

ProMES as part of a new management strategy

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PROMES as Part of a New Management Strategy

Paul Janssen, Ad van Berkel, and Jan Stolk

THE SETTING: VANDRA CORRUGATED FIBREBOARD

Vandra Corrugated Fibreboard is a medium sized firm that produces corrugated packaging for a large variety of customers. It employs approximately 200 people, and 120 of them work in the production department, in two shifts. In a commercial sense, Vandra has prospered over the past decade. The number of people employed has almost doubled since 1983. Sales also have doubled, at least. Return on investment stayed at a level regarded as high in this field of operation. Despite its highly successful performance, Vandra changed its strategic business orientation in the late 1980s. Until then, Vandra operated in a way that is typical for this type of business. The company focused primarily on selling large numbers of packagings. Due to fierce competition among different manufacturers, profit margins on single packagings were fairly small, but by turning out large volumes, the company had been able to maintain good profits.

Now their view changed. Vandra decided that it would be much more profitable to focus on small orders, very short delivery times, and a flexible way of meeting customer demands, getting better prices in return. It is obvious that for such a change, a complete turnaround of the organization was necessary.

Until then, Vandra was a fairly traditional organization. Management decided that a new type of organization was necessary to accomplish their goal. Their ideal was a fairly flat organization, where responsibilities were handed down as much as possible to people on the shop floor and communication between management and the shop floor was direct and straightforward. With regard to quality, for example,

management was opposed to the idea of a separate quality control department. Management, the production manager most of all, was convinced that quality control should be an integral part of everyone's job. In their view, a separate quality control department would weaken attention and motivation for quality on the shop floor, because it would be viewed as other people's responsibility.

With regard to the process of change, management favored a gradual process of change over a drastic, one time reorganization. The concept of a "learning organization" appealed to them very strongly. They were convinced that it would be much better to allow people to adapt gradually to the demands of the new situation and to learn how to cope with it. This way, changes in the organization and procedures could grow in a natural way.

Management was also very much aware that existing values, such as keeping costs low, concentrating foremost on production speed, and following routine procedures without questioning them, had to be replaced by new ones. Flexibility, reliability, and meeting customer demands became much more important. Most of all, people all over the organization had to become aware of the impending changes, and they would have to learn how to incorporate these new values in their own job behavior.

Right at the time when management was pondering how to prepare people on the shop floor for these changes, Vandra's production manager met the senior author of this chapter, who had just acquainted himself with the ideas of Pritchard on performance management and enhancement. After an initial feasibility study, the author proposed to do a pilot project with ProMES in one of the production groups. The production manager agreed on the condition that he could find a group that was willing to engage in such a project on a voluntary basis.

For Vandra, the goal of this pilot project was to find out whether ProMES is effective in altering the attitude and working behavior of people on the shop floor and, thus, leads to improvements in the performance of production groups, ultimately resulting in higher productivity and improved quality. Right from the start, Vandra made it clear to everybody involved that there would be no direct link between ProMES and (individual) performance appraisal or pay.

For the research team of Eindhoven University, the project posed an opportunity to find out whether a system like ProMES could be applied in a Dutch organization. Actually, it was the first attempt to implement the system in Europe, so basic questions like Will the system work here? How will people react to the system? and How will ProMES fit in with the existing organization and its culture? predominated the research.

THE EXPERIMENTAL GROUP

The group of workers willing to try the system operated a die cut machine that produces various kinds of corrugated board boxes. It consisted of four people: a senior operator, an assistant operator, and two fellow workers. Their machine, called the "Cuir," after its French manufacturer, consists of two printing units and a die cutting unit. Sheets of corrugated board, produced by another department, are fed into the machine at the front end. After passing through the printing unit, they are fed into the die cutting unit, where they are cut and molded. At the end of the line, the cut and printed sheets are stacked according to customer specification and transported to the shipping department.

In a technical sense, the process is not very complicated. It is a fairly straightforward production process. In order to operate it in a profitable way, however, sound knowledge of the machine, speed, and accuracy are important.

The setup of the machine, in particular, is critical, because it is directly related to both quality and quantity of production. Each time a new order is produced, the machine setup has to be altered. This means changing the rubber stamps and the ink in the printing units, installing a new cutting form, and adjusting it to the die cutting drum. The average number of new orders in one shift was eight. At the start of the pilot project, the average time needed for the setup of an order was 22 minutes. During setup, production is halted. This means that, on an eight-hour shift, almost three hours of production time were spent on setup activities. Therefore, it is clear that short setup times are very important for good performance. Speed of setup, however, is not the only important factor. A thorough setup of the machine is crucial to the quality of the boxes produced as well as to the speed with which the group can operate the machine during the production run.

