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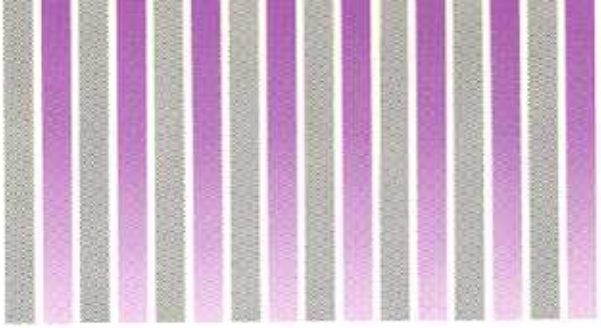

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Quality Improvement through Team Goal Setting, Feedback, and Problem Solving

A Field Experiment

Clinton O. Longenecker and Joseph A. Scazzero
The University of Toledo, College of Business Administration, Toledo, USA, and
Timothy T. Stansfield
Industrial Engineering Technologies, Toledo, USA

Introduction

Manufacturing organizations around the world are under increasing pressure to lower costs, increase efficiencies, and improve quality because of growing global competition. Many organizations have implemented a variety of quality improvement processes as an attempt to address these dynamic pressures[1]. In particular, we have witnessed a global implementation of the concept of total quality management (TQM) which has increased dramatically during the past decade[2].

Deming, Juran, Crosby and other internationally known quality experts strongly encourage all organizations to adopt a continuous improvement culture in support of the goal of total quality[3]. For the TQM process to be set in motion organizations must:

(1) develop a long-term commitment to the process of continuous improvement;

(2) provide the resources necessary to improve quality;

(3) establish clear performance standards at all levels in the organization;

(4) train managers and workers in the process of corrective action;

(5) track performance and provide continuous feedback;

(6) fix problems across the organization that have an impact on reliability and quality once they have been identified[4].

While these organizational practices have demonstrated the ability to improve quality, experts remind us that the achievement of total quality often requires:

(1) a major change in organizational culture;

(2) a substantial expenditure of time and money;

(3) a transformation of traditional management practices;

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(4) a willingness for the organization to experience short-term losses for potential long-term gains.

For these and other reasons, many organizations are reluctant to embark on the journey towards total quality. In other words, organizations may balk at implementing quality improvement efforts because of cost and/or fears, either real or perceived[5]. When an organization chooses not to implement a total quality improvement strategy, managers within such an organization are often left struggling to improve quality without the tools, knowledge, strategy and/or support they need. In our experience, such managers can achieve quality improvement in their areas of responsibility without the overall organization embracing a TQM effort.

We submit that a process of team goal setting, feedback, and problem solving can be useful tools to assist an individual manager in his/her efforts at quality improvement. There has been a significant amount of research on the linkage between effective goal setting and increasing production and output in manufacturing organizations[6]. Effective goal-setting practices have demonstrated the ability to *increase production,* but can the same practice be used *to increase product quality* and reduce product defects? Some have argued that goal setting can be used as a method for achieving quality improvement if properly focused and implemented[7]. When quality improvement goals are established with employee participation and input, workers should tend to take ownership of these improvement goals. Targets established in this manner have been found to galvanize group activity and effort towards the achievement of team goals[8].

The positive impact of feedback in the process of quality improvement is undisputed[9]. Feedback is the process of providing critical performance information to individuals or groups during and/or after a particular performance period. Feedback can be used to:

(1) monitor performance progress;

(2) make adjustments and solve problems;

(3) motivate workers;

(4) provide a basis for future goal-setting activities.

For feedback to be effective in improving quality it must be ongoing, timely, accurate, relevant, and understandable. Most experts agree that effective goal setting requires a feedback mechanism, especially in affecting group performance[9]. Thus, a manager should be able to set group quality-based performance goals and provide workers with an ongoing source of feedback on the group's performance against specific quality goals for quality to improve.

