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Gainsharing: Issues Arising in Navy Applications

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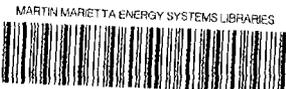
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ABSTRACT

As part of its response to Executive Order 12552 which calls for the military to achieve considerable productivity gains, the Navy has begun instituting a gainsharing program. Gainsharing provides a positive incentive for workers to increase productivity and/or reduce costs by making cash bonus payments based on explicit improvements in formula-based variables. This paper reviews the gainsharing concept, discussing its premises, measurement issues, and past applications. Potential difficulties are highlighted, and a number of issues particular to public sector applications are underscored. A series of recommendations is made for the Navy's consideration. Among these are the use of quantity measures, rather than financial measures; total productivity measures, rather than partial measures; and the need to consider special output characteristics and military-specific goals. It is suggested that gainsharing may not be appropriate in every application and that individual case-by-case decisions are required. Some of the needed measures may not exist. In these instances, additional research should provide the necessary specifications.

1. INTRODUCTION

In response to Executive Order 12552 which sets for the military a target productivity improvement between 1986 and 1992 of 20 percent, the Navy has introduced a multidimensional program to cut costs and improve overall performance. This program is called ACTION 88. An important component of ACTION 88 is productivity improvements/cost savings to be achieved through increased employee involvement and the provision of cash incentives linked to actual savings. The major mechanism chosen to provide incentives is a gainsharing program.

In gainsharing: (1) employees are grouped into units with common goals, (2) a target level of performance for the unit is established, usually relative to some baseline, and (3) a system of incentive payments for improvements from the baseline is established. Progress toward the goal is communicated to the unit members frequently, and payments are made periodically. Gainsharing is intended to be self-liquidating, in the sense that payments are made from the savings that result from the program. For example, one half of the savings could go as bonus payments and one half could be retained by the Navy. In addition to rewarding improvements in a formal, predictable way, the program also provides a mechanism for communicating goals and progress toward goals to employees and a way of encouraging employee involvement in productivity improvement.

Although gainsharing has met with favor in the private sector, there is limited public sector experience, particularly in the military. Moreover, the military has a number of special characteristics which make implementing gainsharing difficult. Among these are: (1) an eclectic financial system that incorporates features of annual budgets, industrial funds, and fees for services, (2) a great diversity of product, service, and R&D outputs, (3) a probabilistic demand for outputs that may range from normal operations to a full wartime posture, with many intermediate steps, and (4) a number of specialized institutional constraints that arise from such various causes as longstanding traditions to the

intermixing of military and civilian work forces to the existence of service-specific military cultures.

To assist in gainsharing implementation, the Navy has brought together a diverse group of organizations, that includes the Assistant Secretary for Shipbuilding and Logistics [ASN (S&L)], the Navy Personnel Research and Development Center (NPRDC), and Martin Marietta Energy Systems, Incorporated. Martin Marietta serves as a prime contractor, carrying out some tasks and drawing on specialized subcontractors for others. Current subcontractors include the SYSCON Corporation, the Virginia Productivity Center, and the American Productivity Center.

The Navy has decided to initiate its gainsharing program through a set of pilot projects. Activities undertaken thus far include the formation of a Gainsharing HIPAT (High Performance Action Team), the tasking of the NPRDC to provide training, limited research support, and monitoring of the pilot projects, and the holding of a Gainsharing Conference on 25-27 August 1987. Among the conference findings are a reaffirmation of the challenges offered by the diverse Navy environment and the potential for errors in the early part of the pilot exercise.

In particular, Rear Admiral John H. Kirkpatrick (AIR 04), in his keynote address, pointed out the need for credibility and cited the damage that could result from ill-considered measures of productivity that promote undesirable behavior or generate claimed results that might later be discredited. He called for a reputable outside organization to examine the Navy's gainsharing plans and measures to ensure that they can withstand the test of public scrutiny and perception.