The die cutter is operated in two shifts. The crew of only one shift was involved in the project. The crew from the other shift made it very clear right from the start that they did not want to participate in the project and that they would certainly not take part in the development of the system. Despite their initially fairly antagonistic attitude to the project, the presence of an almost identical group created an opportunity for comparison between the two as a means to establish the impact of ProMES. We will come back to this later.

DEVELOPMENT OF THE SYSTEM

The development of ProMES was largely done by way of interactive group discussion (Pritchard et al., 1989; Pritchard, 1990). The design team consisted of all four of the machine operators, their supervisor, an assistant production manager, and two facilitators, one of them the

senior author of this chapter. Each week, one session of one and one-half to two hours took place, either right before the group started its shift or after they finished working. Operators received their normal hourly pay for the extra time that was spent on developing the system.

Initially, actual participation in the group discussions varied a great deal. The least educated and experienced operators especially had great trouble expressing their thoughts and ideas. At this stage the facilitators stressed the fact that ultimately the system should be "owned" by the group as a whole and, therefore, participation by all members of the group in the discussions and the decision making was of great importance. The facilitators often had to slow down the process and help clarify the reasoning of other members in order to keep the developmental process clear and make everybody understand the steps taken. All things considered, the development of ProMES constituted a slow but deliberate learning experience for all involved, including the supervisor, the assistant production manager, and the facilitators.

The frequent interactive group discussions and the difficulties the group had to overcome in order to develop a system everybody could agree with also had a clear team-building effect: people learned how to work together and solve problems as a team. The way in which the facilitators supported the process provided a role model for the supervisor and the group with respect to communication and problem solving.

The developmental process differed from the one Pritchard used in two respects. First, at the start of the formal ProMES meetings, the group listed various problems they encountered regularly in their daily work. These ranged from small technical problems to problems in coordinating their own efforts with those of other departments. Minor improvements were made with help from the production manager and the technical department. As this is something that occurs in most projects, but at a later point in time, it is not considered a major deviation from ProMES as Pritchard described it. We look upon these discussions as an integral part of the developmental effort. Actually, we are convinced that the initial problem analysis helped the group to share their knowledge and experience on the job and focus on the really important issues when they started to define products and indicators.

The second aspect in which the developmental process differed from Pritchard's was the extensive use of historical data in establishing contingencies. In order to balance effectiveness scores for different indicators, some financial calculations were made with regard to the economic value of indicator scores. The group used these data to corroborate the effectiveness scores they deducted themselves.

The development of ProMES for the experimental group took 22 meetings (approximately 40 hours), between April and October 1989. In November 1989, the system was operational. Although the number of meetings is fairly large, one has to take into account that for all

participants involved, this was the first attempt at introducing ProMES. Later, with other groups, the number of meetings was reduced a great deal. On the average, development of ProMES took 20 to 25 hours of interactive group discussion.

THE PRODUCTIVITY MEASUREMENT SYSTEM

The productivity measurement system the design team finally came up with was largely in accordance with the criteria Pritchard (1990) listed. Of five products, the most important were quality, speed of production, and effective use of machine time, the last being a product that is very much influenced by speed of setup. These are fairly conventional measures for a production group of this type. It is interesting to note that some of the indicators chosen were fairly gross measures of the responsibilities of the group. Some of them contained considerable variance that was beyond the control of the group. Speed of production, for instance, was partly dependent on the type of order the group had to produce and partly on the size of the order; both factors were beyond the control of the group. Attempts to take these factors into account in defining indicators showed, however, that to do this would result in a measurement system that was too complex and too difficult for at least some of the operators in the group. In order to keep the system simple and easy to comprehend, the design team preferred measures that were less than perfect in terms of controllability but easy to understand. For the facilitators, this was a difficult decision. Had the organization been planning to use the ProMES data in performance appraisals or decisions about pay, the facilitators would have been very reluctant to agree with such a decision. Vandra, however, had stated officially that there would be no direct link to performance appraisal and pay. To the facilitators, the decision of the design team was compatible with the goals of the organization. Therefore, in the end, they agreed.

Developing a valid, meaningful, and cost effective indicator for the product "Quality" initially posed a problem. As we mentioned before, management was opposed to a separate quality control function, which could have provided the necessary data. In the absence of these data, the design team decided on two other indicators for "Quality": the first, and most important, was the number of customer complaints, the second was the number of "internal complaints," that is, the number of times faults are made that are detected in time inside the organization so that they do not reach customers.

