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This report is one of a series under the aegis of the Productivity/ Quality project within MIT's Sloan School of Management. The Project Director is Thomas A. Barocci, Associate Professor of Management. For further information contact Ms. Carolanne Foilb, Project Administrator, Sloan School of Management, MIT, 50 Memorial Drive, E52-454, Cambridge, MA 02139.

# PRODUCTIVITY IMPROVEMENT PROGRAMS IN MATURE MANUFACTURING INDUSTRIES: IMPLEMENTATION AND DIFFUSION

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The tire industry is flat, steel has been rolled over and the automobile sector seems permanently stalled. The productivity problem in the US is most evident in our mature manufacturing industries. Competition revolves around price and quality, with reliability coming in a close third. It took the rubber, steel, and auto industries (and many others) some time to respond to the productivity slowdown. But things are finally moving. (Barocci, April 1982) In addition to streamlining management and trimming overhead, many firms are experimenting with various programs to increase the productivity of production workers. US firms are exploring quality of worklife programs, Quality Control Circles, (Barocci, October 1982) job rotation, incentive pay and many other productivity avenues. However, when immediate economic pressures speed up experimentation and diffusion, these programs often lack the logic and coherence that are necessary to address productivity problems constructively.

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Implementation is not the last step. Unsuccessful programs must be cancelled, and successes diffused throughout the firm. This paper reports the results of our on-site examination of ten productivity enhancement programs, launched in a variety of mature American firms, and evaluates their merits on the basis of a simple model of diffusion. Diffusion theory, as might be expected, does not directly apply to real-life activities. Nevertheless, the programs we examined come close enough to the model that it is possible to conclude by enumerating a set of prerequisites for moving successful experimental programs into full-scale implementation.

## The Model

The implementation of change in an organization's structure or work processes requires maneuvering through four major phases:

1) Problem Identification/Definition
   - Isolation
   - Measures
   - Goal Setting
   - Organizational Support

2) Program Selection
   - Isolate Problem Causes
   - Determine Problem Type

3) Program Testing/Experimentation
   - Pilots
   - Voluntary Participation
   - Test Timing and Site Selection

4) Program Expansion
   - Data Collection from Testing Phase
   - Re-evaluation/Rediagnosis
   - Transferring Human Resources

The first step, problem definition, is interestingly enough often the most difficult. (Walton, 1977)

First, the problem must be isolated. It won't do simply to recognize that things don't feel right. The issue must be defined concretely; for example, "We have five times as many employee grievances as our major

competitors," or, "Our rework levels are twice as high as they were three years ago." You can't solve a problem unless you know specifically what it is.

Second, you have to find measures of the problem that are at once understandable, useful, and consistent with organizational norms. Usually, those norms are quantitative. Measurements that address vague concepts such as the quality of worklife are often less interesting to top management than concrete references to production, sales or profits. If top management isn't interested, no program will have much chance of success.

Third, it's necessary to set up concrete goals against which progress can be measured. This involves figuring out what criteria are to be used for measuring success or failure. The fewer the criteria, the easier it is to solve the measurement problem. In setting up these criteria, it usually helps to consider all the components of an acceptable solution, and then search for ways to reconcile the conflicting goals that may arise.

Finally, the process of solving the problem must be supported by the organization as a whole. The director of the program should find out who in the organization is really bothered by the problem, who should be made more aware of it, and which elements and functions in the organization will be affected by it. In deciding how to create the program, it is important to keep in mind on what basis the organization can justify it, and how much support it is likely to get, given existing cultural norms and organizational structures. How good are vertical and horizontal lines of communication? How easy will it be for the various people who will be affected to get involved in the project? How feasible is it for management and employees to consider the problem and its solution in long-range terms? How are employees going to respond? Who is best equipped to handle the actual implementation of the program? What kind of incentives are there for those involved in the program to try to make it work as best it can? All of these questions depend on the

organization's culture and structure. Any successful program will have to be constructed in such a way as to work with, rather than against, the organization as a whole.

