shops 31, 38, and 56 before and after implementation of the incentive system.

Schedule Adherence

Schedule adherence measures routinely monitored by the shipyard typically measure the ability of the shipyard as a whole to meet completion dates. Schedule adherence measures available at the shop level are based on only a small sample of a shop's work. Further, the shops usually know which high priority items are being monitored and therefore place their greatest efforts in these areas.

For these reasons, a new measure of schedule adherence was developed. This measure consisted of a count of the number of days between the originally scheduled completion date and the actual date of the last charge for a sample of KEYOP line items completed by the shop each period. The originally scheduled completion date was used (instead of the most recent, rescheduled completion date) because jobs are frequently rescheduled simply because managers realize the completion date is not going to be met. Further, foremen typically charge to a line item until it closes, which is 20 days after its

final scheduled completion date. As a result, little variability exists from one line item to another.

Admittedly, use of the originally scheduled completion dates has certain limitations because the resulting schedule adherence measure does not reflect the many times jobs are rescheduled for reasons beyond a shop's control (e.g., lack of parts or materials required to complete a job). As a result, it seems likely that a shop would miss schedule fairly often. Random sampling of large numbers of KEYOPS across time tends to lessen these measurement problems because similar proportions of such KEYOPS are included in each sample. Again, the interest was primarily in trends over time rather than absolute levels of schedule adherence.

All line items of KEYOPS for which Shop 31 was responsible that closed during each performance period were tracked in a PMR data file. A random sample was selected from these files and analyzed for one 12-week period during each quarter of the incentive system test. For each sampled item, a schedule adherence index (SAI) was calculated as follows:

Schedule Adherence Index (SAI) = Originally Scheduled Completion Date - Date of the Last Charge .

An average SAI was then computed for all items sampled from the period. The originally scheduled completion dates were obtained from the shop's copies of the JO KEYOP documents. The date of the last charge against each item was obtained from PMR data files listing each incentive period's time card charges for Shop 31. An SAI value greater than one reflected cases in which the shop missed the scheduled completion date, while an SAI value of less than one indicated that the shop finished ahead of schedule.

Product Quality

The shipyard's quality assurance office monitors and reports the quality of shop work through the use of the Quality Indicator Report (QIR). This report summarizes the results of inspections conducted in the shops during repair and assembly phases. The QIR presents inspection and rejection data for two types of work: Level I (or subsafe) work and non-level work. Level I work consists of critical items that must meet inspection specifications (e.g., nuclear work and items manufactured by the shop), while non-level work consists of the remainder of the shop's jobs. While all of the shop's Level I work is inspected (this represents about 25% of the shop's work), not all of the non-level work is inspected. About 90 percent of the shop's work is covered by QIR data.

The QIR indices for level and non-level work are calculated as follows:

$$\text{QIR Index} = \frac{\text{Number of Items Rejected}}{\text{Number of Inspections Performed}} .$$

The quality assurance office collects and reports QIR data monthly for Shop 31. These data were collected for the seven months prior to system implementation and for each month of the system test.

Participants' Job Attitudes

To assess participants' job attitudes, questionnaires and interviews were administered to Shop 31 employees and foremen. The first questionnaire was given just prior to implementation of the incentive system; the follow-up administration of questionnaires and interviews occurred at the conclusion of the ninth incentive period of the test. These questionnaires assessed participants' job attitudes in three areas: job satisfaction, job stress, and worker cooperation. Each of these measures is described below; actual questionnaire items administered to workers and foremen during the follow-up are presented in Appendices C and D, respectively. (Pretest questionnaires and portions of the follow-up questionnaires are not provided as they included many additional items not related to the incentive system evaluation.)

Job Satisfaction. A 10-item scale was used to assess employees' and supervisors' satisfaction with various aspects of their jobs. Responses were based on a scale ranging from very dissatisfied (1) to very satisfied (5). The job satisfaction measure is shown in Section 8 of Appendix C (Employee Questionnaire Items) and Section 4 of Appendix D (Foreman Questionnaire Items).

Job Stress. A three-item scale was used to assess employee job stress. These items measured the extent to which employees had too much work to do and the extent to which they worked under time pressures. Responses ranged from strongly disagree (1) to strongly agree (5), where higher scores indicated greater job stress. The job stress scale consists of items 4, 16, and 20 of Section 6 of Appendix C. (Item 20 was reverse-scored to correspond to the other items.)

Worker Cooperation. A three-item scale was used to assess worker cooperation. These items tapped the extent to which work gang members cooperated in getting the work done. Responses ranged from strongly disagree (1) to strongly agree (5), where higher scores represented greater worker cooperation. The worker cooperation scale consists of items 7, 10, and 13 in Section 6 of Appendix C.

Participants' Opinions of the Incentive System

Questionnaires administered to employees and supervisors in Shop 31 during the ninth incentive period of the test assessed their perceptions of the incentive system in four areas: perceived outcomes of the incentive system, problems affecting the system test, perceptions of the system itself, and desire to continue the system. Each of these areas is described below; actual questionnaire items are included in Appendices C and D.

Perceived Outcomes of the Incentive System. Employees and foremen were asked to rate the effects of the incentive system on a number of outcome measures. Employees rated perceived outcomes in nine areas (e.g., shop efficiency and work quality) using a scale ranging from very positive effect (1) to very negative effect (5) (shown in Section 1 of Appendix C). Foremen rated the outcomes of the system in 12 similar areas using the same response scale (shown in Section 1 of Appendix D).

Problems Affecting the Incentive System. Employees and foremen rated the extent to which issues, such as insufficient workload and availability of parts, were problems for the test of the incentive system. Responses were based on a scale of (1) not at all to (5) to a great extent. These items are shown in Section 3 of Appendices C and D.

Evaluation of the Incentive System. Twelve items tapped employee and foreman evaluations of various aspects of the incentive system such as adequacy of reward

amounts and prevalence of cheating. A number of different response scales were used for the various items in this section. They can be seen in Section 2 of Appendices C and D.

Desire to Continue the System. Finally, employees and foremen were asked to indicate their desire to have the incentive system continue in Shop 31 by selecting 1 of 4 statements: (1) The current incentive system should continue; (2) the incentive system should continue, but changes should be made; (3) the incentive system should be discontinued, and (4) I don't know. (This item is shown in Section 9 of Appendix C and Section 5 of Appendix D.)

RESULTS AND DISCUSSION

Scope of the Evaluation

The test of the group wage incentive system began in July 1983 and was scheduled to end in February 1984 (a test period comprised of nine 4-week incentive periods). During much of that time the shipyard experienced a decreased workload that limited the assessment of the incentive system's effects. A preliminary evaluation of the first nine 4-week incentive periods showed no negative results and highlighted the problems associated with the decreased workload. In addition, managers both inside and outside Shop 31 expressed interest in seeing the program tested under more favorable workload conditions. Many felt that positive, though unmeasurable, outcomes of the incentive system were occurring, primarily related to the increased emphasis on performance measurement resulting from system implementation. Based on these findings, shipyard managers decided to extend the test. As a result, certain evaluation measures are tied to the originally scheduled test period (e.g., participants' job attitudes), while others (e.g., performance efficiency) were expanded to encompass the full 19 incentive periods that comprised the test.

Further, at the time of the preliminary evaluation, the researchers and shipyard managers monitoring the program agreed that the information provided by the schedule adherence index (SAI) did not justify the labor-intensive efforts required to collect and analyze the data. Schedule adherence measures within the shipyard typically reflect the influence of many outside factors and, in this respect, the SAI was no different. Therefore, only three quarterly assessments of schedule adherence were made during the test phase using the SAI. This measure was supplemented by the subjective assessments of foremen and progressmen (who monitor the shipyard's schedules) of the shop's ability to meet schedule.

The evaluation measures are summarized in Table 1. This table also shows, for each measure, the baseline and incentive test periods for which data were available and the source of the data.

Incentive Awards

The saved hours and incentive earnings accrued by Shop 31 employees during the 19 4-week incentive periods comprising the system test are presented in Table 2. During the system test, 15 of 17 work gangs accrued man-hour savings, and approximately 89 percent of the 475 participating Shop 31 employees earned incentive awards under the program. (Only three employees chose not to participate in the system test.) Of those employees earning awards during the system test, the incentive earnings for the full test averaged $419 per employee and ranged from less than $1 to $2488.

Table 1

Summary of Evaluation Measures

Measure	Source	Time Periods	
		Baseline	Incentive Test
Performance:			
Shop 31 (12-week PF)	PMR system (PM-L18B report)	7 Performance periods	19 Performance periods
Shops 31, 38, & 56 (12-week PF)	PM system (PM 302A report)	7 Performance periods	19 Performance periods
Schedule adherence index (SAI)	PMR data/ shop records	1 Performance period	3 Performance periods
Quality indicator report index	Quality indicator report	6 Months	13 Months
Participants' job attitudes	Worker/foreman questionnaires	July 1983	March 1984
Evaluation of the incentive system	Worker/foreman questionnaires	July 1983	March 1984

Note. A performance period covers all work completed in the previous 12 weeks.