With regard to measurement of "Customer complaints," a technical difficulty did arise. Complaints often did not reach the company until several months after the date of production. Therefore, complete feedback on the performance of the group on this indicator could be given only after a long interval. This is contrary to the demands of

effective feedback (Kopelman, 1990). Feedback should be given within a couple of days after a production period ends, and it should be complete. All other indicator scores were available within a couple of days after the end of a period. The chosen solution was to leave the score for the indicator "Customer complaints" out of the report initially and give priority to the speed with which feedback is presented. Six months later, when, according to experience, all complaints could be expected to have reached the company, the effectiveness score for "Customer complaints" was reported to the group and added to the scores for all the other indicators for the month in which the order was produced. Thus, six months later, the feedback report is completed. (Although the score is added only after six months, the actual complaint is brought to the attention of the group immediately after it is reported to the organization and is analyzed and discussed by the group.)

Another point of interest is the type of feedback scores the group gets. After the indicators were defined and contingencies developed, it became clear that some effectiveness scores and the overall effectiveness score could vary substantially from one period to another. This was caused mainly by characteristics of the indicators chosen. For instance, fairly small differences on an indicator score like "Customer complaints" can cause large differences in effectiveness scores. Although we look upon this as true variance, reflecting true differences in performance, the facilitators were not sure how the group would react to this. They thought that large and sudden differences in overall effectiveness scores from one month to another could create the subjective impression that chance is a major factor. It could also induce the group to "explain" low scores in a way that is favorable to them.

One solution we considered was to reduce variances by lengthening the report period. A decision was needed whether to do this, thus, "diluting" the feedback, or to accept the large variances in monthly scores. In this case, the design team opted for a compromise: each month the overall score for that month is presented along with the progressive mean overall score for the last four months. The feedback report, thus, contains an overall effectiveness score for all indicators minus "Customer complaints" for the month that has just expired; an overall effectiveness score including "Customer complaints," lagging six months behind; and two progressive mean overall effectiveness scores, one for the imminent period and one for the period six months back.

Starting from November 1989, the group received a monthly feedback report. Each month this report is reviewed in a one-hour meeting in which the group itself, its supervisor, and the assistant production manager take part. Scores are reviewed, problems discussed, and solutions offered. Action and decisions are recorded by the group itself. Sometimes, if problems cannot be solved by the group itself, other departments or management is involved. Finally, management also

uses these meetings to inform the group of their plans and ongoing affairs.

THE RESEARCH DESIGN USED

The research design used to evaluate the effects of this pilot project on productivity was basically a times series design. For practical reasons, the inclusion of a baseline period after development finished and before feedback was given was not possible. There was no way in which the researchers could withhold feedback from management and the group once the system was completed. However, at Vandra, like at every other modern organization, a tremendous amount of information is gathered routinely on numerous aspects of performance. Inspection of the information recorded showed that it was possible, for research purposes, to calculate historical baseline scores on the five most important indicators. Only on two minor indicators were no data available, and at their maximum, these accounted for no more than 15 percent of the maximum overall effectiveness score. Throughout this chapter, where overall effectiveness scores are calculated and reported, both these indicators are treated as if their effectiveness scores were zero.

To evaluate effects of ProMES on productivity, effectiveness scores before, during, and after development of the system were calculated and compared. Scores for a period of one year before development started were calculated on the basis of historical data from production records. During development, scores were registered (but not fed back to the group). After feedback started, scores were available for a period of a little more than two years. At the end of 1991, there occurred many changes in the work and the organization of the experimental group. A second, technically improved "Cuir" die cutter was installed, the order package produced at the "old" die cutter changed, and half of the operators were transferred to the new machine. Although the group still uses ProMES, it does not make any sense to compare effectiveness scores before and after this point in time.

RESULTS OF THE PILOT PROJECT

The top half of Figure 3-1 shows the mean overall effectiveness scores for the experimental group (as a percentage of the maximum score) during the baseline period (one year), the developmental phase (eight months), and the feedback period (more than two years after completion). It is clear that productivity scores for the Cuir group increased significantly during the developmental phase and after completion of the system. To evaluate the impact on productivity, we calculated the effect size of ProMES, using the procedure Guzzo, Jette, and Katzell developed for their meta-analysis of productivity