The second step is the selection of the program itself. The sequence is important here. It may seem patently obvious to do so, but in fact programs are not always selected after the problem has been defined. But when the program is chosen first, chances are the problems it addresses are not the ones that most crucially need to be solved. In finding the right kind of program to implement, it's necessary first to find the real causes of the problem -- rather than its obvious and superficial symptoms. Depending on the problem, a wide variety of programs can be introduced as solutions. These include training programs, structural process or organizational changes, changes in the reward system, job redesign, and participatory programs. The type of program that is most likely to be successful can generally be derived from the definition of the problem, as illustrated below:

| PROBLEM | LIKELY SOLUTION |
| --- | --- |
| Knowledge or Skill | Training or Education |
| Quality/Reliability | Structural Changes:<br>-- tools - are they functioning properly?<br>-- product engineering - is it faulty or working?<br>-- process engineering - is it faulty or working?<br>-- defect prevention |
| Motivation | Reward system changes -- piecework, group rewards, monetary rewards.<br>Job redesign -- possibly enrichment.<br>Worker participation -- in decisions affecting their jobs, in the form of quality circles or quality of work life groups. (Walton, July/August 1979) |

Each program will, of course, need to be supported by the general nature and circumstances of the organization. If turnover is particularly high, for example, quality circles are unlikely to be meaningful, since there will be too little time for people in these groups to get to know each other well enough to work together constructively. Similarly, high turnover rates can make it highly cost-ineffective to train employees to raise their firm-specific skill levels.

Once the program has been decided on, it must be tested. This is the third step in the implementation process. To begin with, it must be decided whether a pilot program is called for. If so, are the testing sites substantively similar to the sites at which the program may eventually be implemented on a full-scale basis? Why are pilots necessary? Is it to see how well the program works? Or is it because there are not enough managers and other resources to make full-scale implementation possible immediately? Next, where will the pilot(s) be run? Do the testing sites need to be improved in ways specifically addressed by the program? Are program participants volunteers, or will people resist implementation? Is there room for program failure? This last point may appear superfluous, but in fact it is important that the program have room to fail in the pilot site, since inertia can often make it very difficult to dismantle a productivity project -- even a bad one -- unless a severe economic crunch requires across-the-board cost cutting. Finally, when should the pilot be run? Pilots are often most effective when they coincide with other major changes in production or plant lay-out. However, isolation of program-related effects will be more difficult in this case. Similarly, a period of economic decline can provide fertile ground for a program that may appear to hold promise for raising productivity and revenues. Further, if the firm is unionized it might make sense to postpone pilot implementation until after union elections, when union officers

can give the program the support it needs in the initial stages that may appear threatening to the rank and file.

The final step in the overall process is the expansion of the program beyond its pilot phase. In some cases, expansion may be uncalled for. Sometimes the problem is resolved simply by virtue of the attention it gets in the phases discussed above. Sometimes the pilot is a signal failure, and diffusion of the program would be a waste of time and money. In any case, it is important to be sure enough data are collected from the pilot that the program can fairly be evaluated, and the chances for success accurately guaged. At this point, the manager must return to the success/failure criteria earlier established. Once more, it is crucial that there be enough data to measure whether these criteria have been met. It is also important at this stage of the game to consider the so-called "Hawthorne effect" -- productivity increases in the pilot due to the fact of a program, rather than the nature of the program itself. (Schein, 1980) The latter kinds of improvements are invariably short-lived, and seldom have anything to say about the usefulness of the productivity program itself.

If it makes sense to diffuse the program, it must be decided where. Once again, the sites chosen must show room for improvement as well as failure, and people should be willing to participate in the program voluntarily. It is also important to check for the "star-envy" phenomenon, which occurs when a pilot has been widely successful, and further programs appear unlikely to do as well. (Walton, 1975) This effect can dampen enthusiasm to the extent that program extension is unlikely to reap the results the pilot did.