As can be seen in Table 2, the trend in incentive award earnings and man-hour savings accrued within the shop during each 4-week incentive period declined substantially over the first nine periods of the test. Several factors contributed to this change. As a result of the decreased workload experienced by the shipyard, fewer jobs were available on which the shop could save man-hours and earn incentive awards. Although workload began to drop off at about the time the system was implemented, the effects of this decrease on the incentive system were most severe between the 6th and 10th periods of the test. In addition to the effects of workload, performance differences among sections were reduced. Work gangs with low performance factors (PFs) early in the system test improved, while the performance of some of those initially showing high PFs and earnings declined somewhat. The early improvement in performance of work gangs originally showing low PFs often did not result in positive man-hour savings but rather brought the group closer to the point where incentives could be earned. This change is related to differences in the way foremen charged their employees' time to jobs and work gangs after time card training was conducted.

As the shop's workload and staff were brought into balance (the shop loaned out excess employees and used other methods to accommodate their reduced workload), incentive earnings increased. By the end of the 11th 4-week period, monthly earnings had surpassed those of the earliest months of the system test. Further, several work gangs that had never earned incentives under the system began to at that time. Earnings continued to increase until the end of the full test period.

Table 2

Summary of Saved Hours and Incentive Earnings
During Test of Shop 31 Incentive System

Incentive Period Number	Dates	Saved Hours[a]	Incentive Earnings	Employees Earning Awards[b]
1	18 Jun to 15 Jul	1,064	$ 8,470	204
2	16 Jul to 12 Aug	1,073	$ 8,414	158
3	13 Aug to 9 Sep	779	$ 6,296	158
4	10 Sep to 7 Oct	817	$ 6,652	156
5	8 Oct to 4 Nov	905	$ 7,189	141
6	5 Nov to 2 Dec	677	$ 5,702	171
7	3 Dec to 30 Dec	729	$ 6,084	124
8	1 Jan to 27 Jan	376	$ 3,191	141
9	28 Jan to 24 Feb	495	$ 4,123	134
10	25 Feb to 23 Mar	839	$ 7,061	178
11	24 Mar to 20 Apr	1,120	$ 9,503	230
12	21 Apr to 18 May	1,208	$ 10,148	244
13	19 May to 15 Jun	1,369	$ 11,737	228
14	16 Jun to 13 Jul	1,416	$ 12,057	250
15	14 Jul to 10 Aug	1,702	$ 14,615	220
16	11 Aug to 8 Sep	1,956	$ 16,900	227
17	9 Sep to 5 Oct	1,939	$ 16,829	215
18	6 Oct to 2 Nov	1,339	$ 11,921	156
19	3 Nov to 30 Nov	1,099	$ 10,103	162
	Total	20,902	$176,995	422

[a]Figures for saved hours are the sum of the positive saved hours from Shop 31 work gangs. Note that individual work gangs can have positive saved hours although the shop as a whole does not.

[b]Figures for employees earning awards are the number of individuals who earned an award during each period. The total for this column is the number who earned an award at some time during the system test.

Shop foremen began earning incentive awards in the 13th incentive period when the shop's adjusted performance first exceeded 100 percent. Shop foremen earned a total of $5460 during the 13th and 14th periods of the test when shop performance was above 100

percent. These earnings included the one-time-only award of $3250 to foremen during the important 13th period. Foreman earnings averaged $218.

Performance Efficiency

Figure 1 shows the shop's performance factor (the 12-week PF provided by the new PMR system) before and after system implementation. The PFs shown include the 10 percent adjustment made to place earning incentives within the reach of the shop.

Figure 1. Trends in adjusted 12-week performance factors for Shop 31.

Clearly, no substantial change in performance occurred in the first 8 incentive periods of the test when workload was low. As the shop's staffing level was adapted to its workload around the 9th period (ending 24 February 1984), performance began to improve.

Because the shop's relative workload conditions changed significantly at the time of program implementation and again after approximately 8 months, the incentive test was split into two phases to reflect these changes. The first incentive phase consists of the first eight 4-week incentive periods and the second consists of the remaining eleven incentive periods. A one-way analysis of variance (ANOVA) revealed a significant difference in the shop's performance during these phases ($F = 11.36$, $p < .001$). Newman-Keuls (Winer, 1971) post hoc analyses showed that the shop's average PF during the second incentive phase ($\underline{M} = .983$) was significantly higher than during either the baseline phase ($\underline{M} = .914$) or the first incentive phase ($\underline{M} = .890$). The baseline and first incentive phases did not differ significantly.

Table 3 shows the average performance of Shops 31, 38, and 56 before and after implementation of the incentive system. Again, the incentive test was split into two phases to examine performance during different workload conditions. The first incentive phase consisted of eight 4-week incentive periods; the second incentive phase consisted of eleven 4-week incentive periods. While these data are from the shipyard's standard performance measurement (PM) system rather than the new PMR system, it is important to note that the performance trends for Shop 31 provided by these two systems are remarkably similar. The PM system reports an efficiency that is usually higher than that of the PMR system, primarily due to the fact that the new performance measurement system picks up more of the KEYOP charges (including charges submitted after the closing date) before computing performance factors. Table 3 also shows the average man-day allowances per 4-week period for closed work during the baseline and incentive phases (also from the PM system reports). These man-day allowance figures provide an estimate of the changing workload of the shops.

Table 3

Performance and Workload Trends For Three Key Production Shops During Baseline and Two Incentive Phases

Performance Factor (PF)					
	Baseline[a]	Incentive Phase 1[b]		Incentive Phase 2[c]	
Shop	Average PF[d]	Average PF	% Change From Baseline	Average PF	% Change From Baseline
31	.867	.853	-1.6	.926	+6.8
38	.696	.682	-2.0	.716	+2.9
56	.780	.774	-.8	.792	+1.6

Workload: Average Man-day Allowances per 4-week Period					
	Baseline	Incentive Phase 1		Incentive Phase 2	
Shop	Average Man-days	Average Man-days	% Change From Baseline	Average Man-days	% Change From Baseline
31	8281	5559	-32.9	5952	-28.1
38	7877	7250	- 8.0	7408	- 6.0
56	7913	7816	- 1.2	7935	+ .3

[a]Baseline: 10 January 1983 - 14 July 1983.

[b]Incentive Phase 1: 15 July 1983 - 27 January 1984.

[c]Incentive Phase 2: 28 January 1984 - 30 November 1984.

[d]Figures represent the average PF within each time frame.

Shop 31, which experienced the largest workload decline during the two incentive phases, showed only a small performance decrement during the first incentive phase and a large performance improvement during the second incentive phase. The incentive system may have encouraged the shop to avoid performance declines. By the assigning of excess employees to other shops, for example, workload and staff were brought into balance.

Schedule Adherence

Table 4 shows the results of the SAI analysis for each quarter of the system test. Although the results may seem to indicate that, in general, the shop does a poor job of meeting its scheduled completion dates, this is probably more reflective of the measure itself. It is more important to compare the shop's schedule adherence from one quarter to the next. The data for June 1983 reflect line items that were worked on and completed by the shop prior to implementation of the incentive system. Under pre-incentive conditions, Shop 31 beat or met schedule on 48 percent of the line items sampled and missed schedule on the remaining 52 percent. The remaining three quarters reflect the shop's performance under the incentive program. A one-way ANOVA failed to detect any significant differences in the shop's ability to meet scheduled completion dates during these four periods ($F = 1.57$, n.s.). Given the large variability in this measure, the slight improvement reflected in the data is insignificant.

Table 4

Shop 31 Schedule Adherence Index (SAI)[a]

Performance Period Ending Date	SAI (in days) Mean	SD	Sample Size (KEYOPS)	Meet or Beat Schedule (%)	Missed Schedule (%)
Baseline:					
17 Jun 1983	21.2	55.8	263	48	52
Incentive Test:					
7 Oct 1983	17.5	67.4	224	56	44
27 Jan 1984	12.6	59.0	182	56	44
18 May 1984	25.2	60.2	216	58	42

[a]SAI = Date of last charge - originally scheduled completion date. Positive values indicate the average number of days by which the originally scheduled completion dates were missed.

These results were supported by interviews conducted with progressmen (who monitor the shipyard's schedules), foremen, and general foremen in December and March of the incentive system test. Subjective assessments of the shop's performance in the area of schedule adherence supported the conclusion that no positive or negative changes had resulted from implementation of the incentive system.

Product Quality

Data for Shop 31's monthly Quality Indicator Report (QIR) index were gathered before and after implementation of the incentive system and are summarized in Table 5. It should be noted that these data are collected by the shipyard on a calender-month basis rather than on the 4-week basis used for performance and incentive calculations. Thus, the QIR baseline covered the calender months of January to June 1983, a period fairly comparable to the incentive baseline that covered 4-week incentive periods extending from 10 January to 14 July 1983. The two incentive phases are roughly comparable to those previously used.