When group goal-setting and feedback mechanisms are in operation, the need for problem solving to remove performance barriers becomes readily apparent[10]. Research has demonstrated that group problem-solving activities can be beneficial to quality improvement for the following reasons:

(1) quicker problem identification;

(2) better problem definition;

(3) more complete problem analysis;

(4) an increased number of alternatives for problem resolution;

(5) broader acceptance and support for implementation[11].

Organizations employing major TQM processes typically develop corrective action teams that operate on an organization-wide basis. These participative teams are developed for the primary purpose of problem solving around the issues that threaten product quality. These teams typically receive extensive training and develop formal systems of operation and require high levels of employee involvement and participation[12]. It would appear that individual managers should be able to reap the same advantages in their departments by developing a team problem-solving approach.

The purpose of this study is to demonstrate the practical application of team goal setting, feedback, and problem solving as a quality improvement strategy in a manufacturing organization without the assistance of an overall organizational commitment to TQM.

The Defect Rate Struggle: A Case Study

The research site for this field experiment was a medium-size US automotive manufacturing plant with annual sales of approximately $75 million (US). The plant produced a variety of interior automotive parts for both US and Japanese automakers and employed nearly 900 full-time employees in a continuous three-shift operation. The facility was divided into manufacturing cells with each cell producing one or several products within a particular product line. All of the materials, equipment, labour, and support required to manufacture product were contained within each product-focused cell. As is the case with many manufacturers, the company was under substantial pressure from its customers to increase quality and lower costs.

A major concern in this organization was the product defect rates for each manufacturing cell. Defect rate problems were ongoing and widespread in this organization with no end in sight. Increases in the product defect rate were increasing product cost, lowering productivity and threatening future contracts with automakers. When defect rates reached an unacceptably high level, in a particular manufacturing cell, the organization would respond with an engineering and management taskforce to investigate the problem and take immediate action to reduce the rejection rates to an acceptable level. This practice represented a traditional "fire-fighting" response that demonstrated short-term thinking to systemic quality problems. Employee involvement and participation were minimal in the problem-solving process and workers received little, if any, feedback on quality issues until there was a crisis.

To explore the impact of a more enlightened method of quality improvement a field experiment was conducted. The purpose of this field experiment was to

determine the effect of team goal setting, feedback, and problem solving on product quality and the reduction of defects in manufacturing cells.

Methodology

In this field experiment, a pre-test, post-test with control group design was employed to study the impact of team goal setting, feedback, and problem solving on defect rates for manufacturing cells. The dependent variable in this experiment was the monthly defect rate for the two production cells that participated in this study. Two manufacturing cells were selected to participate in this quality experiment based on their manufacturing similarities which included similar product lines, production processes, production rates, and historical performance on product defect rates. One production cell was randomly selected to receive the experimental treatment and the other served as the control group. Managers and workers in the treatment group received specific training on the use of team goal setting, feedback, and problem-solving techniques as methods to improve quality. Managerial roles were redefined with an emphasis on serving as team leaders with a host of new responsibilities.

First, managers were responsible for facilitating participative team goal-setting activities that included developing aggressive, yet attainable, defect rate reduction goals. The process was developed to encourage employee ownership of defect reduction goals. The experimental teams set specific goals for their cumulative monthly performance in this area. The specific defect rate goals were set as a percentage of the total monthly production for their shift. Goals were easily measurable since each piece of production was tracked as finished product or reject product at the end of the assembly line. Performance was measured for each shift, cumulated for each shift, and cumulated for the combined efforts of the three shifts monthly. The goals were compared to the monthly performance for each shift. All goals were reviewed and revised by the teams. Each monthly goal was independent of the previous month's goal, but the percentage never increased after a successful month.

