Received November 2004
Accepted February 2005

The effects of goal setting and feedback on manufacturing productivity: a field experiment

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Abstract

Purpose – To describe the conduct and outcomes of a field experiment in a US manufacturing facility using goal setting and feedback as productivity improvement tools.

Design/methodology/approach – Initial studies were conducted to determine a baseline of performance. A two-month field experiment was utilized to test and measure productivity. The field experiment involved the implementation of changes to three manufacturing cells for a six-week period and the training of supervisors and staff. Researchers performed the collection of data, implementation of changes and training of workers.

Findings – Findings suggest that goal setting and timely feedback will lead to improved work performance, greater efficiency, and the establishment of more challenging goals. In addition, findings suggest that information systems which facilitate goal setting and feedback are more effective than traditional supervision systems at improving performance.

Research limitations/implications – Several limitations of this study should be noted. First, the time frame for the intervention was limited to two months. A longer data collection period could ensure the longevity of the conclusions of this analysis. Second, all subjects received verbal feedback followed by the addition of graphic feedback. Therefore, sequence effects cannot be ruled out. On an overall basis, though, the findings of this study can clearly be applied to a wide range of manufacturing organizations

Practical implications – The study is useful for all managers seeking a competitive advantage through improved productivity. It provides significant insight into ways to improve productivity through the use of goal setting and performance feedback implemented by information systems.

Originality/value – This paper fulfills a need for insight into methods for improving productivity, as well as offering practical aid to managers in the manufacturing industry.

Keywords Manufacturing industries, Feedback, Productivity rate, Operations and production management

Paper type Case study

Introduction

Modern manufacturing organizations are operating in a globally competitive environment, which mandates continuous improvement. Manufacturing is currently faced with the conflicting pressure to reduce costs while also improving customer satisfaction and service as well as pressures of cost reduction, improving cycle-time, and quality improvement in order to get better results (Campbell, 2004; Longenecker and Simonetti, 2001). Opportunities for productivity improvement through improved labor efficiency and reduced production loss are critical to organizational survival and

International Journal of Productivity and Performance Management
Vol. 55 No. 3/4, 2006
pp. 346-358

1741-0401
DOI 10.1108/17410400610653273

these efforts can be driven through a host of productivity improvement initiatives (Longenecker and Stansfield, 2000; Longenecker *et al.*, 1997).

The domain of goal setting and feedback has been shown to be one such opportunity for improvement, but techniques to implement these practices have not been popular or commonly implemented in manufacturing at the shop floor level (Locke and Latham, 2002). Research has generally been conducted in the laboratory, with occasional field experiments. Nevertheless, few field experiments for this stream of research have been performed in actual discrete manufacturing settings.

Goal setting and feedback have been proven to improve productivity (Locke and Latham, 2002) and in general, the following is true:

Performance goal setting + specific performance feedback = productivity improvement.

Goal setting has been extensively researched to show improved performance. Laboratory research studies involving simple and complex tasks have shown performance improvement in simple problem solving, learning and other student experiments (Locke and Latham, 2002; Locke, 1982; Locke and Shaw, 1984). Research in manufacturing settings has shown that goal setting improves productivity in productivity cells, logging, managerial objectives and total production output (Renn and Fedor, 2001; Locke *et al.*, 1981; Longenecker *et al.*, 1994).

One important component of goal setting rarely addressed within a manufacturing field experiment is feedback, yet the components for feedback are commonly measured and available in manufacturing situations. Feedback has also been studied primarily in laboratory settings and has shown to increase the levels of goal setting and to result in higher levels of motivation (London and Smither, 2002) and other performance enhancing behaviors. In general, feedback can provide information about the type, extent and direction of errors so that they can be corrected (Forza and Salvador, 2000). Given that it is a person's knowledge of his or her performance in relation to a standard that influences the subsequent amount of effort exerted and his overall performance level, it is reasonable to conclude that both a difficult goal and knowledge of progress towards the goal are needed in order to maximize performance improvement. By isolating these benefits separately, implementation methodologies and anticipated results can be developed for manufacturing.

Why hasn't goal setting and feedback been viewed as the panacea of manufacturing problems like MBO, MRP, JIT, TQM, self-directed work teams, kaizen, lean, six sigma and other "fad of the day" solutions to a competitive manufacturing environment? Although goal-setting and feedback have been utilized for productivity improvement in manufacturing (Latham and Yukl, 1975), it has not caught on like other management tools because a structured technique capable of responding to the ever-changing products, processes, markets, design changes etc. (Doll and Vonderembse, 1990), has not been blueprinted, tested or supported within the manufacturing arena (Jessup and Stahelski, 1999).