Chi-square analyses were conducted to determine whether differences between baseline and incentive test periods were significant. They revealed no significant difference in the proportion of Level I work passing and failing inspection during the three phases ($\chi^2 = 4.37$, n.s.), but a significant difference for non-level work ($\chi^2 = 9.19$, $p < .05$). For Level I and non-level work combined, no difference was found ($\chi^2 = .81$, n.s.). The significant difference for non-level work can be understood if the shop's QIR index prior to the baseline phase is examined. The rejection rate for non-level work during the baseline phase was substantially lower than that of the previous year (1.3% vs. 3.3%, respectively). Thus, the slightly increased rejection rate following implementation of the incentive system appears to reflect the shop norm more so than the baseline rate does. It can be concluded, then, that no decrement in quality occurred as a result of the incentive test.

Interviews with shop inspectors, foremen, and general foremen during the test supported the conclusion that no substantial increase or decrease in the quality of shop 31's work occurred after implementation of the incentive system.

Participants' Job Attitudes

A total of 272 Shop 31 employees completed questionnaires before implementation of the incentive system and again at the end of the 9th incentive period of the system test. Of these, 35 percent had either changed work gangs or remained in the shop not more than four months after introduction of the incentive system. To ensure that respondents had enough experience with the incentive system to make adequate judgments about it, all analyses of the questionnaires were limited to those completed by employees who had been in the shop for at least four of the first nine incentive periods. To determine if this smaller sample (N = 177) was representative of the shop as a whole, these workers were compared to those who completed questionnaires but who were excluded from the analyses. The comparison showed that the sample used for analysis did not differ from the remaining workers on the basis of age, education, sex, skill level, or shipyard tenure. In general, the sample can be characterized as middle-aged males with a high school education. Most were journeymen and had worked at the shipyard for 5 to 10 years.

Job attitude data for the experimental sample before and after implementation of the test incentive system are presented in Table 6. For each measure, three means are provided: a baseline measure obtained before the system began (July 1983), a retrospective baseline measure obtained during the test period (March 1984) that measured workers' recollection of job attitudes before implementation, and an incentive measure obtained during the test (March 1984). Howard, Millham, Slaten, and O'Donnell (1981) suggest that these retrospective measures provide a more sensitive assessment of a person's perspective of personal change than do the typical pre-post comparisons and are often more highly correlated with objective outcome measures.

Table 5

Quality Indicator Report Index for Shop 31

Type of Work	Baseline[a]		Incentive Phase 1[b]		Incentive Phase 2[c]		Total Incentive Test	
	Number Inspected	% Rejected	Number Inspected	% Rejected	Number Inspected	% Rejected	Number Inspected	% Rejected
Level I Work[d]	2919	4.6	1009	5.0	1319	6.1	2328	5.6
Non-Level Work[d]	1921	1.3	2962	2.5	5090	2.1	8052	2.3
Total	4840	3.3	3971	3.1	6409	3.0	10380	3.0

Note. Data for the Quality Indicator Report (QIR) Index are collected and reported by the shipyard on a calendar-month basis. The time periods shown are comparable to those based on 4-week incentive periods.

[a]Baseline: January 1983 - June 1983.

[b]Incentive Phase 1: July 1983 - January 1984.

[c]Incentive Phase 2: February 1984 - July 1984.

[d]Level I (subsafe) work represents 25% of the shop's work and includes items that must be inspected and must meet specifications, e.g., nuclear work or items manufactured by the shop. Non-level work represents all other jobs. Not all non-level work requires inspection.

Table 6

Mean Job Attitude Scores for Shop 31 Employees
During Baseline and Incentive Test

Measure	Baseline	Retrospective Baseline[a]	Incentive Test	N
Job satisfaction[b]	3.68	3.65	3.66	164
Job stress[c]	2.73	2.87	2.86	167
Worker cooperation[c]	3.97	4.08	4.11	167

[a]Retrospective baseline measures were obtained during the incentive test period by asking employees to complete the same questions with respect to how they felt before implementation of the system.

[b]Response scale ranged from 1 (very dissatisfied) to 5 (very satisfied).

[c]Response scale ranged from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated greater job stress and greater worker cooperation.

One-way repeated measures ANOVAs were conducted on each of these measures. Significant differences were found for both job stress ($F = 7.06$, $p < .01$) and worker cooperation ($F = 4.94$, $p < .05$), but not for job satisfaction ($F = .49$, n.s.). Newman-Keuls post hoc analyses were conducted on the job stress and worker cooperation measures. They revealed that baseline worker cooperation scores were significantly lower than retrospective baseline or incentive test scores. No significant difference was found between incentive and retrospective baseline worker cooperation scores.

A similar pattern was found for the job stress measure. Retrospective baseline job stress and incentive test job stress scores were significantly higher than baseline job stress scores. Scores for incentive test job stress and retrospective job stress did not differ.

Several conclusions can be drawn from these results. Clearly, the incentive system failed to produce an effect, either positive or negative, on workers' job satisfaction. While an improvement in all job attitudes might have been expected to result from introduction of an incentive system, various shop changes occurring at the same time probably prevented this. The shop's decreased workload prior to administration of the second questionnaire and the resultant turbulence in worker job assignments may have counterbalanced any improvements in job attitudes related to the incentive system. Second, these results suggest that a response shift may have occurred between the administration of the two questionnaires with regard to job stress and worker cooperation. It appears that after several months of experience with the incentive system, employees believed they experienced more job stress prior to the test than they reported at that time. Likewise, they believed there was more worker cooperation prior to the test than they reported at that time. Comparison of baseline and incentive measures indicates that there may have been an increase in both worker cooperation and job stress following

implementation of the incentive system. Whether these differences should be attributed to the incentive system or to the other changes that occurred at the same time cannot be determined. It is likely that both contributed to the differences. The research of Howard et al. (1981) suggests that comparison of retrospective baseline and incentive measures is the more accurate indication of actual change. Given this perspective, the conclusions are clear. No changes in participants' job attitudes were detected.

Shop 31 foremen completed similar questionnaires. The same 10-item job satisfaction measure was obtained from foremen. A summary of the responses of the 15 foremen completing this scale on both questionnaires is provided in Table 7. A one-way repeated measures ANOVA revealed that program implementation did not affect their attitudes ($F = .39$, n.s.).

Table 7

Mean Job Attitude Scores for Shop 31 Foremen
During Baseline and Incentive Test

Measure	Baseline	Retrospective Baseline[a]	Incentive Test	N
Job satisfaction[b]	3.58	3.57	3.66	15

[a]Retrospective baseline measures were obtained during the incentive test by asking foremen to complete the same questions with respect to how they felt before implementation of the system.

[b]Response scale ranged from 1 (very dissatisfied) to 5 (very satisfied).

The apparent lack of impact of this experimental productivity improvement technique on participants' job attitudes is supported in the literature. White et al. (in preparation) as well as Crawford, White, and Magnusson (1983) found neither positive nor negative change in workers' job satisfaction after the introduction of such techniques. This effort represents a further replication of these findings.

Participants' Opinions of the Incentive System

At the second questionnaire administration, nine months after the system was implemented, workers and foremen were asked to rate the test incentive system's effects on various outcome measures. (See Appendices C and D for actual questionnaire items.) These responses are summarized in Tables 8 and 9.

The majority of responses indicate that participants believed the incentive system had either no effect or a slightly positive effect on the various outcome measures. Foreman responses showed a similar, though somewhat more positive, pattern. Workers saw the most positive outcomes in their own work effort, while foremen saw the most positive outcome in the area of worker cooperation, although they too believed that their own work performance had improved. Few foremen or workers perceived negative

Table 8

Effects of Test Incentive System as Perceived by Workers
(N = 173)

Effect On:	Positive Effect (%)	No Effect (%)	Negative Effect (%)
Shop efficiency	35	54	11
Section efficiency	35	62	3
Quality of section's work	30	65	5
Finishing jobs on time	33	63	4
How hard section employees work	30	64	6
Employee cooperation	27	59	14
How hard you work	41	55	4
How you work	35	63	2
Relationship with your supervisor	22	72	6

Table 9

Effects of Test Incentive System as Perceived by Foremen
(N = 18)

Effect On:	Positive Effect (%)	No Effect (%)	Negative Effect (%)
Shop efficiency	41	59	0
Section efficiency	41	59	0
Quality of section's work	29	71	0
Finishing jobs on time	35	65	0
How hard section employees work	41	59	0
Employee cooperation	53	41	6
How hard you work	41	59	0
How you work	35	65	0
Relationship with your supervisor	12	82	6
Relationship with your employees	35	59	6
Cooperation among Shop 31 foremen	18	76	6
Relationship between Shop 31 and other shops	18	76	6

outcomes resulting from the test. The lack of perceived negative effects of the incentive system test is in line with the results for the objective evaluation criteria (e.g., performance, produ t quality, schedule adherence) already discussed. No significant changes in objective criteria were evidenced until some time after the second questionnaires were administered.

