Effects of Leadership Training on the Manufacturing Productivity of Informal Leaders

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Abstract

The purpose of this study was to determine whether leadership training given to informal leaders had a positive effect on manufacturing productivity. The leadership attributes of informal leaders were assessed using the Leader Attributes Inventory (LAI). Non-management employees from various departments in a manufacturing facility were placed in one of four experimental groups. **Findings indicated that training increased the manufacturing productivity of informal leaders and could help manufacturing facilities increase their productivity without capital expenditures.** Based on this study, leadership training for non-management employees may yield gains in manufacturing productivity.

Introduction

Today's fast-moving, increasingly global corporate climate has caused companies to react to the situation they currently face. That climate or situation may change as soon as the company adapts to the new challenge (Johnson, 1998; Walker, Knox, & Beyerlein, 2001).

Miller (1997) described the successful organization of the future as a "chameleon," one that adapts to the environment as the environment changes. Miller further characterized the organization of the future as one that has "great flexibility, commitment to the individual, superior use of teams, strong core competencies, and a taste for diversity" (p. 120). Organizations that can successfully integrate these competencies will succeed in any business environment – past, present, or future (Walker et al., 2001). The role of a leader and the qualities of leadership must be defined for all levels of an organization in order to accept the ever-changing roles of leaders in business today.

Research has shown that leadership training for executives and middle managers results in increased worker productivity (Barling, Weber, & Kelloway, 1996; Bass, 1990). **Leadership development training could have the same benefits if given to the rest of the workforce** (IIE Solutions, 1999). **Leadership development, supervisory**

skills, and teamwork training often rank as the most important and most frequently offered training topics in corporations (“Measuring Training’s Contribution,” 1998).

With the amount of money budgeted for training increasing every year and the marketplace becoming more global and competitive, it is imperative that the money spent on training is utilized to the fullest extent possible (IIE Solutions, 1999).

In 1998, private companies in the United States budgeted over $60.7 billion for formal training. The amount budgeted for management was approximately $14.1 billion. While professionals received approximately $19 billion in budgeted training, all other employees received approximately $19 billion in budgets (“Industry Report,” 1998). The federal government budgeted $524 million in 1998 to help improve learning in schools and the workplace, and $6.8 billion was appropriated for training and employment services (Budget of the United States, 1999). These training programs were specifically designed to enhance the abilities of managers, supervisors, and other professionals.

The bulk of the labor force receives little formal training (“Industry Report,” 1998). Senge (1999) stated that most successful change efforts start at the individual level and move outward. **According to Kapp (1999), manufacturing firms implementing training programs can expect an average gain of 17% in manufacturing productivity.**

Companies must understand that training is portable; that is, the knowledge imparted to employees will leave with the employee, thus benefiting another company. This also allows new employees to bring with them the knowledge gained from previous training programs. It is from this viewpoint that a company must manage its training program to identify the skill sets needed to increase problem solving for the present needs of the business (Miller, 1997).

If gains in manufacturing productivity are achieved through the delivery of leadership training to traditional leadership groups, can similar gains be achieved by providing the same training to hourly employees? Mohrman, Cohen, and Mohrman (1995) suggested that a core group of leaders exists at the hourly level in U.S. corporations. This group of individuals are the informal leaders of the organization (Walker et al., 2001). These individuals do not hold any formal positions within the organization, yet their peers view them as a source of information or guidance. However, at that level, little or no leadership training is provided.

Informal work groups can have either a positive or a negative effect on a company’s productivity. These groups can satisfy many of the basic needs employees have as well as give them a sense of recognition. The groups are formed to protect interests and to satisfy the needs of those in the group. Leadership in these groups may change, depending upon whom the group feels will best obtain the understood goal (Rue & Byars, 2001). A leadership development program for hourly employees would bring new tools for ensuring success to an untapped resource. New challenges to organizational change could be met by a workforce armed with the tools traditionally provided to managers and supervisors (IIE Solutions, 1999).

Purpose of the Study

A review of literature revealed that few studies have been conducted concerning the effects of providing leadership training to those in non-management positions. This study, therefore, investigated whether leadership training could facilitate improvements in manufacturing efficiencies by providing a new skill set for hourly employees.

Discussion

Leadership and leadership development continue to be important concerns in the field of training and development. As more organizations move toward work teams, the idea of empowered leadership becomes more important. A core group of leaders exists at the hourly level in U.S. corporations, called informal leaders (Mohrman, et al 1995; Walker, et al 2001). Although these individuals hold no formal positions within the organization, peers view them as a source of information or guidance. Leadership training for informal leaders may yield gains in organizational productivity.

This study investigated the effects of leadership development training on the manufacturing productivity of informal leaders. The difference in this study and the typical training program was the training population. Nonmanagement, hourly employees were given the same training as that usually given to management employees.