Once it has been decided where to expand, the question is how to do it. It is vitally important at this point to reconsider the diagnosis of the original problem. Chances are, the pilot site will be far from identical to the sites of program expansion. So it is crucial to take into consideration

differences in attitudes and structures, not to mention the possibility that the problem might in fact be different in different parts of the organization. When the pilot program is diffused it is more important to transfer the people who were involved with the testing, and the measures that were used in determining the pilot's success, than simply the program design. Programs don't implement themselves; people are responsible for what is done with the ideas they embody. And you can't transfer ideas unless you transfer people to implement them. It may help at this stage to transfer personnel who were specifically responsible for the success of the pilot, as a sort of intrinsic reward system; this is likely to improve the chances for program success in the final diffusion stage.

## Ten Case Studies

Many of the elements of this model appear to be superficially self-evident, yet in fact the implementation of productivity improvement programs has not often followed along these lines. In order to illustrate the practical manifestations of this model, we conducted interviews and collected questionnaires from four mature manufacturing firms, concerning ten such programs. The firms are briefly described in the figure below. (Confidentiality required fictitious names.)

FIGURE 1 -- Firm Descriptions

| | ACME | BENEFICIAL | CHAMPION | DELTA |
|---|---|---|---|---|
| Sales/ Employment | $2 bil sales; 30,000 emp | $800 mil sales; 10,000 emp | $75 mil sales; 1,000 emp | $1 bil sales; 15,000 emp |
| Products | large mechanical devices | standard components for other divisions of the firm | small consumer goods/ large govt. contracts | small mechanical devices |
| Process | job shop | batch | batch | batch |
| Plant ages in years | 50, 5 | 50, 5 | 50, 20 | 2 to 80 |
| Unions | one | one | none | many |
| Corporate tie | moderate | close | loose | close |

Figure 2 illustrates the types of programs examined in this study, and provides a brief description of the specifics involved in each case. As shown below, four of these programs were chosen to address problems relating to quality issues, four were aimed at solving attitude problems among employees, and two were simply designed to cut costs.

FIGURE 2 -- Productivity Programs

| PROGRAM | PROGRAM TYPE | FIRM | PROGRAM DESCRIPTION |
|---|---|---|---|
| A1 | attitude | Acme | -- quality of work life pilot program; new plant<br>-- discussion of quality, production and environment issues |
| A2 | attitude | Acme | -- quality of worklife program; old plant<br>-- discussion of environment, process design and quality issues |
| A3 | attitude | Beneficial | -- job motivation and enrichment program; new plant<br>-- socio-technical system |
| A4 | attitude | Beneficial | -- communications training program |
| Q1 | quality | Acme | -- quality improvement pilot program<br>-- quality index on assembly lines |
| Q2 | quality | Delta | -- participative problem solving<br>-- quality circles |
| Q3 | quality | Beneficial | -- quality control circles<br>-- statistical quality control<br>-- quality index<br>-- cost of quality measures |
| Q4 | quality | Champion | -- quality control circles<br>-- statistical quality control<br>-- cost of quality measures |
| C1 | cost | Beneficial | -- full scale cost cutting program |
| C2 | cost | Delta | -- manufacturing cost reduction |

Four of these programs are aimed at raising productivity by improving attitudes. Program A1, at Acme, is still in its pilot phase. The idea is to improve the quality of worklife at a new plant through weekly departmental meetings with rotating worker participation. There are no specific measures of success or failure of the pilot.

A2, also at Acme, has similar aims, but takes place at an old plant. This program was the result of a conference on the Quality of Worklife (QWL); it involves all production workers in one hour weekly meetings. Its goals are to improve product quality, to reduce the level of grievances, and to improve schedule attainment and morale. The program is judged on the basis of how well its aims are attained; success is measured by lower test and audit reject levels, lower scrap levels, better batch acceptance, higher quality (as per a quality index), fewer grievances and better met schedules.