Another shortcoming with the extensive line of research is creating a systematic linkage to manufacturing. Although some field experiments in manufacturing situations have been completed, the methodology of goal setting and feedback has not been the focus of significant documentation or inquiry. The actual methodology of intervention has not been defined, nor have alternative methodologies been tested. Clearly, goal setting and feedback as an intervention have been defined in research, but

no systematic approach to implementation in manufacturing has been shown that could ultimately become the model for varied manufacturing applications.

Computer enhanced systems and procedures are rapidly emerging for all manufacturing operations (Arunachalam and Bonita, 1996) and are logical tools to provide feedback information on performance. Current information system models to date have focused on the feedback side, not the goal setting side. Yet, research has shown that the motivational affect of feedback is really due to goal setting (Locke *et al.*, 1968). It seems evident that a computer system that encouraged goal setting and provided feedback should be a required tool for manufacturing. Latham and Locke (1988), arguably the most noted researchers in the goal setting and feedback field, have specifically indicated that one opportunity for further research is to discover what type of feedback is most effective in the goal-performance relationship. A scientific approach to examine this knowledge privation is the focus of this applied manufacturing research study.

Researchers contend that goal setting and feedback improve performance and therefore improve an organization's capacity to compete. Locke and Latham (2002) have clearly defined that one weakness in the current research is the type of feedback that is most effective. Furthermore, the global competitiveness of manufacturing has propelled organizations to accept the challenge of using every opportunity for productivity improvement.

Thus, the general use of feedback through decision support systems regarding direct labor performance and self-set group goal setting needs to be empirically tested on the shop floor. As stated by Locke and Latham (1990), the effective methods of feedback also offer tremendous opportunity for research. For these reasons, this field experiment is designed to measure productivity improvement through goal setting and feedback using several methods of intervention.

The research question to be answered in this field experiment is as follows:

RQ1. To what extent can a manufacturing work cell utilizing an information system, which enhances goal setting and provides specific performance feedback to the employees, improve productivity?

Given this background, four hypotheses emerge that will be tested in this field experiment:

H1. Employees in a manufacturing work cell utilizing goal setting and given timely feedback on the actual duration of changeover time and productivity level will reduce the changeover time and improve performance compared to employees in a manufacturing work cell not utilizing goal setting or given timely feedback.

H2. Employees in a manufacturing work cell given timely feedback and goal setting on their actual production efficiency will improve their efficiency over time.

H3. Employees in a manufacturing work cell given a decision support system to facilitate goal setting and providing timely feedback on actual production efficiency will establish more challenging goals than a group provided the same information through a manual system and provided similar support.

H4. A decision support system facilitating goal setting and feedback on actual production performance is a more effective tool than traditional supervision intervention leading the goal setting and feedback effort.

Applications to manufacturing, methods of feedback, and predictive levels of improvement are the goals of this field experiment that will be tested.

Research methodology

A field experiment was designed to test and measure productivity improvement over a two-month period in a manufacturing setting. This involved initial studies to determine a baseline of performance, implementation of changes to three manufacturing cells for a six-week period and some training of supervisors and staff. The researchers performed the data collection, training and implementation efforts.

Subjects

This study was performed in a traditional manufacturing plant in the midwestern USA. The plant employs 310 direct labor people and produces wood frames for the furniture industry. The manufacturing cells were identical in process capability and are contrived of stand-alone CNC machining centers, which produce 150 similar product variations. Each cell produces any of the frames depending on the current schedule requirements. Individual operators work in each of the three cells across three shifts. This production make-up allowed us to hold one group as a control group and introduce interventions into the other two. The three shift operation allowed us to run three equal experiments simultaneously.

Each manufacturing cell was assigned with one individual to run the total operation. With three cells operating on three shifts, the total number of individuals assigned to this experiment was nine. These individuals will be referred from to here on as the team members. These team members consisted of eight males and one female. The average age of the team members was 28.7 years with the range being from 19 years to 38 years. Although all of the experimental groups were essentially the same, the three resulting groups were the control group which received no intervention, the supervisory group received goal setting and feedback facilitated by the supervisor and a public tracking board of daily performance, and the information systems group received goal setting and feedback facilitated by an on-line decision support system controlled by the individual cell members.