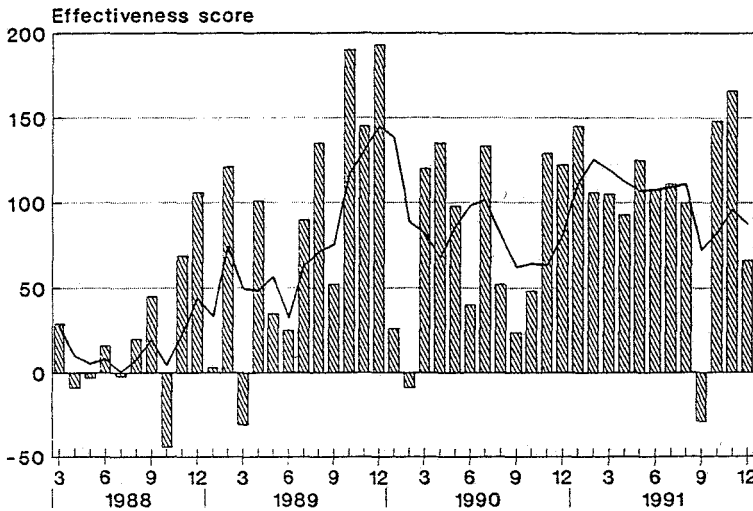
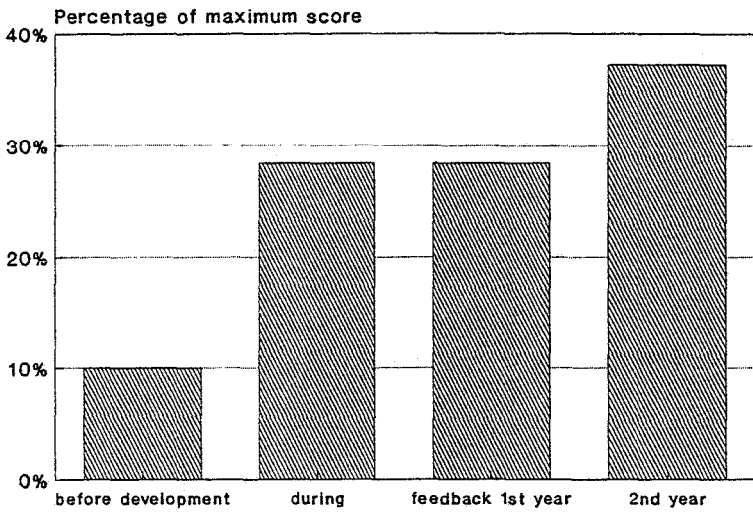


Figure 3-1 Mean Overall Effectiveness Scores for the Experimental Group

The top half of this figure depicts the mean overall effectiveness scores before, during, and after development of PromES; in the bottom half, the monthly scores from March 1988 through December 1991 are presented.

interventions (1985). The effect size was calculated relative to the baseline period before development of the system started. The effect size for the developmental period was 0.92; for the feedback condition, it was 1.24. The effect size for feedback relative to development was 0.22. Compared with effect sizes Guzzo and colleagues (1985) reported for different studies using feedback to enhance productivity, ranging from 0.08 to 0.62, these results look very favorable.

It is interesting to note exactly when and how these improvements occurred. The bottom half of Figure 3-1 depicts the monthly overall effectiveness scores for the experimental group from March 1988 until December 1991. From March 1988 to the end of February 1989 represents the baseline period; in March and April 1989, the group engaged in their initial problem analysis; and from May to October, development of the system was underway. Finally, in November 1989, the group was presented their first feedback report.

As the bottom half of Figure 3-1 shows, effectiveness scores improved rather dramatically during the final part of the developmental phase. After feedback was installed, scores dropped a little, but, on the average, they remained at a level higher than during either the baseline period or the developmental phase. The question is what caused these effects.

Let us first turn to the increase in scores during the developmental phase. A slope like the one depicted in Figure 3-1 could be regarded as evidence for a Hawthorne effect, learning, or role clarification (Locke & Latham, 1990). Although there is some evidence for all these causes, there appear to be two other important factors in play.

First, as was discussed before, in this case, the development started with a short, fairly general analysis of problems the group encountered in their normal work. Suggestions from the design team resulted in some structural changes regarding work practices and the organization of the work. Although we see this as an integral part of a ProMES project, one could argue that some improvements in productivity, in particular, in the first months of the project, were partly caused by actions taken as a result of this specific effort, not so much by goal setting and feedback.

Second, in the latter stages of the developmental process, something interesting happened. In field research like the Vandra project, one has to be aware of the ingenuity of people to obtain data pertaining to their performance once their curiosity is heightened by a project like this. There really is no way to prevent this. One could even actually argue that it would be unwise and demotivating to try to do so. In this project, there is evidence that after it became clear to the group what products and indicators would figure in their reports, they tried, successfully, to obtain performance data pertaining to these products and indicators. In a way, feedback started to be available some months before it was intended.