This paper seeks to address one aspect of Kirkpatrick's concerns by providing an analysis of the economic foundations of gainsharing concepts. To do this, a number of gainsharing issues are examined, including the premises underlying the concept, measurement issues that arise, formulas for calculating bonus payments that have been used by existing gainsharing programs, and other issues. Next, a simplified

economic model of gainsharing is used to evaluate whether the impact of the gainsharing formulas are consistent with the productivity goals the concept is intended to reinforce. Finally, the conclusions from the previous sections are restated in terms of their relevance for the Navy, and several recommendations are made.

The advantage of this approach is that it provides a clear-cut and cost-effective way of examining the proposals, apart from the various confounding influences of the actual application. As is evident from the discussion, actual applications frequently become so preoccupied with details that larger aspects may be overlooked. The disadvantage is that it is an abstraction, that lacks the real-world flavor which the pilot projects will provide. Unfortunately, there is no ex ante method that can certify that the pilot projects will succeed. The modest goal of this work is to attempt to identify potential pitfalls. This should increase the probability that the pilots will generate information useful in the development of a Navy-wide gainsharing program.

2. GAINSHARING ISSUES

This section examines the issues that underlie the adoption of a gainsharing program and sets the foundation for the following section which provides a more detailed analysis of gainsharing monitoring (bonus) formulas. It is divided into four subsections which examine: 1) the premises underlying the concept; 2) issues of measurement for monitoring program success; 3) monitoring measures chosen by past plans; and 4) other potential issues.

2.1 GAINSHARING PREMISES

For gainsharing to succeed, there must be potential cost savings or productivity improvements available that can be achieved without new investments or other basic changes to an organization's productive process. On the surface, this could imply that managers are doing a poor job prior to the gainsharing program and that the program offers a mechanism for correcting this level of performance. We have chosen to reject this interpretation of gainsharing for two reasons.

First, though it may be definitionally true that if performance can be improved, current management is imperfect, it may be equally true that managers are doing as well as they can with existing tools and that gainsharing offers a new, previously unavailable, tool. In particular, gainsharing is a two-step process¹. Under gainsharing, in addition to hiring workers, management must subsequently bargain with them relative to some particular performance measure. But why not simply reach agreement through the one-step process as is usually depicted in traditional microeconomic models of the firm in which firms and workers negotiate quantities and prices of labor inputs?

¹In actual practice, implementing a gainsharing program may be a multi-step process which includes quality circles, employee involvement or other programs. To simplify our analysis, we have chosen to present gainsharing in its simplest form.

The answer to this query is that the one-step model does not necessarily square with the logic of the workplace. Upon examination, one finds the one step model too simple, assuming away barriers which prevent firms or workers from revealing bargaining positions fully and difficulties in performance monitoring which permit individual workers to act as free riders in a shop-wide wage and salary negotiation. This observation has not gone unrecognized in the theoretical literature, and a variety of models has arisen. Some, such as the theory of principal-agent relationships, have arisen to describe the delegation of decision making authority to individuals with different goals. Others, such as the theory of profit sharing, focus on the theory of group incentives and the potential for horizontal monitoring by peers, i.e., placing pressure on individuals to conform to group goals.

In our particular application, we assume that "administered" wage-setting and hiring policies leave managers with the expectation that higher wages will not lead directly to improved worker performance and workers with the expectation that improved performance will not lead directly to higher wages. Gainsharing, administered as a contingency agreement, provides a direct linkage between performance and reward, thereby overcoming the inertia of the administered solution and leading workers and managers to reveal fully their respective supply and demand functions. Moreover, horizontal monitoring by peers provides pressures against shirking and encourages cooperation.² One can therefore view salary administration as a two-part process. The first is a long run part which sets the base salary relative to overall labor characteristics, long term capital and technical choices by the firm, and the worker productivity levels they imply. The second part is a bonus part which

²This assertion does not require the assumption that in the long run workers will fail to be paid the value of their marginal product. It rests on the observation that the adjustment process is slow and can lead to considerable inefficiency. To the extent that wage changes trail productivity changes in upward or downward directions, workers receive imperfect signals. Moreover, the management literature which concludes that wages/salaries of limited consequence in motivating workers tends to reinforce such signals.

relates compensation to short term productivity changes that are attributable to worker behavior.