Supervisors and employees also rated the extent to which various factors were problems during the test of the incentive system in Shop 31. These responses are summarized in Tables 10 and 11.

Table 10

Extent to Which Workers Saw Problem Areas as Negatively Affecting the Incentive System Test (N = 163)

Problem Area	Great Extent (%)	Some Extent (%)	Small Extent (%)	Not at All (%)	Do Not Know (%)
Unequal chance to earn incentives in different work groups	58	14	9	9	10
Insufficient workload	37	22	14	20	7
Lack of parts/materials	22	37	16	22	3
Lack of information about the incentive system	11	16	24	41	7
Lack of foreman support	12	20	20	39	9

Table 11

Extent to Which Foremen Saw Problem Areas as Negatively Affecting the Incentive System Test (N = 18)

Problem Area	Great Extent (%)	Some Extent (%)	Small Extent (%)	Not at All (%)	Do Not Know (%)
Unequal chance to earn incentives in different work groups	47	41	0	12	0
Insufficient workload	35	41	12	12	0
Lack of parts/materials	12	52	18	18	0
Lack of information about the incentive system	0	0	50	44	6
Lack of management support	6	6	24	58	6
Lack of employee interest	0	24	29	47	0

Clearly, the unequal chance to earn incentives in the various Shop 31 work gangs was seen by workers and foremen alike as the most significant problem. Lack of workload was, to a lesser extent, also seen as a problem. As would be expected, the unequal chance to earn incentives was perceived as most severe in those sections that had not earned awards up to that point in the system test. It is interesting to note that a majority of employees believed lack of foreman support was a problem and an equal portion of foremen believed lack of employee interest was a problem. This pattern of responses may be an additional reflection of the low workload situation in existence during the first half of the system test. Involvement in the incentive system test was somewhat lacking while the shop attempted to cope with the workload crisis.

A 12-item questionnaire section assessed participants' knowledge and perceptions of the incentive system. Some of the items tapped the extent to which the system produced negative effects, namely, cheating to earn awards and exertion of too much pressure on participants to work harder. Workers' responses indicated that neither issue was perceived as a problem. A large majority of employees (60 to 75%) indicated that these things never occurred.

Three items comprised a test of workers' understanding of the incentive system. These were true-or-false questions that focused on how awards are calculated. A majority of workers who answered true or false knew that the shop received a 10 percent boost for the purposes of award calculations (72%) and that worker awards were not based on overall shop performance (85%). Only 33 percent correctly indicated that the system is not based on meeting scheduled completion dates. This confusion may reflect the importance of schedule adherence to the shop. Perhaps more interesting was the finding that many workers reported they did not know the answers to these questions. Only 35 percent of those completing questionnaires ventured a guess to the first two questions. While only 30 percent admitted they did not know the answer to the third question, the majority of those who tried to answer the question got it wrong. These results indicate a need for additional incentive system training. Initial training had occurred prior to implementation, but was followed by a period in which a low workload detracted from the test system. With an improved workload situation and some experience with the system, employees will probably be more receptive to additional training sessions.

Finally, as part of the employee questionnaires and foremen interviews, shop members rated their desire to see the incentive system continued in Shop 31. Table 12 summarizes the responses of workers. Of workers expressing an opinion, fully 80 percent favored continuing the system, this, in spite of the limited improvement and substantial problems perceived by workers. Of the many who indicated changes were needed, most focused on the unequal chance to earn incentives in the various work gangs. Only 16 percent of all responding employees felt the program should be entirely discontinued. It is not surprising to note that employees who earned little or no incentive awards during the test were more critical of the system and more frequently indicated that system changes were needed.

Of the 23 foremen interviewed during the 9th incentive period, 70 percent favored continuing the system and only 13 percent believed it should be discontinued. Interestingly, the three foremen who favored discontinuing the system were all assigned to the backshifts (second and third shifts). These individuals have less control over the work they are assigned, are less able to influence earnings of their employees, and seem to feel less a part of the system.

Table 12

Workers' Preference for Continuing the Incentive System
(N = 142)

Response	Percent of Workers
The current system should continue.	28
The current system should continue, but with changes.	36
The incentive system should be discontinued.	16
I don't know.	20

In summary, employees and foremen in Shop 31 felt that the incentive system was, in general, worth continuing. They saw slightly positive outcomes of the system after the first nine months and identified some problem areas needing attention. They were very much in favor of continuing the incentive system in Shop 31, especially if attempts are made to make the system more equitable. These attitudes were expressed at a time when the shop was facing a low workload and before any objective improvement in performance was evidenced. Had a follow-up questionnaire been administered later in the system test, a more positive attitudinal assessment might have resulted.

Costs and Benefits of Operating the Incentive System

In order to assess the net costs or savings accrued by the shipyard during the program test, a cost savings analysis was conducted. As described below, this analysis identified the shipyard's fixed and variable costs associated with the program and the savings resulting from performance improvement. Based on costs and savings for each 4-week incentive period during the test, net savings were calculated for each period as well as for the test as a whole. No attempt was made to assess the developmental costs associated with the test program (e.g., costs of designing and programming the new PMR). Since the purpose of the cost savings evaluation was to assist the shipyard in deciding whether to continue the program, only the ongoing operating costs were considered. Further, no attempt was made to assess the positive, yet non-quantifiable benefits of the system discussed in the following section on shop practices.

Program Costs

Fixed costs were those that remained relatively stable during each period of the test and were independent of shop performance changes. In evaluating the Shop 31 program, fixed costs were identified in four areas:

1. Costs associated with running the new PMR system and producing performance and incentive reports for each period were estimated by shipyard personnel responsible for the PMR system to be approximately $663 for each incentive period. (Actual PMR costs were $1325/period, but included both Shops 31 and 38. Thus, only one-half of these costs was included in the present analysis.)

2. The costs accrued by the industrial relations office (IRO) in processing the incentive awards each period were calculated by IRO. While these costs, in fact, depend on the number of awards being made, figures used for the cost savings analysis were based on an average number of checks being processed each period. Approximately $200 in labor and material costs were required to process Shop 31 incentive award checks each period.

3. The cost of the time spent on this project by Shop 31's Incentive Coordinator was estimated to be 60 hours per 4-week period at $20.00 per hour (based on the individual's approximate hourly wage).

4. The costs associated with NAVPERSRANDCEN's time in consulting with shipyard personnel and assisting in the maintenance of the program were estimated at the rate of $55,000 per year based on charges to the shipyard.

Fixed costs in these four areas are summarized in Table 13. A total of $6294 in fixed costs was incurred by the shipyard in administering the program during each 4-week period of the system test.

Table 13

Summary of Fixed Costs Incurred by the Shipyard
During Each 4-week Incentive Period of the System Test

Fixed Cost Category	Cost Per Period ($)
PMR processing and printing	663
Awards processing (based on average number of checks)	200
Shop Incentive Coordinator (60 hours @ $20.00 per hour)	1,200
NAVPERSRANDCEN consultation and maintenance (@ $55,000 per year)	4,231
Total fixed costs	6,294

Variable costs are those that may change each period and depend on the shop's performance level for the incentive period. They consist of the amount of the incentive awards earned by employees and foremen. While incentive earnings less than $25 were not paid out the month they were earned, variable cost calculations were based on incentive earnings for each period rather than awards actually paid out.

The shipyard's total costs for each incentive period consisted of the sum of the period's variable costs (employee and foreman incentive earnings) and the fixed costs ($6294).

Program Savings

The savings accrued by the shipyard are based on performance changes and were estimated by the man-hour savings resulting from performance above or below the shop's baseline performance level. During the baseline (consisting of seven 4-week periods), Shop 31's average adjusted PF was .914. Without any change in the shop's performance, the PF would be expected to stay the same during each incentive period of the system test. Whenever performance exceeds this level, actual man-hour savings are accrued by the shipyard. With an expected PF of .914 and a specific amount of work completed (estimated by the man-hour allowances for work completed during the period), the man-hours expected to be expended by the shop in doing that work can be calculated. The Expected Expended Hours (EEH) to accomplish work during each 4-week incentive period of the test were calculated as follows:

$$\text{Expected Expended Hours (EEH)} = \frac{\text{Actual Allowed Hours (AAH)}}{.914}$$

where AAH represent one-third of the man-hours allowed for work completed during the 12-week performance period. (One third represents the average 4-week allowances during the 12-week performance period.) Thus, EEH is also an average 4-week figure. The hours saved for performance above or below baseline were then calculated as follows:

$$\text{Saved Hours} = \text{Expected Expended Hours (EEH)} - \text{Actual Expended Hours (AEH)}.$$

Like AAH and EEH, AEH represent one-third of the expended hours on work completed during the 12-week performance period, and include the 10 percent adjustment used for performance calculations. When performance is above the baseline (PF = .914), saved hours will be a positive value. When performance is below .914, saved hours will be a negative value indicating man-hours expended in excess of expected man-hours required to accomplish the work.