Study design

This study utilized three CNC manufacturing cells. These three cells were labeled A, B and C and observations were made on each of three shifts resulting in nine cells total. To ensure no experimental biases due to the cells selected for intervention, Cell A was the control group on the first shift, the information systems intervention group on second shift, and the supervisory intervention group on the third shift. Cells B and C followed the same plan.

Table I summarizes the group breakdowns for this experiment. A total of nine groups were evaluated with pre-test and post-test data collection. The first set of three groups was the control group with all production procedures (mediating and moderating variables) held constant, as well as the feedback of appropriate

performance measures. This group did not set goals of performance during the experiment. (This was the current method of production.) The second and third sets of three groups had goal setting (GS) and feedback (FB) introduced as an intervention to improve performance.

The first group defined was the "control" group. No intervention regarding additional feedback, goal setting or training other than what they had been getting prior to the experiment was provided to this group during the entire experiment. *The "supervisor feedback" intervention group* utilized traditional manual techniques of tabulating performance and posting results for the team. Within-group knowledge of results was allowed but not between the different intervention or control groups. The measures of feedback included total up-time and total performance against standard. This team received initial training regarding how to compute the productivity measurements and how to post the information on the board.

The "information systems technology" intervention group was provided on-line feedback regarding performance. This feedback involved user interaction to enter information regarding pieces completed, as well as identify when set-ups, breaks and lunch periods were started and ended. The system utilized the computer's internal clock to track these times and computed the productivity performance. The computer also tabulated goal-setting performance. This also enhanced the goal setting effort through more timely feedback and evaluation of goal setting improvement levels. The information system was on the shop floor and utilized by the workers. Training was provided during the initial stages of implementation to ensure operator proficiency utilizing the system.

Procedure

The first group served as the "control group" for the entire experiment period. An eight-month history of production information was collected for all groups. This established a baseline of comparison for all groups before the intervention. The intervention period was two months and data was collected daily for each of the nine groups in the experiment during this intervention period.

The "supervisory feedback" intervention group received traditional feedback and goal setting through the supervisor. The supervisor was trained and scripted to provide daily feedback regarding the performance of the previous day's work. This feedback was given during the first few minutes of each shift. The supervisors also directed (but did not dictate) the weekly goal setting sessions during this same morning meeting. The supervisor's role was to facilitate the data and present the results to the cell.

In the "information systems feedback" intervention, the supervisor's feedback was replaced with an on-line information system. This PC-based system provided feedback to the operator at any time during the shift. The operator entered his or her own

Table I. Group breakdown

Production shift	Cell A	Cell B	Cell C
Shift one	Control group	Supervisory GS and FB	Info systems GS and FB
Shift two	Info systems GS and FB	Control group	Supervisory GS and FB
Shift three	Supervisory GS and FB	Info systems GS and FB	Control group

performance data with measurements being immediate. The system directed goal setting by evaluating goals on level of improvement. This system was totally operator controlled. Specific training regarding the systems use was provided during the initial phase of this experiment.

Measures

The measures of performance were labor efficiency (pieces per shift), set-up and changeover time, down time and interference time. Each manufacturing cell measured performance against standard based on the number of units produced and the time available for production. This information indicated that little variance among cells existed regarding performance against standard. The dependent variables in this experiment were production up time and pieces produced against standard. The production for each of these nine cells was interchangeable and the measures of performance were consistently measured in the following format: PROD $\times$ STD = EH, where PROD equals the number of pieces produced, STD equals the standard hours per piece allowed, and EH equals the earned hours.

The total production for each product (PROD) was summarized at the end of the shift and a total number of earned hours (EH) were calculated using the standard hours (STD). This number of earned hours was divided by the number of hours available (typically 8.0) for the shift and the ratio was the daily productivity for the shift (i.e. 6.0 hours earned divided by 8.0 hours available resulted in a 75.0 percent efficiency for the shift). The total production had always been tracked on a daily basis by shift and machine. However, the calculations of productivity were through a mainframe MRP system and feedback and summary results were calculated and presented monthly. Therefore, the daily production sheets for a six-month history of performance for these cells were gathered and daily productivity was measured as a baseline for each of the cells in this experiment.

The results indicated no difference among cells across the three shifts during the baseline performance period. The control group in each of three cases did not change significantly following the intervention period. The goal setting with supervisory assistance cells improved significantly during the intervention period. The goal setting facilitated by information systems cells each improved significantly and more than the supervisory assisted cells.