For all groups in the study, manufacturing productivity increased after all treatments were completed. Experimental Group 3 had statistically significant higher productivity data than Groups 1 and 2. The data for Group 4, control group treatment cycle 1, were statistically significantly higher than Group 1. **The overall gain by productivity period was 1.21, or 21%, in manufacturing productivity.** This measurement was an average of each of the three-week periods. The gain after the first week of each treatment was larger than that of the subsequent two weeks. **The final week after all treatments were completed indicated an overall 21% increase in manufacturing. This is typical of what Kapp (1999) found in his research.**

The Leader Attributes Inventory was used to give the employees involved in the training a report containing feedback from their peers as compared to their own opinions. Individual reports were prepared that included the results of the self-assessment as well as their co-worker assessments. A comparison chart was prepared to illustrate the results of the two assessments and the overall assessment of the experiment. This information was presented to each employee in a private setting with no discussion of the individual results of other employees.

As previously stated, large proportions of training budgets are used to deliver leadership development training to management employees. **Based on this study, the same training, given to non-management employees, may yield gains in productivity. One important concern is the return on investment from this type of training. The overall gain in manufacturing productivity after the completion of the training program was significant from a continuous improvement aspect, and any gains in productivity without increased costs are important.** Phillips (1997) utilized a return-on-investment formula that placed a quantifiable measurement on cost savings; however, that analysis is beyond the scope of this study.

The participating company has already begun using this training curriculum and inventory sets as part of a leadership development program at another facility. The curriculum will be given first to the management group and then to non-management employees. The purchase of this company by a larger company has changed the corporate culture. How does leadership training fit the new culture? The company that emerges from this acquisition would have the identity of both companies and the identity of other purchased groups. This new identity would be formulated from the existing cultures and also from the knowledge acquired in training programs that all the groups bring to the merger. Each location would need to incorporate the new philosophy into its existing culture. The success of this integration may depend upon the acceptance of the hourly employees.

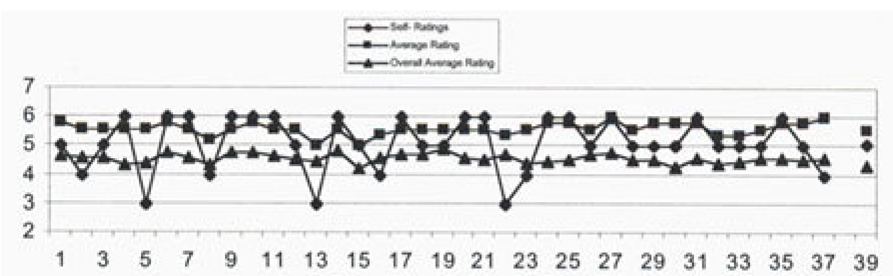

Figure 1
Sample Results Presented to Employee

Methods

Population and Sample

The population consisted of non-exempt employees in a manufacturing facility in the Northwest Texas area. The facility in this study had 500 non-exempt employees in the manufacturing area (N=500). This facility manufactures cast metal components. A mold is built out of wax, and then is coated with a ceramic mixture.

The coated mold is then heated and metal is poured in the mold. After the molding is removed, the exposed metal is worked to smooth the surfaces. The final product undergoes a thorough non-destructive testing process and shipped to the customer if all specifications are met. This facility has three eight-hour shifts of hourly employees. These employees had various levels of experience and performed tasks in a variety of eight manufacturing departments within three business centers. The various departments were Wax, Metal, Coating, Non-destructive Testing and Maintenance. Those individuals selected came from various departments and shifts within the business centers. Each department had a unique manufacturing portfolio and product mix.

Table 1
Personnel Group Assignments by Department

Group	Department											
	2	4	6	11	12	19	60	63	64	67	72	Total
Group 1	2	1	0	2	1	0	1	1	0	1	1	10
Group 2	2	1	3	0	1	0	1	2	0	1	0	11
Group 3	0	1	0	0	0	1	1	0	1	1	0	5
Group 4	2	3	0	1	1	2	0	0	2	0	0	11
Total	6	6	3	3	3	3	3	3	3	3	1	37

The sample consisted of 37 employees from various production departments and shifts. A stratified sample of employees was selected based on the shift and department to which the employee was assigned. Each employee was fully trained in an assigned work area. The employees were then placed in one of four treatment groups using a random number generator. The employee badge number was recorded to allow the researcher to track the proper productivity measurements. Each department had a unique productivity measurement. One employee, from Treatment Group 1, was assigned to the maintenance department. There were no associated productivity measurements in this department.

Instrumentation

The Leader Attributes Inventory (LAI), initially developed by Moss et al. in 1991 and later refined in 1994 by Moss, Lambrecht, Jensrud, and Finch, was administered to determine an employee's affinity for leadership. This instrument is designed for use in a vocational education setting. This company was a manufacturing firm and the instrument lent itself to this environment. The published internal consistency of LAI scores yielded a Cronbach's alpha of .97. The published interrater reliability of scores was measured at .75 to .84 and the coefficient for the average score was measured at .91 (Moss et al., 1994). The LAI is a two-part instrument, with the first part being a self-rating and the second part, an observer-rating.

The administration of this tool required a self-assessment and five observer assessments. The results of these assessments were averaged and scaled. For the first treatment cycle, the inventory was given to the participants placed in Groups 1 and 2 to establish a pre-treatment baseline. After the first treatment cycle, participants in all four groups were given the assessment.