The dollar value of saved hours accrued for each incentive period was calculated at the rate of $37 per hour, which was the shipyard's customer charge during the system test.

Net Cost Savings

The shipyard's net cost savings for each incentive period were calculated by subtracting total costs (the sum of fixed and variable costs) from the dollar value of the period's saved hours. A sample calculation of net cost savings for one 4-week incentive period is shown in Table 14. The net cost savings for each period of the incentive test are shown in Figure 2. Positive cost savings began in the 12th period of the program. Over the 19 periods of the test program, the shipyard accrued total net savings of $608,435. If the shop's current performance levels are maintained, the shipyard will continue to accrue approximately $150,000 in cost savings each period. At that rate, the projected net cost savings for the next year (1985) will approach $2,000,000.

Effects on Shop Practices

In addition to the evaluation issues discussed above, a number of other areas were identified in which additional benefits of the incentive system might occur. These include shop practices such as time accounting, worker job assignment, reporting of rework, and increased interest in performance within the shop.

Table 14

Calculation of Net Cost Savings Accrued
During Sample 4-week Incentive Period

Variable			Amount
Actual allowed hours (AAH)	=	1/3 12-week allowed hours	
	=	1/3 (119268.5)	39756.2
Actual expended hours (AEH)	=	1/3 12-week expended hours	
	=	1/3 (113134.5)	37711.5
Expected expended hours (EEH)	=	AAH / baseline PF	
	=	39756.2 / .914	43496.9
Saved hours	=	EEH - AEH	
	=	43496.9 - 37711.5	5785.4
Dollar value of saved hours	=	Saved hours x $37.00	
	=	5785.4 x $37.00	$214,059.80
Fixed costs	=	From Table 13	$ 6,294.00
Variable costs	=	Employee earnings + foreman earnings	
	=	$12,057.28 + $1,711.00	$ 13,768.28
Total costs	=	Fixed costs + variable costs	
	=	$6,294.00 + $13,768.28	$ 20,062.28
Net cost savings	=	Dollar value of saved hours - total costs	
	=	$214,059.80 - $20,062.28	$214,058.80

Note. These calculations are based on shop performance and incentive earnings for the incentive period ending 13 July 1984. The shop's adjusted PF for the period was 1.054, which represents a 15.3 percent improvement over average baseline performance.

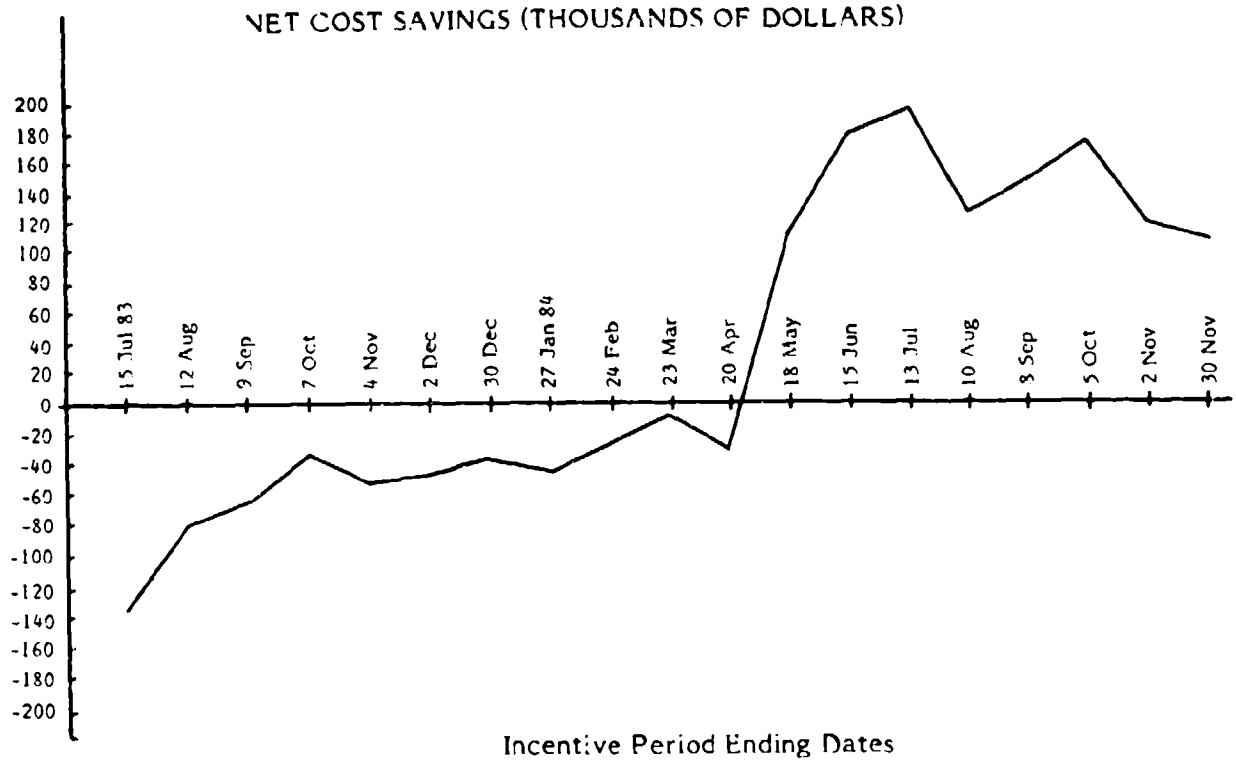

Figure 2. Net cost savings for each period of the incentive system test.

Time Accounting

Since incentive awards under the test system are based on man-hour savings, supervisors are encouraged to submit accurate labor charges for their employees. Supervisor training prior to implementation included a review of proper time card charge procedures to help foremen achieve this goal. To assess the accuracy of time card charges submitted by foremen, several measures were available.

One problem in this area was the occasional failure of foremen to put supervisor codes on employee time cards. Although such charges are not rejected by the MIS, they limit the shipyard's ability to accurately account for foreman performance. Further, employees are ineligible for incentive awards for any time that is charged without a supervisor code. A slight improvement was found in this area after system implementation. The proportion of man-hours charged to production work without a supervisor code during the baseline period was .59 percent. During the test of the incentive system (July 1983 to November 1984) it was .44 percent.

Labor charges that are submitted incorrectly by shop foremen are often rejected by the shipyard MIS and require correction. Rejected labor charges occur, for instance, when an incorrect JO KEYOP number is used or when the job has already been reported as

completed. Such charges initially go to the shop's unallocated costs account and, if not corrected, are later transferred to overhead. Reducing labor charge rejects provides one means to control unallocated and overhead costs. During the baseline period, 7.9 percent of the hours charged in Shop 31 were rejected. During the 19 incentive periods comprising the system test, 10.2 percent were rejected. A chi square analysis revealed that this increase was significant ($\chi^2 = 1809.5$, $p < .05$). Because a large number of time card rejects occur for reasons outside the supervisor's control, an additional measure was examined. It was discovered that the proportion of time card rejects due to previous job closure was 41.5 percent during baseline, but dropped to 36.6 percent during the system test. This significant reduction ($\chi^2 = 157.9$, $p < .05$) may indicate that foremen were more careful in preparing time cards after implementation.

Worker Job Assignment

As previously discussed, the shipyard experienced a significant decline in workload at about the time the incentive system began in Shop 31. In such situations, shop managers can react in at least two different ways:

1. They can attempt to keep assigned employees in the shop by charging the same number of man-hours to fewer jobs, thereby causing a decline in performance efficiency.

2. They can keep their staffing levels in line with the decreased workload and maintain their performance efficiency level, for example, by loaning out their employees.

Because reducing man-hour expenditures is one way to earn incentive awards under the test system, managers in Shop 31 were apparently motivated to choose the second means of addressing workload problems. They took timely steps to loan out employees and to implement a program of forced leave.

Rework Charges

Shortly before implementation of Shop 31's incentive system, the shipyard instituted a new procedure for reporting rework that relied on time card charge inputs. The new rework program was intended to accurately account for all required rework in a non-punitive fashion. By properly reporting time spent on rework, foremen can reduce labor charges to the original KEYOP and help their work gangs save man-hours. Further, for the purposes of performance and incentive calculations, foremen were awarded allowances equal to their rework expenditures. Thus, the incentive system did not penalize foremen who reported rework but rather encouraged them to accurately account for necessary rework.

Interest in Performance Improvement

As a result of the increased emphasis on accurate time accounting and performance measurement engendered by the incentive system, Shop 31 foremen and managers showed an increased interest in identifying and solving impediments to the shop's productivity. It was reported that foremen took a more active role in reviewing work documents received from the planning department, in identifying and attempting to resolve labor-charging problems, in determining reasons for the inequitable opportunities to earn awards, and in investigating discrepancies between data shown on work documents and those shown on MIS and PMR reports.