Secondly, managers were responsible for sharing daily production defect rate information with workers in pre-shift meetings and by charting defect rate performance and posting this information on the production line. Workers were provided with ongoing feedback on both their daily defect rate performance as well as their cumulative performance on each shift. Thirdly, managerial personnel developed quality improvement teams on each shift that conducted regular meetings to identify quality problems and develop specific strategies for problem resolution. Team meetings were characterized by high levels of employee involvement and participation in developing action plans to fix production problems affecting defect rates. The discussion and input from these meetings was shared with the entire workforce of the production cell to encourage additional input and ownership of solutions. Problem-solving teams were directly responsible for implementing team quality improvement action plans on an ongoing basis.

During the entire study, the control group was not informed that it was being monitored as part of this experiment. The control group received no training and operated under the traditional management culture of the organization. The two manufacturing cells were located in separate buildings at the same site and communication between the two cells was negligible. In addition, there were no substantial changes in manufacturing operations during the time of study.

Results

The monthly defect rates for the two manufacturing cells were used to determine what effect, if any, the factors of team goal setting, feedback, and problem solving had on improving product quality. For the first 12 months, denoted the baseline period, the average defect rate was 7.8 per cent for one cell and 6.6 per cent for the other production cell. Since no significant difference exists between these average defect rates ($t_{11} = 2.15, p = 0.055$), the two cells can be considered "equivalent" with respect to their average defect rates. After the baseline period, one manufacturing cell was randomly assigned the team goal setting, feedback, and problem-solving treatment while the other cell did not receive this treatment. These cells are referred to as the treatment and control groups, respectively. For the next 15 months, called the intervention period, the average defect rate was 3.7 per cent for the treatment group and 6.9 per cent for the control group. The average defect rates for both groups during the baseline and intervention periods are summarized in Table I.

After the intervention, the average defect rate decreased from 7.8 per cent to 3.7 per cent for the treatment group although it increased from 6.6 per cent to 6.9 per cent for the control group. While the decrease in the average defect rate for the treatment group was significant ($t_{25} = 7.30, p = 0.000$), the increase for the control group was not significant ($t_{25} = -0.94, p = 0.36$). Since the only differences between the two groups consisted of team goal setting, feedback, and problem solving, these factors can be attributed to the improved performance of the treatment group. The improved performance, which resulted in a 53 per cent decrease in the average defect rate for the treatment group, resulted in both a considerable lowering of quality-related costs and higher productivity in the treatment production cell.

Discussion

Juran has recently stated that many organizations are still unconvinced about the importance and worth of TQM efforts[5]. To organizations with this belief he strongly suggests the need to encourage individual managers to conduct

Group	Baseline (%)	Intervention (%)
Treatment	7.8	3.7
Control	6.6	6.9

Table I.
Average Defect Rates

quality experiments and improvement efforts on their own to demonstrate the worth of such practices to the organization at large. The field experiment described above is a case in point regarding one such endeavour.

The organization in this study was struggling to improve quality with a traditional management and engineering-driven approach. Its customers were demanding that it increase quality and lower costs or run the risk of being replaced by a competitor. The organization had no overall TQM strategy and increasing levels of pressure were being brought to bear on individual managers to "fix their quality problems now". The organization's response was an attempt to become more proficient at the traditional top-down approach to quality improvement and it was not working.

The team goal-setting, feedback, and problem-solving process employed by the treatment group in this study was developed and implemented by the production cell manager and an engineer who believed a better approach to quality improvement was needed. This quality improvement strategy was developed with the belief that the workers were an untapped resource to date and were the key to long-term quality improvement. The production cell manager was determined to make quality a focal point in his operation, in addition to production demands.

Goal setting was a long-established organizational practice for production so the manager believed the focus provided by the process could be used to provide focus on specific results. Participative group goal setting was employed to encourage worker ownership of the improvement process. This approach was coupled with the practice of providing workers with ongoing feedback on defect rates on a daily basis, as opposed to simply when defect rates became unacceptably high. The quality problem-solving teams were set up to tap worker input on a regular and systematic basis and to encourage worker involvement in developing and implementing solutions to quality problems.