Next, we focus on the decline in effectiveness scores two months after formal feedback started. The explanation actually is fairly simple. As happens in field research, sometimes there are unexpected incidents and decisions that go against the goals of a project. In this case, the senior operator, who was officially in charge of the machine, was transferred to another group, along with one of his fellow workers. This happened on January 1, 1991. His assistant, until then the second in command, was promoted to first operator, and two new operators joined the crew. Although they were thoroughly introduced to ProMES and the job at hand, obviously, the group needed some time to regain their former level of proficiency. Actually, when asked, the newly appointed first operator stated that he willingly slowed down production to adapt to the level of proficiency of the new members of his team and that he took time off to instruct and train them on the job. It is obvious that under these circumstances, effectiveness scores should drop to a lower level. It is significant, however, that their scores for that year stayed well above the level before ProMES was introduced. Overall, management was very pleased with the way in which the new Cuir group performed in spite of personnel changes.

From a research perspective, we infer that long-lasting, consistent improvements in productivity were made by the experimental group as a result of developing and introducing ProMES.

HOW DOES ProMES WORK?

Next we turn to the issue of how different indicators contributed to this overall improvement. Inspection of the change in mean effectiveness scores on the three main indicators from baseline to feedback shows that the effectiveness scores on "Quality" improved by 55 points, on "Effective use of machine time" by 20 points, and on "Speed of production" by just 10 points. These findings show that improvements were not a result of frenetic work behavior but of better awareness and attention to quality demands and a more effective organization of setup activities. The indicators that changed most were those that were dependent on making intelligent decisions, anticipation, and maintaining high work standards. When asked, workers made it clear that they did not feel they were working any harder than before but that they felt more knowledgeable, involved, and responsible for their work. All this confirms Pritchard's (1990) summarizing statement that ProMES brings people to "work smarter, not (necessarily) harder."

We can highlight the way in which operators learned from using ProMES with a typical example. One month, shortly after feedback started, the effectiveness score of the group dropped remarkably when compared with their scores in the previous month. On inspection, it appeared that the indicator "Effective use of machine time" had dropped sharply. Further exploration brought to light that the machine

operator, who took pride in his job, had tried to overcome problems in setting up an especially difficult job all by himself. Instead of the approximately 18 minutes that it would have taken him normally, it had taken him almost four hours. In doing so, he had shown great persistence and a strong commitment to quality. His choice, however, was erroneous. As the feedback report showed, the indicator for production time had dropped sharply, and as a result, overall scores for that period were disappointing. In discussing this with the group and his supervisor, they came up with a better strategy to cope with future problems of this kind. Instead of going through all kinds of pain and trouble to do a good setup job, in the future, he should decide to put the order aside, start working on the next order, work out the problem with the difficult setup away from the production line, and put the job back on again after the problem was solved. ProMES stimulates such thinking about priorities by showing the impact of alternative decisions and strategies on overall effectiveness. It helps people to learn from mistakes and become more effective.

PRODUCTIVITY CHANGES IN THE ALTERNATE SHIFT

As mentioned before, the production at Vandra operates in two shifts. In addition to the experimental group, there is another group that operates the same machine in the other shift. Both groups are identical except for the fact that one group developed ProMES where the other refused to take part in the project. The second group initially showed a fairly negative attitude toward the experimental group. They refused to cooperate in attempts to change work practices. They even engaged in a fierce competition with the experimental group, trying to outperform them. The authors, therefore, decided initially that a control group design to evaluate the impact of ProMES on productivity was not feasible. However, as time went by, relations between the two groups improved and got back to normal. Therefore, a comparison of productivity data of both groups over a period of some years can give at least some evidence of the effects of ProMES. To compute effectiveness scores for the control group, we extracted indicator data for this group from company records and used the contingency functions developed by the experimental group to translate these into effectiveness scores. Figure 3-2 shows the "mean overall effectiveness scores" of both groups for the years 1988 to 1991. Remember that development of the system in the experimental group took place in 1989 and that the group started to receive feedback in November of that year.