Results and discussion

The intent of this research was to develop a model of efficient and effective goal setting and feedback practices for manufacturing. Effectiveness and efficiency were used to make an overall assessment of the independent variable, which was the productivity measurement and improvement system process. The independent variable had three levels of treatment - baseline, feedback plus goal setting directed by the supervisor, and feedback plus goal setting directed through a shop floor decision support system.

Baseline data results

An eight-month history of performance was collected for each of the nine cells in this experiment. Table II summarizes the baseline performance for each production cell.

As indicated, the average productivity rate was 55.5 percent daily. The variance between shifts was primarily due to the level of experience and support that cell

Shift	Group description	Mean productivity (%)	Std dev. (%)	$F_{0.05}$
One	Control group	55.1	9.2	
One	Supervisor – GS and FB	56.8	11.2	
One	Info systems – GS and FB	54.9	11.7	0.430
Two	Control group	56.1	7.9	
Two	Supervisor – GS and FB	56.2	9.4	
Two	Info systems – GS and FB	55.5	7.1	0.172
Three	Control group	55.3	12.1	
Three	Supervisor – GS and FB	54.9	12.2	
Three	Info systems – GS and FB	54.3	11.1	0.391
Total		55.5	10.2	

Table II.
Baseline performance by cell

received. Each cell's performance was compared to the control group's performance on that shift. ANOVA was performed to ensure each group of comparison was the same. This analysis provided $F_{0.05}$ values of 0.43, 0.17 and 0.39. The performance was not significantly different between each shift within a 0.05 level of confidence.

Intervention data results

All of the performances were summarized following the experimental period. A summary of each group's performance is shown in Table III.

As indicated in Table III, the average performance for the control groups after the intervention was 53.9 percent. Each of the cell's performance was compared to the control group's performance on that shift. ANOVA was performed to evaluate if any significant difference before and after intervention could be determined. This analysis was completed for each of the three groups individually. This analysis provided $F_{0.05}$ values of 0.15, 0.09 and 1.19. The performance is not significantly different within each shift at a 0.05 level of confidence. This established that each control group's productivity did not significantly change during the experimental period.

The average performance after the intervention was 61.2 percent for the groups that received the supervisory goal setting and feedback intervention. Each of the cell's

Shift	Group description	Productivity pre-intervention (%)	Productivity post-intervention (%)	Difference (%)	$F_{0.05}$
1	Control group	54.8	55.1	0.3	0.15
2	Control group	55.4	54.6	−0.8	0.09
3	Control group	56.8	52.1	−4.7	1.19
Total	*Control cells*	*55.7*	*53.9*	*− 1.7*	
1	Supervisor GS and FB	55.8	60.9	5.1	1.64
2	Supervisor GS and FB	56.1	61.3	5.2	4.46
3	Supervisor GS and FB	57.2	61.3	4.1	2.05
Total	*Supervisor cells*	*56.4*	*61.2*	*4.8*	
1	Info systems GS and FB	55.2	66.2	11.0	4.18
2	Info systems GS and FB	55.9	64.6	8.7	10.86
3	Info systems GS and FB	57.8	67.0	9.2	8.14
Total	*Info systems cells*	*56.3*	*65.9*	*9.6*	

Table III.
Intervention performance by cell

performance was compared to the control group's performance on that shift. ANOVA was performed to evaluate if any significant difference before and after intervention could be determined. This analysis was completed for each of the three groups individually. This analysis provided $F_{0.05}$ values of 1.64, 4.46 and 2.05. Although the performance of each of the three groups had improved over the intervention period, only the second shift group had improved significantly within a 0.05 level of confidence. The conclusion made from this analysis was that the supervisory directed methodology for goal setting and feedback improved the productivity for one of the three manufacturing cells. A longer period of performance is required before the other two cells will be significantly improved.

The average performance after the intervention was 65.9 percent for the groups that received the information systems goal setting and feedback assistance. Each of the cell's performance was compared to the control group's performance on that shift. ANOVA was performed to evaluate if any significant difference before and after intervention could be determined. This analysis was completed for each of the three groups individually. This analysis provided $F_{0.05}$ values of 4.18, 10.86 and 8.14. The performance of each of the three groups improved over the intervention period significantly within a 0.05 level of confidence. The conclusion made from this analysis is that the information systems directed methodology for goal setting and feedback improved the productivity for all of the three manufacturing cells.