Second, the benefits of gainsharing may not be universal. This work and others will explore the logical consistency of gainsharing, and the pilot projects will provide an empirical basis for judging gainsharing's efficacy. However, it should be recognized that gainsharing programs are most applicable in operations where linking measurable outputs to worker behavior is possible and desirable. In some cases, where outputs cannot be easily measured or where operations are likely to be significantly reordered, gainsharing may be inappropriate. In any event, until specific results are posted, it is premature to pass final judgement on the new practice or to condemn the practices of the past.

2.2 MEASUREMENT ISSUES

To enact a gainsharing program, it is necessary to measure levels of performance at some baseline point and at a series of future points to monitor the extent that improvement has occurred. In principle, one would like to hold constant all other influences and to measure the change in profitability that the gainsharing program caused. A share of the incremental profit would then be distributed to the labor force, the baseline would be adjusted for confounding influences, and the process would be repeated. However, in practice, such measurements are quite hard to make. As a result, a good deal of consideration must go into the choice of gainsharing performance monitors.

First, some basic concepts. Profits are the residual between revenues and costs. Revenues are the summation of output sales, where one can think of each transaction as composed of a unit price multiplied by a quantity of output. Costs are the sum of the quantities of each purchased input, multiplied by the unit cost of the input. For simplicity, we assume that inputs can be represented as a fixed capital stock to which varying amounts of labor and materials are added. Later we will compare these concepts with past gainsharing bonus formulas. For now, it is enough to realize that a number of difficulties arise in

operationalizing this apparently simple concept. We can thus write the organization's profit function in terms of these relationships.

$$\pi = P_Q Q - P_K K - P_L L - P_M M \quad (1)$$

where: P_i is the price of the subscripted quantity

Q, K, L, and M are quantities of output, capital, labor and materials, respectively

π is profits.

On the revenue side several problems are present. In particular, the price of output may change for a number of reasons unrelated to the gainsharing program. If price increases occur due to some windfall, the organization may not want to distribute the resulting profit share to workers. Similarly, if prices fall due to outside forces, the firm may not feel workers should bear the penalty. From the gainsharing perspective, windfall price changes should not be included because they act as false signals to workers, thereby weakening the incentive created by the program.³

It may also be that revenues are indirectly tied to a process's outputs, or not even present at all. For example, within a complex organization, outputs from one process may be used in another process without dollars changing hands, or with an accounting entry made that bears little relation to our revenue concept. Other activities, like many government activities, are budgeted rather than sold, with the result that no link between output and revenue results. In contrast,

³It should be noted that the practice followed by the firm in response to exogenous price changes, and, indeed, all changes in business operations, must be viewed in terms of the firm's goals. Conceivably, a firm might wish to buffer itself from price swings by making a portion of the wage or salary level contingent on profits. This would provide an automatic reduction in labor costs in bad times and an increase in good times. In the absence of such a mechanism, a firm might be forced to decrease or increase employment levels in response to such shocks.

some government activities assess user fees that may or may not fully cover costs. Price and quantity changes may be related. A firm which supplies a major market share may cause price changes when altering marketed quantities, as could be done if a gainsharing program led to increased output. Conversely, price changes can reflect subtle changes in product attributes, which could occur, for example, if output is increased at the expense of quality. The choice of revenues as a gainsharing monitor requires taking these influences into account. Finally, output changes may occur when more or different capital is added. This result must be netted out of the gainsharing measure.

Because prices may change or revenue measures may not exist, output is sometimes an attractive performance monitor, often in ratio form with one or more inputs, such as output per worker. These are termed productivity measures. In the simple case, where output is discrete, tangible, and can be enumerated, it can provide a monitor of performance unaffected by price swings. Even in this case, however, it should be remembered that output may have several attributes that can be hidden by the quantity measure. Output is typically characterized by a rate of production of a certain quality, at a particular location, on a specified schedule. It may be necessary to include such considerations in the performance monitor measure. Outputs may also be associated with other goals, such as safety, that must be taken into account.