Program A3, at Beneficial, is less thorough. The aim of creating satisfying jobs is not measured with any specific reference to employee attitudes. Nonetheless, the environment this program seeks to create for Beneficial employees is a progressive one: people work in teams, pay is based more on knowledge than on the particular job held and there are no visible status symbols separating management from workers. The program appears to be successful enough that diffusion to other, older plants is planned.

Another of Beneficial's programs (A4) was to reduce grievances at one of its plants by improving communications between foremen and stewards. Results were quick: when each side pressured for early settlement of grievances, the backlog was reduced substantially enough that the program itself was never implemented. This case illustrates how the mere fact of calling attention to a problem can serve to resolve it without a formal program.

Four of the programs were responses to problems of product quality.

Acme's Q1 pilot developed out of a series of independent efforts within the firm to improve quality in a number of ways. Foremen meet on a weekly basis to discuss quality-related issues, and Acme has plans to extend this aspect of the pilot to production employees. The experiment is to be extended into a full-fledged program as soon as possible.

Q2 is one of Delta's programs, involving problem solving training to improve the quality of worklife and quality circles for employees and many managers to improve plant performance. One draw-back of Q2 is the fact that Delta has no measurements of the relative success of the program.

Q3, at Beneficial is ultimately aimed at reducing costs, but through quality circles and statistical quality control. Success is measured on the basis of scrap and rework levels. Foremen are trained in statistical techniques and group process facilitation.

Champion's Q4 uses similar methods to lower reject rates and customer complaint levels. This program was born of an outside seminar on quality control. Its problem solving techniques appear so far to be quite successful.

The last two programs in our series of case studies aim at cost reduction. Beneficial's C1 was developed specifically to avoid having to lay off engineers after the 1975 recession. When standard production and overhead costs were lowered, management adopted an on-going, full-scale cost reduction program. The goal of keeping on the engineers was met successfully.

Finally, program C2, at Delta, was implemented to reduce manufacturing costs between three and six percent annually. The goal has come to be accepted as standard, although the program addresses no specific problems, save that of poor profitability.

The following section will discuss the components of the model in relation to these programs.

Program Evaluation

Part of the first phase -- problem definition -- involves the establishment of goals, measures and program attributes necessary to address the problem. Figure 3 illustrates the ways in which this process was completed for each of the programs. It is interesting to note at the outset that it was usually difficult for managers to define the problem clearly in the first place. In several cases, notably Q2 and C2, the managers had never been asked specifically to do so. In those cases where there was some sort of problem definition, it was generally broad and vague enough to be barely useful. This is illustrated particularly well by cases A2 and A3. Program goals were defined a little more concisely. C1, for example, wanted explicitly to avoid lay-offs; C2 wanted to cut costs; A1 desired a QWL program; A4 wanted early settlement of grievances.

The measurements adopted were even clearer than the goals; both tended to match the definition of the problem. Where they did not match, it was almost invariably a matter of not having defined the problem clearly to begin with. Further, it is unclear whether the sequence of these steps always made sense -- it appears that in some cases the measurements helped define the goals, and the goals the problems. This sequence can contort problem definition, so that even the most successful program could end up addressing issues that are not -- or should not be -- of primary concern to the firm. It should be noted that in the process of program evaluation, employee attitudes were not considered in any of these cases. Furthermore, even where criteria for success and failure existed, cut-off points (at which definite decisions about adoption or abandonment of the program would be made) were seldom included in these criteria.

The importance of clear problem definition cannot be overstated.

Particularly in the cases where cost-reduction and quality-improvement were the objectives, clear definitions and applicable measurements appear to have been extremely helpful in getting the program accepted by the organization as a whole. Cases A1 and A3 illustrate the difficulties that can arise when these circumstances do not hold.