Further analysis was performed to evaluate the difference between the two groups of cells that received the intervention. The average performance of the information systems group was 4.8 percent better improvement than the supervisory groups. ANOVA was performed to evaluate if any significant difference between these two groups could be determined. This analysis was completed for each of the three groups individually. This analysis provided $F_{0.05}$ values of 4.93, 6.94 and 3.94. Although the performance of each of the six groups had improved over the intervention period, this analysis showed clearly that information systems supported goal setting and feedback was a superior method. This was shown within a 0.05 level of confidence.

Analysis of hypotheses

Four hypotheses were actually tested in this research and were evaluated individually to identify specific improvement strategies to enhance manufacturing performance. This research has shown that significant productivity improvement was achieved during this experiment using goal setting and feedback. *H1* addressed the potential reasons for the productivity improvement within the individual intervention cells. *H2* compared the level of productivity and the level of goal setting for the intervention cells with the control group. *H3* and *H4* compared the productivity level between the two sets of intervention groups.

H1. Employees in a manufacturing work cell utilizing goal setting and given timely feedback on the actual duration of changeover time and productivity level will reduce the changeover time and improve performance compared to employees in a manufacturing work cell not utilizing goal setting or given timely feedback.

The preliminary study of the work cells in this experiment has indicated that the operators perform their own changeovers during the shift for scheduled product

changes. These changeovers occur one to three times daily and are scheduled to take approximately 30 minutes. These same operators have to contend with interferences that can delay these changeovers. These interferences are under the control of the operators. The measurements of this experiment are testing the hypothesis that the work cells that get feedback regarding these time losses due to changeovers actually reduce these losses.

The results indicated that these cells did significantly improve their production changeover time delays significantly. The first two weeks of data collection and feedback regarding this time were averaging 120.2, 118.2 and 111.5 minutes of delay per day at the beginning of the shift respectively for the three information systems intervention groups (these groups combined were 117.2 minutes of set-up time per day). The last two weeks of data collection and feedback regarding this time were averaging 96.4, 114.5 and 99.2 minutes of delay per day at the beginning of the shift respectively for the three information systems intervention groups (these groups combined were 102.1 minutes of set-up time per day). This change was significant at $p < 0.05$. Therefore, *H1* is supported.

H2. Employees in a manufacturing work cell given timely feedback and goal setting on their actual production efficiency will improve their efficiency over time.

As a result of the operators in the two cells receiving the intervention, they were expected to control the interferences within their operation that were under their control and ultimately to improve production efficiency. Essentially, the two cell groups, which received the intervention, should improve their performance against standard. The measurements of this experiment were testing the hypothesis that the two work cell groups that get feedback regarding their performance would improve their performance.

As previously indicated, the average performance after the intervention was 61.2 percent for the supervisory groups and 65.9 percent for the information systems groups. Each cell's performance was compared to the control group's performance on that shift. ANOVA was performed to evaluate if any significant difference before and after intervention could be determined. This analysis was completed for each of the three groups individually. This analysis provided $F_{0.05}$ values of 4.46 and 2.05 for the supervisory groups and 4.18, 10.86 and 8.14 for the information systems groups. The performance of each of the six intervention groups had improved over the intervention period but only four had improved significantly within a 0.05 level of confidence. The conclusion made from this analysis is that the information systems directed methodology for goal setting and feedback improved the productivity for all of the three manufacturing cells. Based on this analysis, *H2* is supported.

H3. Employees in a manufacturing work cell given a decision support system to facilitate goal setting and providing timely feedback on actual production efficiency will establish more challenging goals than a group provided the same information through a manual system and provided similar support.

Each of the intervention groups established weekly goals of performance. The supervisory intervention groups established the same goal for the entire eight-week period. This goal was 75 percent productivity. This goal did not change over the

experimental period. The information systems groups established goals of 80 percent, 85 percent and 85 percent respectively for each shift. These goals also did not change over the eight weeks of intervention. Although the information systems group did not change over the period of intervention, the goals were higher than the supervisory goals; thus, *H3* is supported.

H4. A decision support system facilitating goal setting and feedback on actual production performance is a more effective tool than traditional supervision intervention leading the goal setting and feedback effort.