In some cases outputs are not discrete and tangible. Service industries and R&D facilities tend to fall into this category. Revenues may or may not be observable. In private sector industries, the producing firm may not observe Q , but does observe revenue (PQ). In public sector cases where goods are not marketed, the producing firm may not observe P , Q , or PQ . In these cases, measuring performance directly using output or revenues is not feasible. It is, however, important to note that the party obtaining the output is often capable of observing

outputs.⁴ In these instances, the producing firm may have to rely on signaling devices to measure performance. For example, an increased level or quality of services may lead to an increase in willingness to pay for a constant level input activity, whereas a decreased level or quality of services may lead to a decrease in willingness to pay.⁵

On the factor input side, measuring performance changes may also be ambiguous. Our interest is in analyzing programs which change the performance of the work force favorably, for example, by working harder or working smarter. Other less favorable changes are also possible, such as substituting other inputs, such as materials, for labor or by allowing the quality of output to decline. These undesirable gainsharing outcomes, which firms must guard against, are taken up in the following section.

Positive labor input changes which reflect working harder can take a number of forms, but in general can be thought of as shifting the short term labor supply curve to the right. Examples of working harder at a given wage or salary might include reduced absenteeism, taking smaller amounts of time for breaks or lunches, or simply increasing efforts. To qualify, such improvements must be discretionary on the part of the worker and otherwise escape conventional methods of supervisor monitoring. As such, they represent an extraordinary effort on the part of the employee that if uncompensated would likely be avoided.

⁴It follows that a firm or individual purchasing or consuming a service makes its choice on the basis of the worth of the service to their purposes. Firms measure the marginal contribution of the service to output or profits and individuals do likewise in terms of satisfaction or utility. This is possible because the firms and consumers have at their disposal information unavailable to the producer, namely the ability to measure the worth of the service relative to complements and substitutes in their respective production or utility functions.

⁵Public services or products which are indivisible in production and consumption, the so-called case of pure public goods can generally not be easily evaluated by the public. Examples are the national defense and its constituents, a system of justice, and the like. Nevertheless, individual elements of these products (planes, ships, tanks) can be measured.

Labor input changes characterized by working smarter affect the quality rather than the quantity of labor and can be thought of as increasing the marginal productivity of labor. Such changes can include increased attentiveness, cooperation, or proficiency. Modern management theory suggests that many workers will voluntarily produce these kinds of positive effects when given the opportunity and incentive to do so, because they increase job satisfaction as well as productivity. Thus, gainsharing is often combined with other management initiatives, such as employee involvement, quality circles, or the like.

Analytically, increases in worker productivity are more desirable than mere increases in effort because of the concept of diminishing returns to other fixed factors. Thus, there are limits to the gains that can be achieved by working harder, while working smarter can, in principle, increase the productivity of the fixed factors as well. There is also the added factor of the positive image of increasing output through brains rather than brawn, but in application one should take care not to draw the distinctions too finely. Measurements of decreased absenteeism may be useful in tuning a program to special needs, but one would not wish to use such devices to reverse the many legitimate benefits which the labor force enjoys. Also, increases in output per worker due to working harder or smarter may be indistinguishable empirically.

2.3 GAINSHARING PLANS AND FORMULAS

The previous discussion has indicated a number of potential pitfalls which may be encountered in constructing an operational gainsharing formula. To combat these, complicated administrative procedures have been developed to manage gainsharing programs and to define the base

against which progress is to be measured. We consider four different gainsharing programs which have been implemented in the past.⁶

2.3.1 Scanlon Plan

The Scanlon Plan was originated in 1935 at the Empire Steel and Tinplate Company by Joseph Scanlon, a Vice-President of the United Steelworkers. It sought to raise the productivity of the average worker through innovative motivational techniques and increased involvement in the production planning process. The Plan proved successful and was applied subsequently in a number of organizations in which it was feared that union jobs would be lost. During World War II, a bonus system was added which paid cash rewards for quantitative improvements in performance from a measured baseline. Ultimately, the Plan was applied many times in different circumstances and evolved into a fairly structured system including such features as a distinctive implementation plan that includes worker voting, a system of steering and production committees, a detailed process for calculating the reward system, and a procedure for evaluating and maintaining the plan.