Among our cases, participatory and engineering programs are the most popular; this is particularly appropriate in a mature industry which is dependent mostly on a high quantity of high quality outputs. In general, the programs chosen fit relatively well with the problems perceived. For C1 and Q2, however, this was not the case, possibly because the programs may have been conceived before the goals were set and the problems defined. In this case, goals and problems appear to be functions of the program's capabilities, rather than responses to the actual needs of the firm.

The support systems designed to aid these programs were not particularly impressive in any of the cases. A3 changed its reward system to apply to groups, but none of the other firms modified their reward structures to help ensure program success. Management resistance was also evident in a number of the cases we studied. Middle-level managers and first line supervisors appear particularly reluctant to accept new programs that require new skills and attitudes. Further, managers tended to use measurements more as a control

FIGURE 3 -- Problems, Goals, Measures, and Programs

| | PROBLEM | GOALS | MEASURES | PROGRAMS |
|---|---|---|---|---|
| A1 | Corporate wants QWL | Have a QWL program running | None | QWL |
| A2 | Poor labor relations | Improve quality<br><br>Reduce grievances<br>Improve schedule attainment<br>People feel things are better | Rejects & scrap (% acceptance in batches)<br>Quality Index<br>Grievance rates<br>Schedule attainment | QWL |
| A3 | Opportunity to experiment | Provide enriched jobs | None | Job enrichment |
| A4 | Excessive grievance backlog | Settle grievances earlier | Grievance backlog<br>% settled at each step | Communications training |
| Q1 | Poor quality image | Improve quality | Customer complaints<br>Warranty costs | Quality improvement |
| Q2 | Poor profit performance | Improve performance by identifying and solving problems | None | QCs |
| Q3 | High rework rates<br>Recurring problems | Bring process under control | Rework & scrap rates<br>QI and COQ<br>Problems solved | SQC and QCCs |
| C1 | Threatened layoffs of engineers | Keep engineering jobs | Manufacturing costs | Cost Reduction |
| C2 | Poor profit performance | Cut costs 3% to 5% per year | Manufacturing costs | Cost Reduction |

than as a diagnostic tool. This problem reflects the general lack of clarity all along the line. It will reemerge in the paragraphs to follow.

The management of the programs themselves was not always placed in the most useful hands. In case Q3, the decision to bring in a new skilled and experienced person to run the program was clearly a wise one; the manager who had decided to implement the program would have been less able to garner the support necessary to make the program a success. Not all of the programs were so well run. Where a steering committee is designated to administer the program, it is important to keep in mind that success hinges on the continued involvement of all members of that group. In cases A1 and Q1, the withdrawal of active union support posed serious constraints on program success. An active steering committee provides the table for negotiations - a vital ingredient, especially when a union is involved.

The third phase is program testing -- pilots or other kinds of tests, to see how efficiently and smoothly the thing is likely to run. Seven of the ten cases examined here had or planned pilot programs. The reasons for these pilots were almost uniformly the desire to test, and a lack of adequate resources or certainty to put the program into full swing right off the bat. The pilot group was generally chosen on the basis of the severity of the problem, however it was defined, and the availability of volunteers to get involved in the program. One of the easiest ways to elicit volunteers is to time the program so as to coincide with a plant start-up or reorganization; this was done in two of the cases we studied. Similarly, it is helpful to juxtapose programs against product or process changes. Most of the programs we examined were set up with room to fail, as well as to succeed, whereever that was possible. In general, however, the programs in this study were responses to immediate problems. Unfortunately, this makes it difficult to define the issues clearly; whatever crisis prevails can bias the program's

design. Unfortunately, this is probably a wide-spread problem, since the implementation of new and innovative programs often requires more pressure than can be brought to bear in calmer settings.