In 1989 and 1990, both groups succeeded in improving their performance substantially. We partly ascribe this to the fact that the control group benefited from structural improvements that resulted from suggestions from the experimental group. However, improvements in productivity for the control group also partly were due to the fact that

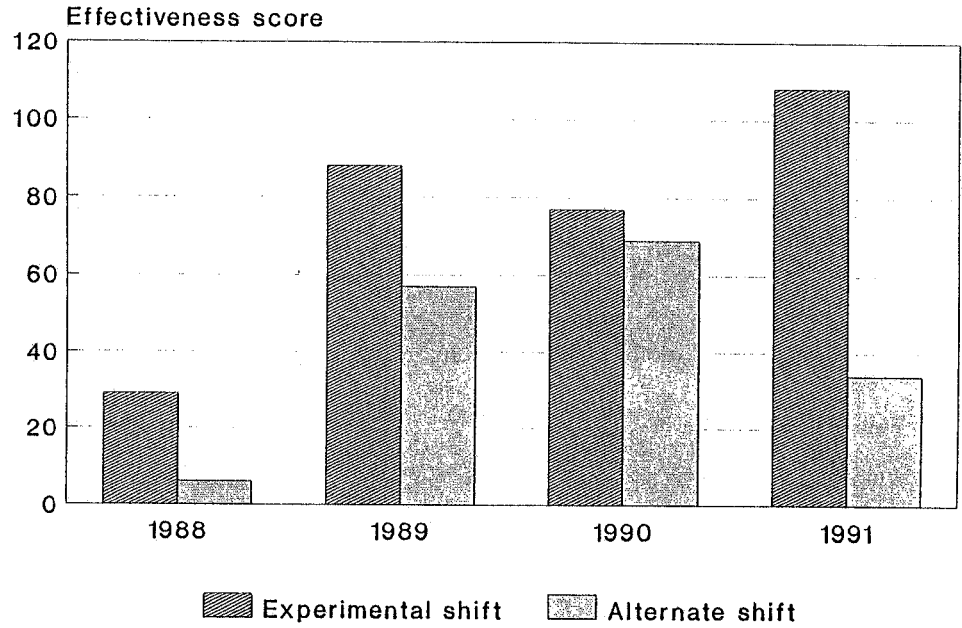


Figure 3-2 Mean Overall Effectiveness Scores for the Experimental Group and the Control Group from 1988 to 1991

they did their very best to outperform the experimental group. Later on, in 1991, with relations between both groups back to normal, the experimental group maintained their high level of performance, whereas the control group slid back to substantially lower effectiveness scores.

It is interesting to note that the two groups increased productivity in different ways. The experimental group improved in performance on "Quality" and succeeded in bringing down setup times. The effectiveness score on "Customer complaints" improved steadily from 16 points in 1988 to 79 points in 1991. The control group raised their productivity in a more traditional way: they exceeded previous standards of "Production Speed" by far, thus, turning out large volumes of production. On the negative side, their performance on "Quality" did not improve at all. The average effectiveness score on "Quality" for the control group was 16 in 1988, 0 in 1989, 16 in 1990, and 8 in 1991.

When interpreting these results, one should keep in mind that for the organization as a whole, "Quality" was a major strategic issue. Therefore, considering that the experimental group had to cope with personnel changes while the control group did not, both the improvement and the makeup of the effectiveness scores for the experimental group look very favorable.

SUBJECTIVE REACTIONS TO ProMES

One of the key elements of ProMES is the sense of ownership it creates in people at the shop floor. Because of the small number of people involved, we decided to evaluate subjective reactions of the operator group, their supervisor, and management through interviews. When asked, the operators revealed that they looked upon the system very much as their own. They stated that they felt much more involved, both with their own work and with the organization as a whole. As a result, there were frequent suggestions for improvements. Also, in their view, their performance as a team and communications with their supervisor and management had improved significantly. Both the operators and management stated that knowledge and influence in the group of operators were more equally shared than before ProMES. More important, these changes last. When asked in 1993, almost three years after the development of ProMES was finished, the group of operators working at this machine still expressed the same feelings and opinions about ProMES. Throughout the years, the group and the operators transferred to other groups have acted as ambassadors for ProMES in other parts of the organization.

We also asked the people involved how they evaluated the developmental process. Those who were engaged in the process state that it was a fairly difficult task. To them, concepts and instruments used in ProMES were not easy to understand completely, partly because they

are not used to abstract reasoning. Because the facilitators thought that the developmental process took rather long, they asked the group whether they would have preferred a faster and less time-consuming approach. This they denied unanimously. Their feeling was that a shortened or more compact approach would have provided less understanding and less working knowledge of the system. Both management and the supervisor shared their opinion.

AN ECONOMIC EVALUATION OF RESULTS

For organizations like Vandra, statistical significance or a large effect size, criteria often used in psychological research, is not enough to justify the amount of energy, time, and money required for a project like this. A project aimed at increasing productivity has to show sizable economic effects. Therefore, we evaluated the project also from this angle.