This interest in improvement extended to shipyard managers outside the shop as well. Prior to expanding the system to another shop in the production department, a shipyard-wide problem-solving team was established to research, document, and solve various management control problems that were highlighted by the incentive system. The team addressed issues such as problems in inputting JO KEYOPS to the MIS, work procedures that might allow manipulation of performance measurement and incentive calculations, and factors that affect the equitable opportunity to earn awards in the various work gangs in the shop. For the most part, these problems were recurrent and systemic shipyard problems. Implementation of the test incentive system provided the impetus for managers throughout the shipyard to begin working together to solve these management control issues.

Program Maintenance Issues

Several program maintenance issues arose during the system test that may have limited the effectiveness of the incentive system. The first of these involved distribution of the PMR reports. These reports were the single source of performance feedback for most employees and foremen, but were not always distributed. In general, foremen indicated that they knew the reports were available for their use and did not consider report distribution to be a problem. (The Shop Incentive Coordinator kept the PMR reports in a central location for use by foremen and general foremen.) Employees, on the other hand, sometimes did not receive their Employee Award Reports and, thus, had no means of knowing how well their work gangs were performing. In fact, workers' questionnaire responses indicated that only 16 percent of shop employees received award reports most months. Additionally, 44 percent said that they received reports only some of the time. Groups whose performance was close to the level at which incentives could be earned and who might have been able to reach this goal with only a slight increase in work effectiveness were sometimes unaware of this fact. Participants in such programs need to receive systematic feedback about their performance to strengthen the performance-reward contingency and to encourage efforts toward improvement.

A related program maintenance problem involved delays in the incentive awards processing cycle. Effective reward systems require timely distribution of payments. Rewards received soon after improvement have a greater effect on future performance than delayed rewards. Due to administrative constraints, the timeliness of awards under this program was somewhat limited to begin with. Further unexpected delay seriously jeopardizes the ability of awards to motivate improved performance and may undermine the integrity of the system in the eyes of the participants. A number of the payments during the implementation period were made two to four weeks later than scheduled. These delays were due to a variety of administrative problems that occurred and, to an extent, were attributable to the novelty of the processing procedures. With increased experience in processing such awards, the delays decreased.

The importance of continued support for such programs cannot be underestimated. Organizations cannot implement innovative programs and hope they will survive without maintenance. Managers must monitor the outcomes of these programs on an ongoing basis to determine whether program objectives are being met. Problems that arise after implementation must be identified and resolved. Further, incentive programs may need to be adapted to changing conditions in the work environment to assure their continued effectiveness. Likewise, factors that limit the ability of some or all participants to earn incentives need to be addressed. Inequitable incentive systems can undermine the long-term effectiveness of these programs and hurt employee morale.

CONCLUSIONS

1. Group wage incentive systems are effectiv- in increasing performance efficiency and result in significant cost savings in Navy industrial settings. They do not negatively affect schedule adherence, product quality, or participants' job attitudes.

2. Incentive systems can result in additional benefits to the organization in areas such as labor accounting accuracy.

3. Incentive systems focus attention on performance and highlight organizational problems, insufficient management controls, and impediments to productivity, thereby encouraging efforts to resolve these issues.

4. Implementing and maintaining a credible, cost-effective incentive system requires continued system support and efforts to address factors that limit incentive earnings.

RECOMMENDATIONS

1. Shipyard managers should continue to support the system. They should conduct periodic evaluations of the system to ensure that its objectives continue to be met, to identify problems that may have surfaced, and to change the system when necessary to solve problems or accommodate changes in the test shop.

2. Shipyard managers should continue to solve problems tnat limit the ability of the shop to improve its performance and those that limit the eligibility of all sections for incentive awards.

3. Shipyard managers should consider expanding the group wage incentive system to other production shops at NAVSHIPYDPEARL.

4. Naval Sea Systems Command managers should consider transferring the group incentive system to other naval shipyards.

5. Managers in other Navy industrial facilities should consider developing incentive systems to improve performance and reduce costs.

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APPENDIX A

FOREMAN INCENTIVE AWARDS

Foreman Incentive Awards[1]
(Dollar Amount)

Adjusted Foreman Performance Factor

Adjusted Shop Performance Factor	0	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	11	11	11	11	11	11	12	13	14	15	16	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
102	21	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
103	32	32	32	32	32	32	34	36	38	40	42	44	46	48	50	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
104	44	44	44	44	44	44	44	44	47	50	53	56	59	62	65	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
105	55	55	55	55	55	55	55	55	58	61	64	67	70	73	76	79	82	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
106	64	64	64	64	64	64	64	64	64	68	72	76	80	84	88	92	96	100	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104
107	78	78	78	78	78	78	78	78	78	78	78	83	88	93	98	103	108	113	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118	118
108	88	88	88	88	88	88	88	88	88	88	88	88	94	100	106	112	118	124	130	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136
109	96	96	96	96	96	96	96	96	96	96	96	96	102	108	114	120	126	132	138	144	150	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156
110	105	105	105	105	105	105	105	105	105	105	105	105	105	112	119	126	133	140	147	154	161	168	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175	175
111	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	130	138	146	154	162	170	178	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186
112	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	136	144	152	160	168	176	184	192	200	208	208	208	208	208	208	208	208	208	208	208	208	208	208
113	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	146	155	164	173	182	191	200	209	218	227	227	227	227	227	227	227	227	227	227	227	227	227
114	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	166	176	186	196	206	216	226	236	236	236	236	236	236	236	236	236	236	236	236	236
115	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	170	180	190	200	210	220	230	240	250	260	260	260	260	260	260	260	260	260	260	260
116	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	169	180	191	202	213	224	235	246	257	268	279	279	279	279	279	279	279	279	279	279
117	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	202	214	226	238	250	262	274	286	286	286	286	286	286	286	286	286	286
118	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	213	226	239	252	265	278	291	304	304	304	304	304	304	304	304	304
119	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201	214	227	240	253	266	279	292	305	318	331	331	331	331	331	331	331
120	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	224	238	252	266	280	294	308	322	336	350	350	350	350	350	350

[1] Computed for 4-week incentive periods

APPENDIX B

SAMPLE AWARD REQUEST REPORT

PM-L25A

Employee Awards Certification and Recommendation Report
Period Covering Aug 11 to Sep 07

Issue Date 08 Sep 84
Data Date 07 Sep 84

Group/Shop Codes	Award Number	Badge Number	Name	Current Award	Verification	Social Security No.	Occupation Code	Occupation Type
							Incentive Period Aug 11 to Sep 07	

I certify that the individual employees identified below having participated as members of a productivity improvement reward program were instrumental in contributing to the savings hours. The individual award nominations have been thoroughly reviewed and have been found to be in compliance with all applicable regulations and instructions.

Recommended By: _____ Name/ Signature/ Code/ Date

Via Code 930: _____ Name/ Signature/ Date

Via Code 931: _____ Name/ Signature/ Date

Approved By: _____ Name/ Signature/ Code/ Date

930 31		19157	Bitner, Daniel	31.65		001-31-8117	WG10-5	3414
930 31		18801	Chung, Philip	158.27		001-24-8736	WG10-5	3414
930 31		20423	Eamer, Barry	77.27		001-24-2524	WG10-5	3414
930 31		23569	Homza, David	133.44		001-27-0622	WG11-5	3414
930 31		20695	Cazares, Armando	188.06		001-28-0670	WG10-5	05334
930 31		21612	Morson, Gloria	96.68		001-27-5983	WG09-5	3711
930 31		21142	Pinnell, Paul	109.09		001-32-3381	WG11-5	3414
930 31		2129	Hoang, Nhu	113.30		001-36-6895	WG14-5	3401
930 31		21400	Graham, Earl	109.86		001-28-5364	WG10-5	05334

Notes.

1. Names, badge numbers, and social security numbers have been changed to protect the privacy of shop employees.

2. Additional information about the fields on this report can be found in Riedel et al. (in preparation).

3. During the system test, awards were recommended by the shop incentive coordinator, forwarded via the shop superintendent (Code 931) and the group superintendent (Code 930), and approved by the production officer (Code 300).

APPENDIX C

EMPLOYEE OPINION QUESTIONNAIRE ITEMS

INSTRUCTIONS - SECTION 1

The items in Section 1 ask about the effects of the incentive system. For each of the items listed below, compare how these things were BEFORE the trial incentive system began in Shop 31 to how they are NOW. Please answer each question by circling the number under the response that tells what effect you feel the incentive system has had on each item in Section 1.

EXAMPLE QUESTION

What effect do you feel the incentive system has had on each of the following?

	A Very Positive Effect	A Positive Effect	No Effect	A Negative Effect	A Very Negative Effect
1. The weather in this area	1	2	(3)	4	5

By marking response (3) you have indicated that you feel the incentive system has had no effect on the weather in this area.