Of particular interest here is the formula for the bonus payments. Although several formulas have been used in Scanlon applications, the most basic plan divides total personnel costs by the total sales value of production to calculate a base ratio. In actual implementation, criteria for including and excluding personnel costs must be created. For example, all direct and indirect labor is included, but salesmen's commissions are excluded. Defining the sales value of production is also critical, because inventory changes must be taken into account and work-in-progress must be included. A variety of other formulas have also been employed in Scanlon Plans, which include splitting the formula to account for the production of different products, including costs other than labor in the ratio's numerator, incorporating value added in different ways, and using "allowed labor". This latter form differs considerably

⁶Information concerning these plans has been largely drawn from materials presented by the American Productivity Center at the August 1987 Conference.

from other formulas, because it applies a standard, based on engineering criteria or past behavior, to calculate the "appropriate" labor quantity in forming the base ratio. This approach offers the advantage of allowing a focus on fairly small labor groups thereby permitting the isolation of problem areas and the incorporation of intergroup differences. The disadvantage of these measures is that when based on engineering standards, rather than on past experience, they can appear arbitrary.

2.3.2 Rucker Plan

The concept of the Rucker Plan also began in the 1930's, reportedly based on the belief by Alan W. Rucker that ratios of payroll to production value were relatively constant over time and could be used as a standard for monitoring exemplary or deficient performance. The goal of the Plan is to maximize the output value of merchandise for a given input value of payroll.

Like the Scanlon Plan, the Rucker Plan evolved over time through successive applications to include a systematic implementation and execution procedure. Emphasizing the use of past and current accounting records, the Plan includes less flexibility in bonus formula calculation, but substantial flexibility in employee involvement through committees, meetings, presentations, etc.

Calculating the cash bonus requires adding the total value of goods shipped to the net change in inventories and subtracting returns and non-production receipts. From this, all materials costs and certain other non-payroll costs are subtracted, leaving the production value of output, essentially value added. The Rucker standard is then calculated by dividing the production value into variable payroll costs. By multiplying the Rucker standard by production value one can calculate allowable labor costs and compare them with actual labor costs. The result is the bonus which can be allocated to the workforce in various ways.

2.3.3 IMPROSHARE

IMPROSHARE (IMproved PROductivity through SHARing) was developed by Mitchell Fein to focus attention on worker productivity and cash incentives. Unlike the other two programs discussed, it is stated in physical rather than financial terms and does not incorporate elaborate systems for employee involvement. Consequently, its most important aspect is the formula that provides incentives for improved productivity.

The IMPROSHARE formula is quite simple. For single product operations, a standard number of hours per unit output is established. From this, the actual number of hours worked per unit output is subtracted and the number of hours saved is calculated. Saved hours are then divided between management and labor and the number of hours saved is divided by hours worked to calculate a percentage bonus. Like the other plans, a number of complications must be worked out, for example, to share overhead labor among multiple output operations, to deal with goods-in-process, and the like.

2.3.4 Profit Sharing

Profit sharing is a generic process rather than a specific plan. It has gained wide favor among many industries as a way of permitting employees to participate in the long term performance of the firm. Typically, profit sharing is established separately from other motivational or employee involvement programs. It may consist of an annual payout or may take the form of a pension fund bonus.

The formula for profit sharing is quite similar to that shown above with profits residualized as revenues minus costs. As in the other plans, adjustments must be taken into account, but here such items as accounting practices, accruals, and taxes take on increased importance. Many of the elements which determine profits are beyond the control of individual employees, for example, domestic and foreign competition, national economic conditions, strategic management planning, and the like. For this reason, profit sharing within a complex organization is often viewed more as a risk sharing measure than as a motivational

measure, though the practice certainly serves as a device for sensitizing employees to the firm's overall performance. In extreme cases, firms set salaries so that a substantial fraction of worker earnings are variable, depending on residual revenues.⁷ In these cases, firms can achieve economies through automatic wage adjustments, rather than through layoffs or other adjustments in labor inputs. This can preserve jobs, while adding uncertainty to annual worker earnings.⁸

2.4 OTHER ISSUES

Finally, it is useful to make note of a number of additional considerations which must be taken into account. Of course, each gainsharing implementation will encounter special circumstances, some of which will be unanticipated. The partial list treated here gives some idea of such occurrences.