First, let us turn to the costs of the project. Roughly estimated, the development of ProMES for the experimental group took 40 hours. Because development took place after normal working hours, there was no loss of production time. Extra hours were paid at the normal rate; no overtime allowance was given. In operator wages, the costs were approximately \$3,100. Although the supervisor and the assistant production manager participated in their normal working hours, it is fair to calculate their time also. Expressed as wages, this amounts to another \$2,500. In this case, because of the nature of the pilot project, the facilitators did not charge the company. The net time investment for one skilled facilitator would normally amount to 60 hours, and in external consulting fees, this would mean an extra \$5,000. Total investment would be somewhere around \$10,600.

Next, we calculated the financial benefits from the pilot project. The method we used is called Activity Based Costing. First, we calculated the economic value of scores on each of the indicators. From there, it is easy to calculate the economic value of changes in indicator scores attributed to ProMES. Elaborating on this approach, we also calculated the value of a change of one unit on the effectiveness scale for each of the different indicators. Our results show that, by and large, an improvement of one unit on the effectiveness scale equals \$90 in productivity gains per month. There are no huge differences in this respect among different indicators. We interpret this as an economic validation of contingency functions in the system. With regard to the economic value of productivity improvements brought about by ProMES, according to our calculations, the productivity improvement of just over 90 points in effectiveness scores, which was the mean improvement over 1989 to 1991, represents an economic value of \$8,200 each month. Considering the relatively small investment that was needed, the results are fairly convincing.

However, some caution is necessary when interpreting these data. An Activity Based Costing approach enables only a fairly limited view of the real benefits, because it does not take into account profits (or losses) generated by the company as a whole. If, for instance, ProMES leads to increased productivity of the Cuir group and if the excess capacity that is generated that way is used to produce more orders or to put people on other tasks, then revenues of these activities could be considered profits resulting from ProMES. If, on the other hand, the excess capacity is not put to use, there is really no extra profit gained from the project. That is why a broader perspective is needed to evaluate the economic consequences of an intervention like ProMES.

A promising but rather complex solution to this problem is an evaluation based on a Cash Flow Model. We are planning to use such a model in future evaluations at Vandra and have been engaged in some preliminary research.

EXTENSION OF ProMES INTO THE ORGANIZATION

As a result of positive evaluations of ProMES at the Cuir, Vandra decided in 1990 to extend ProMES to other production groups and the shipping department. Sufficient data for evaluation are available for a total of eight groups, the Cuir group included. Figure 3-3 shows the mean cumulative overall effectiveness scores, expressed as percentage of the maximum score for these eight groups, before, during, and after development of ProMES. A period of one year before ProMES was introduced serves as a baseline period. Development extends over a period of four to six months, depending on the group. Data on the feedback condition cover a period of one year.

Overall, these scores follow the same pattern as the scores for the experimental group. Although improvements in productivity vary from one group to the other, the data show a clear increase, both during development and during feedback. The mean effect size for the change from the baseline to the feedback condition for these seven additional groups is 1.67. One group shows a small negative effect size of -0.30 . For the other groups, the effect sizes are 0.80, 1.39, 2.04, 2.09, 2.58, and 3.11. The negative effect size is caused mainly by an industrial accident the group encountered recently and by high turnover in the original group just when feedback started. Although the scores for this group also show a clear positive trend in general, the weight of their score for safety is such that the overall effect size drops significantly.

In early 1993, by chance, a very unexpected and interesting possibility for research arose. At that time, Vandra installed a new management information system, developed by an external agent. As it happened, the new system did not function properly in the beginning. For a period of four months, no productivity data were available, so, temporarily, no feedback to the ProMES groups was possible.