C-1

What effect do you feel the incentive system has had on each of the following?

	A Very Positive Effect	A Positive Effect	No Effect	A Negative Effect	A Very Negative Effect
1. The efficiency of the shop.	1	2	3	4	5
2. The quality of your section's work.	1	2	3	4	5
3. The ability of your section to finish jobs on time.	1	2	3	4	5
4. How hard employees in your section work.	1	2	3	4	5
5. The cooperation among employees in the shop.	1	2	3	4	5
6. How hard you work.	1	2	3	4	5
7. The efficiency of your section.	1	2	3	4	5
8. How, rather than how hard, you work.	1	2	3	4	5
9. Your relationship with your supervisor.	1	2	3	4	5

TURN OVER

INSTRUCTIONS - SECTION 2

The items in Section 2 ask your opinions and feelings about the incentive system. Please answer each question by circling the number next to the answer that is best for you. Circle only one response for each item.

EXAMPLE QUESTION

1. The weather in this area is very good.
   1. Strongly disagree
   2. Disagree
   3. Neither agree nor disagree
   (4) Agree
   5. Strongly agree

By marking response (4) you have indicated that you agree that the weather in this area is very good.

1. The incentive system puts too much pressure on workers to work harder:
   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

2. There has been too much pressure from foremen to work harder since the incentive system began:
   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

3. Since the incentive system began, some workers have been putting too much pressure on others to work harder:
   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

4. My foreman tells me about how much time I should spend on each of my jobs:
   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

5. Employees have been cheating in order to earn incentive awards:
   1. A lot
   2. A little
   3. Not at all
   4. I don't know

6. Foremen have been cheating to help their workgangs earn incentive awards:
   1. A lot
   2. A little
   3. Not at all
   4. I don't know

7. The amount of money employees can earn under the incentive system is:
   1. Too much
   2. About right
   3. Too little
   4. I don't know

8. I have received an Individual Employee Award Report (PM-L24) each month since the incentive system began:
   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know what an Employee Award Report is

9. Shipyard managers have implemented this incentive system:
   1. To increase productivity and share cost savings with employees.
   2. To get us to speed up so they can get by with fewer employees.

10. Shop 31 is given a 10% boost in their allowances to give workers a better chance to earn incentives:
    1. True
    2. False
    3. I don't know

11. Workgang members earn incentive awards only when the performance (PF) of the entire shop is above 1.0:
    1. True
    2. False
    3. I don't know

12. Incentive awards under this system are based on meeting scheduled completion dates:
    1. True
    2. False
    3. I don't know

GO TO NEXT PAGE

INSTRUCTIONS - SECTION 3

The items in this section ask about a number of items that might have been problems for the trial incentive system in Shop 31. Please answer each question by circling the number under the response that tells to what extent you feel each item in Section 3 has been a problem.

To what extent do you feel the following items have been problems for th· incentive system?

	To A Great Extent	To Some Extent	To A Small Extent	Not At All	I Don't Know
1. Workload	1	2	3	4	5
2. Availability of parts or material to do your job	1	2	3	4	5
3. Lack of information about the incentive system	1	2	3	4	5
4. Unequal chance to earn incentives in the different sections in Shop 31	1	2	3	4	5
5. Lack of support from foremen	1	2	3	4	5
6. Others (write in) _____	1	2	3	4	5

_____

_____

C-3

TURN OVER

The items in this section ask about you and your workgang. Each item is asked in two ways: A. What answer do you think is best for you NOW? B. What answer do you think was best for you BEFORE the trial incentive system? Circle only one response in each part.

Example Question

1A. The weather in this area is very good.

1. Strongly disagree
(2.) Disagree
3. Not sure
4. Agree
5. Strongly agree

1B. Before the trial incentive system, the weather in this area was very good.

1. Strongly disagree
2. Disagree
3. Not sure
(4.) Agree
5. Strongly agree

By marking response item (2) in Part A, and response item (4) in Part B, you have indicated that you disagree that the weather in this area is very good NOW, and that you agree that the weather in this area was very good BEFORE the trial incentive system.

1A. How does your workgang compare to others in this shop in the way people stick together? My workgang is:

1. Below average
2. Average
3. Above average
4. One of the best
5. The best

1B. Before the trial incentive system, how did your workgang compare to others in this shop in the way people stick together? My workgang was:

1. Below average
2. Average
3. Above average
4. One of the best
5. The best

2A. Most of the workers in this shop feel that my workgang is:

1. Below average in performance
2. Average in performance
3. Above average in performance (top 40%)
4. One of the best performing (top 20%)
5. The best performing

2B. Before the trial incentive system, most of the workers in this shop felt that my workgang was:

1. Below average in performance
2. Average in performance
3. Above average in performance (top 40%)
4. One of the best performing (top 20%)
5. The best performing

3A. People in my workgang are friendly to one another.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

3B. Before the trial incentive system, people in my workgang were friendly to one another.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

4A. I have too much work for one person to do.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

4B. Before the trial incentive system, I had too much work for one person to do.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

C-4

TURN OVER

5A. People in my workgang try to do the best job possible.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

5B. Before the trial incentive system, people in my workgang tried to do the best job possible.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

6A. I like the people in my workgang.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

6B. Before the trial incentive system, I liked the people in my workgang.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

7A. There is a spirit of cooperation (willingness to help one another) in my workgang.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

7B. Before the trial incentive system, there was a spirit of cooperation (willingness to help one another) in my workgang.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

8A. People in my workgang trust one another.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

8B. Before the trial incentive system, people in my workgang trusted one another.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

9A. If you had a chance to do the same kind of work for the same pay in another workgang, how would you feel about it?

1. Would want very much to work in another workgang.
2. Would prefer to work in another workgang.
3. Would make no difference to me.
4. Would prefer to stay in this workgang.
5. Would want very much to stay in this workgang.

9B. Before the trial incentive system, if you had had a chance to do the same kind of work for the same pay in another workgang, how would you have felt about it?

1. Would have wanted very much to work in another workgang.
2. Would have preferred to work in another workgang.
3. Would have made no difference to me.
4. Would have preferred to stay in this workgang.
5. Would have wanted very much to stay in this workgang.

10A. People in my workgang cooperate to get the job done.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

10B. Before the trial incentive system, people in my workgang cooperated to get the job done.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

11A. People in my workgang are willing to listen to one another's problems.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

11B. Before the trial incentive system, people in my workgang were willing to listen to one another's problems.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

12A. How do you feel your workgang performs compared to all other workgangs in the shop? My workgang is:

1. Below average in performance
2. Average in performance
3. Above average in performance (top 40%)
4. One of the best performing (top 20%)
5. The best performing

12B. Before the trial incentive system, how did you feel your workgang performed compared to all other workgangs in the shop? My workgang was:

1. Below average in performance
2. Average in performance
3. Above average in performance (top 40%)
4. One of the best performing (top 20%)
5. The best performing

13A. People in my workgang help one another to get hard jobs done.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

13B. Before the trial incentive system, people in my workgang helped one another get hard jobs done.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

14A. People in my workgang take pride in the jobs they do.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

14B. Before the trial incentive system, people in my workgang took pride in the jobs they did.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

15A. I feel that I am really part of my workgang.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

15B. Before the trial incentive system, I felt that I was really part of my workgang.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

16A. There is not enough time for me to finish my work.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

16B. Before the trial incentive system, there was not enough time for me to finish my work.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

17A. To what extent does how hard you work affect how well your workgang does?

1. Not at all
2. To a small extent
3. To some extent
4. To a large extent
5. To a very large extent

17B. Before the trial incentive system, to what extent did how hard you worked affect how well your workgang did?

1. Not at all
2. To a small extent
3. To some extent
4. To a large extent
5. To a very large extent

18A. People in my workgang think that we are the best workgang in the shop.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

18B. Before the trial incentive system, people in my workgang thought we were the best workgang in the shop.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

19A. How would you rate the quality of work done by your workgang?

1. Poor
2. Fair
3. Good
4. Very good
5. Excellent/outstanding

19B. Before the trial incentive system, how would you have rated the quality of work done by your workgang?

1. Poor
2. Fair
3. Good
4. Very good
5. Excellent/outstanding

20A. I have plenty of time to get my work done.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

20B. Before the trial incentive system, I had plenty of time to get my work done.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

21A. How does your workgang compare to others in this shop in the way people get along together? My workgang is:

1. Below average
2. Average
3. Above average
4. One of the best
5. The best

21B. Before the trial incentive system, how did your workgang compare to others in this shop in the way people got along together? My workgang was:

1. Below average
2. Average
3. Above average
4. One of the best
5. The best

22A. People in my workgang have a hard time talking to one another.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

22B. Before the trial incentive system, people in my workgang had a hard time talking to one another.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

23A. Most of the foremen in this shop feel that my workgang is:

1. Below average in performance
2. Average in performance
3. Above average in performance (top 40%)
4. One of the best performing (top 20%)
5. The best performing

23B. Before the trial incentive system, most of the foremen in this shop felt that my workgang was:

1. Below average in performance
2. Average in performance
3. Above average in performance (top 40%)
4. One of the best performing (top 20%)
5. The best performing

24A. How hard I work makes a difference in my workgang's performance.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

24B. Before the trial incentive system, how hard I worked made a difference in my workgang's performance.