The final stage of the implementation process is program diffusion. The basic data on the cases in this study appear in Figure 4. Only two of the original pilot programs in this study have been expanded to full-scale implementation; A2 and Q2. The rest have been scrapped or are still in testing stages; for some, expansion is planned in the near future. The relationship between the decision to expand a program and the reasons for piloting it in the first place is a mysterious one in the cases we studied. Two cases were piloted because of resource shortages -- Q3 and A4 -- but will not expand before measureable results are obtained. Another, Q1, was piloted to test its effects, but will be expanded before the test results are in. One can only gather that the reasons given for running pilots were inaccurate or spontaneous; they seem to have little to do with the diffusion of the programs in question. On the other hand, the choice of expansion sites appears to have been made on the basis of the same criteria as those for the pilots.

One of the most obvious difficulties involved in the programs studied here derived from the fact that they were not re-diagnosed <u>before</u> expansion to other sites. We found no modifications in the programs that were diffused. One of the reasons for this acceptance of the pilots as iron models may well have been the fact that the programs were generally flexible enough that they could have been transferred almost anywhere, and adapted accordingly. But it might also be just another reflection of the lack of concise definition of the initial problem.

FIGURE 4 -- Expansion Issues

| | EXPANDED? | DELAY | REASON FOR PILOT | RESULTS AVAILABLE? | SITE SELECTION CRITERIA | PUBLICITY? |
|---|---|---|---|---|---|---|
| A1 | Not yet | 1-2 mos (expectd) | Resource shortage | No | Volunteers | Upward only |
| A2 | Yes | 4 months | Test | Yes | Volunteers | Internal only |
| A3 | No pilot | ---- | ---- | --- | ----- | Internal & external |
| A4 | No | ---- | Test | ---- | ---- | ---- |
| Q1 | Not yet | 1 month (expectd) | Test | No | Volume of production | Internal only |
| Q2 | Yes | 6 months | Test | Yes | Volunteers | ---- |
| Q3 | Not yet | ---- | Resource shortage | Will be | ---- | Internal & external |
| Q4 | Not yet | ---- | Resource shortage | Will be | Problem severity | Internal only |
| C1 | No pilot | ---- | ----- | ---- | ----- | Internal only |
| C2 | No pilot | ---- | ---- | ----- | ----- | Internal only |

## Conclusion

The problems that plagued these ten productivity improvement programs can be narrowed down to six broad issues:

1. Fuzzy definition of the problem preceding a search for some solution (A1, A3);
2. Lack of attention to the creation of criteria to define successful or unsuccessful programs (A1, Q1, Q2);
3. Lack of measures to evaluate attitude improvement programs (A1, Q1, Q2);
4. A tendency to choose or develop programs that address the symptoms -- sometimes to the exclusion of the causes -- of the problems to be addressed;
5. Lack of clarity as to why a program is being piloted (almost all);
6. No rediagnosis of the problem before plans for expansion of pilots are made and/or put into action (Q3, A4, Q1).

The sequence of events recommended by the model discussed in the introduction required that first the problem be defined, then a program selected, next that program tested, and finally that it be expanded. It may have appeared to be a self-evidently logical progression of events, but as the case studies have illustrated, this sequence is not always followed. The result, of course, is that the programs fail to address the specific problems that called for a productivity improvement program in the first place, or that they speak to issues that may be related to, but do not directly cause low productivity. Thus, it is important to stress that problem definition must precede program selection, and that at all times the manager(s) charged with raising productivity through a program of this kind keep in mind exactly what they are trying to do, and why they are trying to do it.

Because "productivity" is such a big word, and because lots of people have defined it in lots of ways, it is relatively easy for a manager in charge of raising it to tackle the problem from such a high level of abstraction that no specific problems are addressed. There are a number of dangers inherent in this kind of approach. Most obviously, that the program will fail to obtain its objectives, because in fact it never had any clear objectives in the first place. Less obviously, but just as important, that the failure of the program to reap concrete results will lead to a wholesale rejection of the productivity improvement programs in general. American industries -- particularly mature industries -- can hardly afford to take this risk. By following the guidelines suggested by the six often obscured issues listed above, and by emphasizing clarity and constant definition of what is to be accomplished, the manager can maneuver a productivity program so as to avoid both of these dangers.

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