The manager of this production cell set up this improvement effort on his own as a straightforward and simple approach to quality improvement through *people*. It required that he and his supervisors change their approach to quality improvement and develop a more participative approach in running the production cell. Their efforts began showing results early on in the process which reinforced attempts at change. This effort took place without widespread organizational knowledge or support and demonstrated Juran's belief that individual "quality champions" can help get the entire organization on the road to continuous improvement.

This field experiment provided this organization with invaluable evidence that significant strides in quality could be achieved using a different approach that ran contrary to the organization's traditional management philosophy and practice. The findings of this study were used to demonstrate to upper-level management that employee involvement and participation were the keys to quality improvement and that similar results could be expected across the entire organization.

The lessons learned by this organization were numerous, but several lessons are applicable across organizations desiring to improve quality without the benefits of formal TQM efforts.

- *Lesson 1: Managers Do Not Need an Organization-wide TQM Strategy to Start the Improvement Process* – Individual managers can start the quality improvement process on their own without waiting for the entire organization. It requires a commitment to change, a willingness to experiment and get workers involved, and a desire to rethink traditional views on quality. Many large-scale TQM efforts have evolved from the actions and efforts of a few quality-minded individuals.
- *Lesson 2: Employee Involvement Is the Key to Quality Improvement* – In this organization, management traditionally tried to fix quality problems without worker involvement and participation. By creating a system that educates and involves workers in the continuous improvement process, managers unleashed a tremendous force for organizational change. Quality improvement efforts that are not driven by employee involvement are destined to fail in the long-run. Employee involvement and empowerment must be encouraged through systematic organizational practices like participative decision making, education, and team problem-solving.
- *Lesson 3: Provide Training and Support to Help People to Understand Quality* – The manager in this study provided his people with training regarding the processes that would help the quality improvement effort to get started. Training and coaching both supervisors and workers around their new and expanded roles is critical if the improvement effort is to have a chance to take root. Educating workers can be a time-consuming process but it must be viewed as an investment in the organization's long-term survival and success. Formal training, pre-shift meetings, and on-the-job coaching are all needed on an ongoing basis.
- *Lesson 4: Provide Proper Focus and Measure Quality* – The key quality indicator in this organization was the defect rate as a percentage of total production. Managers and workers alike found this to be a relevant point of focus because it had a direct impact on product costs and productivity. Once key variables are identified they must be measured consistently to encourage focus and follow-up. If workers are educated and encouraged to focus on the right measurements they will develop the appropriate supportive work behaviours.
- *Lesson 5: Provide Continuous, Relevant Feedback* – In this organization, workers traditionally received feedback on quality issues only in times of crisis. Once workers have been educated to understand and interpret performance data, feedback must be continuous to keep all parties involved and informed of the group's performance. This feedback allows the group the opportunity to feel good about positive performance and make adjustments when performance is deficient.

- *Lesson 6: Quality Problem-Solving Teams Work* – When the manager of this production cell set up quality problem-solving teams to respond to defect rate problems he received not only quicker response times but better decision making and more rapid implementation of solutions. Effective teams can be a potent force to ease the pressure traditional managers experience to fix quality problems themselves or with the assistance of engineers alone. Teams must be nurtured and developed to become effective but the benefits of group involvement, participation, and ownership of the quality improvement process are numerous.

In closing, it must be stated that while these lessons are often repeated in the quality literature at the organizational level, individual managers must be encouraged to act along these lines with or without the rest of their organization. If they can demonstrate quality improvement in practice and in getting results, the rest of the organization will generally follow their lead. This is a bold step for managers but not one without precedent or tremendous potential benefits. The manager of this production cell experienced a significant increase in quality by taking the steps necessary to make his employees part of the quality solution rather than leaving them as part of the quality problem. Team goal setting, feedback and problem solving are a big step on the road to continuous improvement.

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