1. Strongly disagree
2. Disagree
3. Not sure
4. Agree
5. Strongly agree

INSTRUCTIONS - SECTION B

Circle the number below the answer which best indicates your degree of satisfaction with each of the items in Parts A and B. Circle only one number in each part.

	A. What answer do you think is best for you NOW?					B. What answer do you think was best for you BEFORE the trial incentive system?				
	Very Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Very Dissatisfied	Very Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Very Dissatisfied
1. The people you work with.	1	2	3	4	5	1	2	3	4	5
2. The opportunities you have to develop your skills.	1	2	3	4	5	1	2	3	4	5
3. The pay you receive for the job you do.	1	2	3	4	5	1	2	3	4	5
4. The directions and orders you get from your foreman.	1	2	3	4	5	1	2	3	4	5
5. The respect you get from the people with whom you work.	1	2	3	4	5	1	2	3	4	5
6. The way your foreman treats you.	1	2	3	4	5	1	2	3	4	5
7. The pay you receive for your level of performance.	1	2	3	4	5	1	2	3	4	5
8. The recognition you get from your foreman for doing a good job.	1	2	3	4	5	1	2	3	4	5
9. Your foreman in general.	1	2	3	4	5	1	2	3	4	5
10. Your job in general.	1	2	3	4	5	1	2	3	4	5

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GO TO NEXT PAGE

INSTRUCTIONS - SECTION 9

The items in this section ask some final questions about the incentive system. Please write in your responses in the spaces provided.

1. Approximately how much have you earned in incentive pay since the trial system began in July 1983? _____.

2. How do you think members of your workgang could increase your incentive earnings?

3. Would you like the incentive system to continue in Shop 31? (Circle the answer that is best for you. If you feel answer b or c is best for you, please circle the answer and write in your response.)

   a. Yes, the current incentive system should continue.

   b. Yes, the incentive system should continue but the following changes should be made (write your ideas here):

   c. No, the incentive system should be discontinued because (write your reasons here):

   d. I don't know.

If you have any additional comments, for instance about the benefits of the incentive system, problems with the system, or suggestions for improving the system, please feel free to use the space below or the back of this sheet. Thank you.

* * THIS IS THE END OF THE QUESTIONNAIRE * *

THANK YOU FOR YOUR COOPERATION

APPENDIX D

FOREMAN OPINION QUESTIONNAIRE ITEMS

INSTRUCTIONS - SECTION 1

The items in Section 1 ask about the effects of the incentive system. For each of the items listed below, compare how these things were BEFORE the trial incentive system began in Shop 31 to how they are NOW. Please answer each question by circling the number under the response that tells what effect you feel the incentive system has had on each item in Section 1.

Example Question

What effect do you feel the incentive system has had on each of the following?

	A Very Positive Effect	A Positive Effect	No Effect	A Negative Effect	A Very Negative Effect
1. The weather in this area	1	2	(3)	4	5

By marking response (3) you have indicated that you feel the incentive system has had no effect on the weather in this area.

What effect do you feel the incentive system has had on each of the following?

	A Very Positive Effect	A Positive Effect	No Effect	A Negative Effect	A Very Negative Effect
1. The efficiency of the Shop.	1	2	3	4	5
2. The quality of your section's work.	1	2	3	4	5
3. The ability of your section to finish jobs on time.	1	2	3	4	5
4. How hard employees in your section work.	1	2	3	4	5
5. The cooperation among employees in your section.	1	2	3	4	5
6. How hard you work.	1	2	3	4	5
7. The efficiency of your workgang.	1	2	3	4	5
8. How, rather than how hard, you work.	1	2	3	4	5
9. Your relationship with your employees.	1	2	3	4	5
10. The cooperation among foremen in Shop 31.	1	2	3	4	5
11. The relationship between Shop 31 and other shops.	1	2	3	4	5
12. Your relationship with your general foreman.	1	2	3	4	5

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TURN OVER

The items in Section 2 ask your opinions and feelings *about the incentive system*. *Please answer each* question by circling the number next to the answer that is best for you. Circle only one response for each item.

Example question

1. The weather in this area is very good.

   1. Strongly disagree
   2. Disagree
   3. Neither agree nor disagree
   (4) Agree
   5. Strongly agree

By marking response (4) you have indicated that you agree that the weather in this area is very good.

1. The incentive system puts too much pressure on foremen:

   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

2. Since the incentive system began, some workers have been putting too much pressure on others to work harder:

   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

3. I tell my employees about how much time they should spend on each of their jobs:

   1. Always
   2. Most of the time
   3. Some of the time
   4. Never
   5. I don't know

4. Employees have been cheating in order to earn incentive awards:

   1. A lot
   2. A little
   3. Not at all
   4. I don't know

5. Foremen have been cheating to help their workgangs earn incentive awards:

   1. A lot
   2. A little
   3. Not at all
   4. I don't know

6. The amount of money employees can earn under the incentive system is:

   1. Too much
   2. About right
   3. Too little
   4. I don't know

7. Shipyard managers have implemented this incentive system:

   1. To increase productivity and share cost savings with Shop members.
   2. To get the Shop to speed up so they can get by with fewer employees.

8. Shop 31 is given a 10% boost in their allowances to give workers a better chance to earn incentives.

   1. True
   2. False
   3. I don't know

9. Workgang members earn incentive awards only when the performance (PF) of the entire shop is above 1.0.

   1. True
   2. False
   3. I don't know

10. Incentive awards under this system are based on meeting scheduled completion dates.

    1. True
    2. False
    3. I don't know

11. The performance measurement reports have been available to me whenever I needed to use them.

    1. Always
    2. Most of the time
    3. Some of the time
    4. Never
    5. I never used them

[illegible] Section 3

The items in this section ask about a number of items that might have been problems for the trial incentive system in Shop 31. Please answer each question by circling the number under the response that tells to what extent you feel each item in Section 3 has been a problem.

To what extent do you feel the following items have been problems for the incentive system?

	To A Great Extent	To Some Extent	To A Small Extent	Not At All	I Don't Know
1. Workload	1	2	3	4	5
2. Availability of parts or material to do the work in your section	1	2	3	4	5
3. Lack of information about the incentive system	1	2	3	4	5
4. Unequal chance to earn incentives in the different sections in Shop 31	1	2	3	4	5
5. Lack of support from management	1	2	3	4	5
6. Lack of interest from employees	1	2	3	4	5
7. Others (write in) _____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

INSTRUCTIONS - SECTION 4

Circle the number below the answer which best indicates your degree of satisfaction with each of the items in Parts A and B. Circle only one number in each part.

	A. What answer do you think is best for you NOW?					B. What answer do you think was best for you BEFORE the trial incentive system?				
	Very Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Very Dissatisfied	Very Satisfied	Satisfied	Neither Satisfied Nor Dissatisfied	Dissatisfied	Very Dissatisfied
1. The people you work with.	1	2	3	4	5	1	2	3	4	5
2. The opportunities you have to develop your skills.	1	2	3	4	5	1	2	3	4	5
3. The pay you receive for the job you do.	1	2	3	4	5	1	2	3	4	5
4. The directions and orders you get from your general foreman.	1	2	3	4	5	1	2	3	4	5
5. The respect you get from the people with whom you work.	1	2	3	4	5	1	2	3	4	5
6. The way your general foreman treats you.	1	2	3	4	5	1	2	3	4	5
7. The pay you receive for your level of performance.	1	2	3	4	5	1	2	3	4	5
8. The recognition you get from your general foreman for doing a good job.	1	2	3	4	5	1	2	3	4	5
9. Your general foreman in general.	1	2	3	4	5	1	2	3	4	5
10. Your job in general.	1	2	3	4	5	1	2	3	4	5

GO TO NEXT PAGE

FOLLOW-ON - SECTION D

The items in this section ask some final questions about th incentive system. Please write in your responses in the spaces p ovided.

1. Would you like the incentive system to continue in Shop 31? (Circle the answer that is best for you. If you feel answer b or c is best for you, please circle the answer and write in your response.)

   a. Yes, the current incentive system should continue.

   b. Yes, the incentive system should continue, but the following changes should be made (write your ideas here):

   c. No, the incentive system should be discontinued because (write your reasons here):

   d. I don't know.

2. If you have any additional comments, for instance about the benefits of the incentive system, problems with the system, or suggestions for improving the system, please feel free to use the space below and the back of this sheet. Thank you.

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* * THIS IS THE END OF THE QUESTIONNAIRE * *

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