It is typically recognized that gainsharing plans are implemented as short run actions, that is, they assume a given technology and capital stock. When capital is upgraded or new technologies are employed, adjustments to the gainsharing formula must be made. For example, if a new, labor saving technology is put into place, labor productivity will be enhanced and, without adjustment, would be captured in the gainsharing bonus. It is generally desirable that such changes be captured in the base wage rate rather than the bonus share, because, in general, such productivity gains cannot be controlled by the workers and a confusing message may be sent to workers. There must be a feature in the

⁷Martin Weitzman has recently suggested that firms commit a share of revenues to labor, rather than negotiating a wage rate. Under such a system, the wage bill would automatically be reduced in bad times and increased in good times and individual workers' salaries would do likewise. See Martin L. Weitzman, The Share Economy, (Cambridge, Mass., Harvard University Press, 1984).

⁸Such systems find support by managers who would otherwise be forced to deal with layoffs and subsequent retraining costs. Unions are often less supportive, because such plans run counter to traditional union bargaining points such as the privileges due seniority, work rules, and the like.

gainsharing plan to adjust base wages to long run conditions and bonus shares to short run conditions that workers can control.

A second matter, which is partially a short run problem is the matter of cash flow. Some organizations, particularly in the public sector, are budgeted, with the characteristic that a fixed fund for activities is made available well in advance of the productive activity. Clearly, for gainsharing to work, either a variable source of compensation must be made available or it must be possible to pay workers dollars saved through cost reductions. More troubling may be the case when short run losses are made. If an organization is losing money, there may be considerable resistance to adopting a program which increases worker salaries.

This issue has two aspects. First, it is a well known economic result that operations incurring losses may continue for some time as long as variable costs and some portion of fixed costs are covered. Thus, even when there are short term losses, adopting gainsharing could be effective in either reducing losses or possibly generating profits. Second, long term conditions may dictate persisting losses unless fundamental changes to business operations are made. In this case, gainsharing could be part of a package to reorder base salaries and make other changes. From a strictly administrative standpoint, however, it makes little sense to implement gainsharing in the face of massive layoffs or other certain disruptions.

On the other hand, gainsharing implementation can be complicated by existing bonus programs aimed at individuals, management plans which feature overtime as an ongoing practice⁹, and expanding enterprises which pay overtime until additional staff members are added. Multiple bonus

⁹Some factories preserve flexibility through a combination of actions that include overtime. 3M, for example, organizes some of its factories at 10 percent overtime, 10 percent part time staff, and 10 percent subcontracting, to permit an adjustment of 30 percent before a permanent employee would be affected.

plans confuse workers and provide mixed incentives. Overtime can be more complicated. If a worker feels that by increasing productivity he or she may lose overtime hours, they have a disincentive to cooperate. Once again, it is necessary to implement the plan within the context of long run compensation policy.

Last, there may be a number of institutional matters to be taken into account. Labor unions, employee associations, safety committees, quality circles, and the like must be involved in early planning, lest these groups feel they will lose legitimacy or power through the new program. Public sector implementations may confront additional barriers relative to government-wide policies, civil service laws and regulations, and the special circumstances that confront military personnel. Reconciling long run and short run management practices can take on special significance for the military, which purposefully maintains some redundancies for readiness, surge, and mobilization capacity. These issues must be faced prior to program implementation.