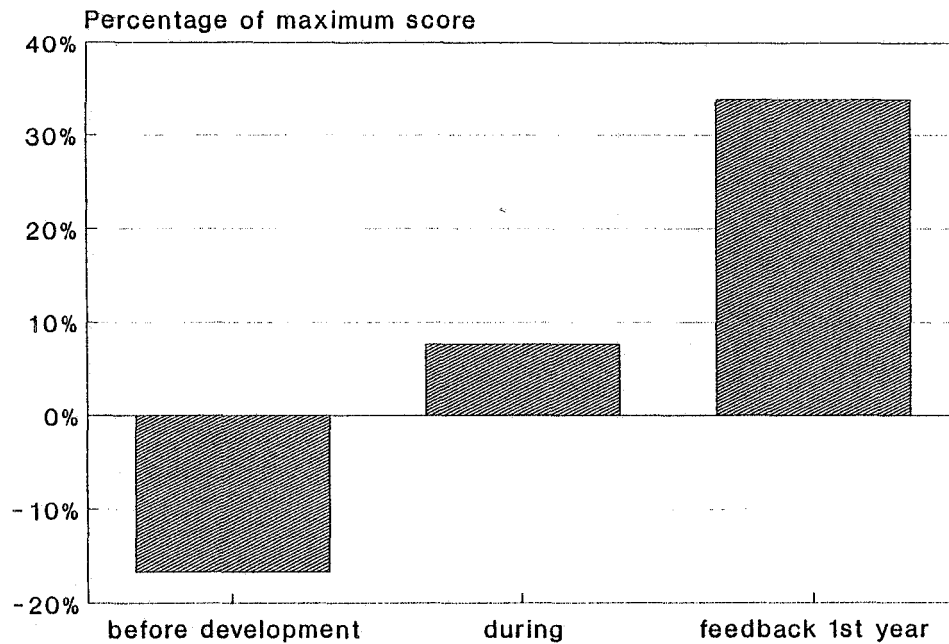


Figure 3-3 Cumulative Overall Effectiveness Scores for Eight Groups Before, During, and After Development of PromES as a Percentage of Maximum

Thereafter, normal feedback was resumed. Afterward, we were able to calculate effectiveness scores for the period that no feedback was possible from company records. Thus, we were able to monitor changes in productivity as a result of withholding feedback to the groups. In 1992, with feedback provided on a monthly basis, the mean cumulative overall effectiveness score for the ProMES groups was 620 points. During the breakdown of the system, this score dropped to a mean of -80 points. After feedback was resumed, the cumulative score over the next four months went up again to 428 points. It is important to note that no other major changes took place during this time, so, most of the changes can be attributed to lack of feedback.

From these data, we conclude that feedback played a major role in creating the productivity improvements we reported above. The effects of learning and increased role clarity, although evident, seem limited, because all groups did use ProMES for at least one year when feedback was intermittent and neither the level of proficiency of the operators nor the clarity of their role changed.

VIABILITY OF ProMES

In 1993, four years after the first experimental group started, ProMES is still expanding in the organization. At this time, ProMES is operational in 11 groups. In two more groups, development is almost done. With only two other groups remaining, almost all of the production groups use ProMES. In addition, development is planned in the model making department and, possibly, some groups in sales.

Meanwhile, the company is changing in the direction management has planned. Gradually, the work in the production department is getting more difficult and complex. The number of hierarchical layers in the organization is reduced. Interaction between different departments is much more dynamic and open than it was five years ago.

In a series of interviews the authors recently held, people all over the organization expressed their commitment to ProMES. Because of changing demands, existing ProMES systems will be up for a systematic review in a couple of months.

CONCLUSIONS AND FINAL REMARKS

From the results of this project, we conclude that ProMES can lead to substantial productivity improvements. It is obvious that the system can be applied in Europe as well as in the United States. In general, people react favorably to ProMES. It is also evident that ProMES, as it is used at Vandra, is a fairly complex organizational intervention. There seem to be a lot of causal factors in play, which, together, create a strong positive effect on productivity.

Learning seems to be an important factor early on in the process. There is also some evidence for a Hawthorne effect. Both factors, however, can explain only a small part of the improvements in productivity.

More important is the fact that by taking feedback reports as a starting point for analysis and problem solving activities, the ProMES groups are able to suggest substantial improvements with regard to working methods, the organization of their work, and the way they interact with other groups or departments. We attribute these effects to ProMES.

Feedback seems to be a major factor. As soon as feedback was available to the experimental group, productivity started to increase. The decline of effectiveness scores when feedback was omitted during the breakdown of the management information system and the quick recovery when feedback was reinstalled are rather strong signs that feedback as provided by ProMES causes productivity improvement in itself.

Apart from direct productivity improvements, but, for many organizations, at least equally important, is the effect ProMES can have on the attitude and the working behavior of the work force. Organizational communication and coordination also are improved. There is a better understanding of interdependencies among different groups in the organization. Operators are more aware of the way in which other groups affect their performance, and vice versa. When necessary, they communicate their preferences and their demands to other groups, either directly or through their supervisor. Thus, ProMES triggers improvements in intergroup relations and communication.

For management, regular ProMES meetings constitute an important communication channel, especially when the supervisor plays an active part in linking discussions to broader organizational issues. Especially when organizational change is needed, companies often encounter great difficulties in getting the message down to the shop floor and explaining how these changes affect the work of every day. In this project, ProMES has proved to be of great help in this respect.

A word of caution is also in place. According to our experience in this project, ProMES is not a technique that guarantees success in an easy way. It takes a lot of commitment and effort from people on the shop floor, supervisors, and management to get the system going. Once installed, constant effort is needed to keep the system alive. Organizations have to be willing to commit themselves to ProMES and integrate the system in their day-to-day business to get results.

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