The measurements of this experiment were testing the hypothesis that the work cells that received feedback regarding their overall performance through the information system would perform better (more production against standard) than the intervention group utilizing the manual system. As previously indicated, the average performance of the information systems group was 4.8 percent better improvement than the supervisory groups. ANOVA was performed to evaluate if any significant difference between groups could be determined. This analysis was completed for each of the three groups individually. This analysis provided $F_{0.05}$ values of 4.93, 6.94 and 3.94. Although the performance of each of the six groups had improved over the intervention period, this analysis shows clearly that information systems supported goal setting and feedback is a superior method. This is shown within a 0.05 level of confidence and, therefore, *H4* is supported.

Summary

The research question was, "To what extent can a manufacturing work cell utilizing an information system, which enhances goal setting and provides specific performance feedback to the employees, improve productivity?" The results of the present study demonstrate the efficacy of a daily-adjusted goal setting and feedback procedure for improving the performance and efficiency of production employees in a furniture manufacturing company. Most importantly, this study revealed that an information system, facilitating goal setting and feedback, can provide the critical role as catalyst to the goal setting and feedback phenomena and can play an important role in improving individual performance levels.

Even though feedback and goal setting have been shown to be effective in changing performance, some specific types of feedback appear to enhance the improvements more than others. In the present study, the data indicated that graphic feedback display combined with goal setting was more effective than verbal feedback combined with goal setting. Furthermore, these improvements were maintained and were consistent across individuals and sections of the organization. This finding is in agreement with other research, which has shown graphic feedback to be superior to other types (Locke and Latham, 2002).

One possible reason for improvements noted during the verbal feedback plus graphic feedback phase is the value of the information being provided to the employees. With graphic feedback, employees can more closely monitor their individual performance levels and adjust it precisely to improve output; the relationship between behavior change and change in the numerical data on the visual display provides a more precise and sensitive indicator of performance than verbal descriptors.

Another aspect of this study that proved to be a strong mechanism in gaining initial support and interest in the program was the self-recording performance data sheets. Employees were initially very hesitant to cooperate with the researcher; however, by instituting the data sheets prior to any intervention, the employees were eased into the program gradually and had the opportunity to ask questions and understand what this program entailed. Self-recording provided a mechanism by which the employees became involved in the day-to-day data keeping of a program. Furthermore, they could monitor their own performances and budget their time accordingly. Particularly for repetitious, process work, self-recording provides an excellent content to be used with other forms of performance feedback.

In spite of overall positive outcomes, several limitations of this study should be noted. First, the time frame for the intervention was limited to two months. A longer data collection period could ensure the longevity of the conclusions of this analysis. Second, all subjects received verbal feedback followed by the addition of graphic feedback. Therefore, sequence effects cannot be ruled out and it is not known if the results would have been altered if graphic feedback plus goal setting were provided before the verbal feedback plus goal setting phase. A component analysis is needed to assess the relative contributions of these intervention elements in different sequences.

Conclusions

Productivity is a major area of concern for all manufacturers in this globally competitive market. Productivity improvement through people is the most likely method for achieving competitive cost advantage (Longenecker *et al.*, 1997). Goal setting and feedback are a proven method of improving productivity through people. Tools that offer managers assistance in the difficult task of implementing these concepts are of tremendous value. Therefore, this scientific research has clearly shown that information systems support to a self directed work team could be a key component to this competitive advantage effort.

One purpose of this study was to expand previous research that makes it clear that goal setting and feedback work in manufacturing settings. This has been clearly shown. Second, the purpose of this study was to evaluate varied methods of implementation and determine which is most effective. The decision support system was the superior method of implementation. The primary reason for this is the structure that the information system offers. Supervisors and production people who are continually responding to their changing environment cannot add to their towering workload unless it is an activity that is viewed as valuable, interesting, clearly defined and not time consuming. Goal setting and feedback address the value issues, and the decision support system offers the interest, definition and timesavings.

The significant reason for improvement was through the operator's ability to improve the change over time. This was shown in hypothesis three to be significant for the information systems group. It also should be noted that the information systems group was given feedback pertaining to lost changeover time that could only be calculated and tabulated through a computer system. Therefore, the computer system was the significant element to improving productivity significantly within this field experiment.

In conclusion, if a manufacturer believes it has employees who require increased achievement, job involvement and productivity, goal setting and feedback

interventions offer tremendous opportunities for improvement when properly designed and implemented. The results of this experiment included a 10 percent increase in average productivity after this intervention and this should certainly interest any practitioner. Employee motivation and performance were both improved in this field experiment, which lead to increased organizational performance and profitability. Goal setting and feedback can provide manufacturers a real competitive advantage with a minimum investment of time and capital if they are willing to implement these practices with thought, rigor, coordination, and discipline.

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