3. ANALYSIS OF FORMULAS

Based on the information contained in the previous section, it is now possible to analyze the various gainsharing formulas. First, as a point of departure, it is useful to consider the sources of change in profits from equation (1) above. In considering profit changes, several simplifications have been made that ignore feedback effects that may be dictated by technology (such as a direct link between factors) or management behavior (such as a change in labor induced by a change in materials prices). These omissions are made acceptable by the fact that we are considering a short term analysis (in which capital and technology are held constant) and by the desirability of simplicity. We are left with a simple accounting relationship

$$\delta\pi = Q\delta P_Q + P_Q\delta Q - P_L\delta L - L\delta P_L - P_K\delta K - K\delta P_K - P_M\delta M - M\delta P_M \quad (2)$$

where the operator δ is used to indicate a change in the variable that follows. Thus, a change in profits could result from a change in any of the variables or any of the prices.

The goal of gainsharing is to provide incentives that will cause favorable changes in one or more of the variables contained in this equation. For example, working harder has the impact of increasing output without changing L (i.e., the long term employment level). This could permit the same level of output with reduced L or a larger output with the same level of L . For a private sector firm this would yield increased profits which could be returned through gainsharing and for the Navy it would yield reduced costs that could be shared. Based on the earlier review of the four plans, one can describe the bonus formulas in similar terms. Price changes are omitted.

$$\begin{aligned}
 \text{Scanlon Base} &= LP_L / QP_Q & (3) \\
 \text{targets} &= P_L\delta L, P_Q\delta Q \\
 \text{omitted} &= P_M\delta M, P_K\delta K,
 \end{aligned}$$

$$\begin{aligned}
 \text{Rucker Base} &= LP_L / (QP_Q - MP_M) & (4) \\
 \text{targets} &= P_Q\delta Q, P_L\delta L, P_M\delta M \\
 \text{omitted} &= P_K\delta K,
 \end{aligned}$$

$$\begin{aligned}
 \text{IMPROSHARE} &= L / Q & (5) \\
 \text{targets} &= P_Q\delta Q, P_L\delta L \\
 \text{omitted} &= P_K\delta K, P_M\delta M, \text{ output characteristics}
 \end{aligned}$$

$$\begin{aligned}
 \text{Profit Sharing} &= QP_Q - LP_L - KP_K - MP_M \\
 \text{targets} &= P_Q\delta Q, P_L\delta L, P_K\delta K, P_M\delta M \\
 \text{omitted} &= \text{nothing}
 \end{aligned}$$

Of course, these representations are simplified and do not include the many qualification that may accompany actual implementation. Nevertheless, they illustrate the basic features of each plan's formula. Drawing from equation (2) which describes the sources of change in revenues and costs, target variables given positive incentives and omitted variables are highlighted. Note that when revenues are part of the formula, it can be argued that output characteristics are taken into account (see ft. 4).

Several points are noteworthy. First, all are financial plans (i.e., stated in dollar terms) except IMPROSHARE, but in no case can the worker control the price variables. Thus, the larger the number of price variables, the more potential for changes unrelated to worker activities. Conversely, inclusion of price variables offers some potential to capture output characteristics. Profit sharing is the formula most likely to lead to confusing incentives, despite its conceptual attractiveness. IMPROSHARE's simple productivity ratio has the least.

Second, measures of output figure heavily in each formula. IMPROSHARE includes an output measure and the other three employ the value of output. For these latter three, output price changes may affect the result. As noted above, not all enterprises can use these measures easily or interchangeably. For example, for Service or R&D organizations acceptable surrogates for output must be established. Moreover, as was noted above, output is associated with characteristics such as quality, timeliness, and other goals such as safety. These factors are omitted from the formula, but must be taken into account. As discussed above, when the value of output is considered, there is some positive incentive to maintain output quality. For organizations without sales, such as many Navy activities, this incentive may not be present. In these cases, the existence of a buyer/seller relationship could prove valuable.

Third, the variables omitted from each formula may be as important as the ones included. This importance owes to the fact that workers may obtain their objective, such as reducing work time, by substituting other inputs such as capital (e.g., foregoing proper maintenance in the short run) or materials (e.g., a maintenance shop replacing old parts rather than fixing them). The importance of these omitted factors will be different for each application. Where the possibility of substituting factors arises, the relative proportions of each must be taken into account. Whereas it might make sense to use small additional quantities of inexpensive materials to obtain labor savings, destroying highly expensive component inputs to save labor would be wasteful.

In sum, one is left with a dilemma. The formula which includes all relevant variables is too complex to be useful, but the simple formula omits important controls that may defeat the purpose of the plan. Further, employees have little or no influence over any prices, yet most plans are based on financial data, perhaps because it is most easily available.

To be effective a plan must, in some way, consider all potential input changes, apart from price changes, and, in some way, measure output. In addition, other relevant output characteristics, such as quality, timeliness, and safety must be added. None of this is simple, and its implementation opens the possible need for a new set of productivity accounts, but it also opens the way for management to communicate more clearly with labor. It is also of clear importance for the Navy, where failure to agree on first principles, in the face of enormous complexity and variation, could spell early defeat for gainsharing.

4. CONCLUSIONS AND RECOMMENDATIONS

This paper has reviewed the concept of gainsharing, the premises underlying it, the issues associated with measuring important variables, and the various formulas applied by past programs. Care in selecting formula variables has been emphasized. When some variables are selected and others omitted, workers have explicit incentives to improve performance for those selected and implicit incentives to decrease performance on those omitted. Thus, omitting important variables could seriously undermine a program's effectiveness. In some instances, measures specific to military needs will not be available, and research will be required to provide proper specifications.

Much of the past experience has been with private sector activities. Applying gainsharing to Navy activities will likely prove much more troublesome. Issues that will arise are the inability to measure outputs, operations with budget limitations, operations that are "operating at a loss," and excess capacity associated with readiness or surge goals. Other potential issues center on mixed workforces of military and civilian composition and the overall military culture.

Certain existing institutions must be incorporated into any gainsharing effort. Labor unions may view gainsharing as a threat. Current bonus programs may offer conflicting or confusing incentives. Overtime payments may exceed gainsharing bonuses. In certain instances, gainsharing may be inappropriate, or at least inappropriate without companion programs. Gainsharing should not be initiated if significant long term adjustments to operations are anticipated. Moreover, gainsharing is a short term activity, in the sense that it cannot accommodate long term adjustments to capital equipment or technology. Periodic adjustments to the base compensation package must be incorporated in the plan.

It is recommended that as the Navy gains experience through the development and evaluation of the pilot programs it should develop a generic format for succeeding programs. This recognizes that although each program will have very distinctive characteristics, the Navy requires a common basis for comparing existing programs, making decisions as to whether or not to continue programs, and making decisions about new programs. In doing this, it should consider the following actions:

1. Define outputs carefully in a measurable manner, preferably in physical units. Assess the future demand for these outputs, realistically evaluating the future viability of the operation. Make note of any special output characteristics (quality, timeliness, safety, readiness) that might qualify productivity measures.
2. Assess all inputs to the process to determine how they are measured in physical terms, their technical relationships, and the potential for savings or losses through modified worker behavior.
3. Decide if gainsharing is beneficial or if a different program might better help the Navy meet its objectives.
4. If a decision to adopt gainsharing is made, develop physical measures of inputs and outputs and consider relating them to one another through a total factor productivity measure. Such a measure calculates the ratio of total outputs to total inputs, with total inputs weighted by their proportion in the productive process. This weight may be a policy consideration as well as a technical one. Choose this measure or a separate measure as a primary target variable. Develop secondary variables that protect against slippages in quality, timeliness, or any other Navy goals. State all monitoring devices in quantitative terms.
5. Define savings using the total factor productivity measure and define bonus payments based on savings. State explicitly the sources of funds and conditions of payouts.

In carrying out these efforts, the Navy should develop a method for evaluating individual gainsharing projects against one another and against its other activities in ACTION 88. It should conserve its management talents in applying these programs, choosing only programs with demonstrable potential for success.

The most difficult aspect in carrying out these recommendations will be to strive for measuring behavior in appropriate, rather than convenient ways. Research to develop new measures may be called for, and new systems for productivity accounting may be required. The Navy should not assume that its existing accounting systems will contain the information needed for gainsharing.

The Navy should take care to state its goals explicitly, particularly as they regard items often considered intangible, such as readiness. If lower level decisions are overturned or ignored in the name of readiness, the program will fail.

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