Research Design

The first design employed in this study was a Solomon four-group experimental design, referred to as the first treatment cycle (see Table 2). The Solomon four-group design controlled for threats to internal validity (Campbell & Stanley, 1963; Gall, Borg & Gall, 1996). The treatment was repeated one time to establish the validity of the measurements. The second design was a one-group pretest - posttest design, referred to as the second treatment cycle (see Table 3). The Leader Attributes Inventory was used as the pre-treatment for the research.

Table 2

Treatment Cycle 1 Research Design (Solomon Four Group)

Group	Random Design	Pretest (LAI)	Treatment	Posttest (LAI)
1	R	O_1	X	O_2
2	R	O_1		O_2
3	R		X	O_2
4	R			O_2

Note: R=Random selection, O_1= Pretest given, X=Treatment received, O_2= Posttest given

Table 3
Treatment Cycle 2 Research Design (Pretest–Posttest)

Pretest (LAI)	Treatment	Posttest (LAI)
O_1	X	O_2

The Solomon four-group design was chosen to minimize any threats to internal validity (Campbell & Stanley, 1963; Gall et al., 1996). Thirty-seven employees received training during this process. Moss, Johansen, and Preskill (1991) utilized a three-week period of time between pre- and posttest administrations of the LAI, and this study utilized the same time period between assessments.

The productivity measurement, molds per employee, was tracked in weekly intervals starting three-weeks prior to both the first treatment (see Table 4) and the second treatment (see Table 5). A time-series design was used for this data collection.

Table 4
Treatment Cycle 1 Productivity Data Collection

Group	5/22/00	5/29/00	6/6/00	Treatment 6/12/00	6/19/00	6/26/00	7/3/00
1	O_1	O_2	O_3	X	O_4	O_5	O_6
2	O_1	O_2	O_3		O_4	O_5	O_6
3	O_1	O_2	O_3	X	O_4	O_5	O_6
4	O_1	O_2	O_3		O_4	O_5	O_6

Note: Subscripted O indicates time period of measurement.

Table 5
Treatment Cycle 2 Productivity Data Collection

6/19/00	6/26/00	7/3/00	Treatment 7/10/00	7/17/00	7/24/00	7/31/00
O_1	O_2	O_3	X	O_4	O_5	O_6

Procedure

The company that participated in the study covered five subjects in leadership training: leadership style, appreciation for diversity, conflict resolution, work teams, and business practices. The existing training courses were offered only to exempt employees in supervisory and management positions. The treatment was delivered during a three-day training program. During the first treatment cycle, designated attendees were given the LAI at the beginning of the training program. Five coworkers of these employees were selected at random and given LAI assessments to rate these individuals. This designation was based upon which treatment group the individual was placed in.

Established trainers currently employed or contracted by the company were used to facilitate the courses. The trainers delivered the same sections of training for both treatment cycles. Three weeks after the conclusion of the training program, all employees who had been placed in one of the four groups were given an LAI assessment, and five of their coworkers were randomly selected to complete LAI assessments.

The second treatment cycle consisted of those employees selected to participate in the study but who did not receive the treatment (Groups 2 and 4). These individuals received the same treatment as those in the first cycle. The only difference was the design of the study, which shifted from a Solomon four-group to a static group pretest – posttest design. Three weeks after the conclusion of this training cycle the LAI was given to the participants, and five of their coworkers, randomly selected based upon their employee number, completed the LAI assessments. Manufacturing productivity data were collected weekly by the scheduling department and forwarded to the researcher.

During the first treatment cycle, the Leader Attributes Inventory was administered to Groups 1 and 2, and the treatment was provided to Groups 1 and 3. Pre-treatment productivity data were collected for the three weekly periods before the treatment for all machines and shifts. The same data were collected for the three weekly periods after the treatment. The data were analyzed for each treatment group. The supervisor of the employee distributed the five LAI observer-ratings forms to peers of the employees involved in the study.

In the second treatment cycle, the Leader Attributes Inventory was administered to all participants for both pre and posttreatment. Productivity data were collected for the three weekly periods prior to and after the treatment. The same number of forms was utilized for each employee. The return rate of the LAI forms was greater than 98%.

To allow comparisons to be made between departments, a common measurement was devised using the productivity data for each department and shift within that department. The productivity of each shift and department was tracked on a weekly basis, and each employee was trained to operate the assigned equipment. The data used were the productivity data averaged for the 3 weeks prior to the treatment and the week of the initial treatment for each department. The data collected represents the productivity of the department and shift the employee was assigned to work, not an individual measurement, which accounts for the small sample number.

Analysis

The first treatment cycle design was a Solomon four-group for the administration of the Leader Attributes Inventory. Manufacturing productivity data were collected using a time-series design for all four experimental groups. The first training cycle took place during the week of June 12, 2000, and those manufacturing data were not used because the individuals receiving the treatment were unavailable for work during that time period. The second treatment cycle was a one-group pretest-posttest design for the Leader

Attributes Inventory data collection and a time-series design for the collection of manufacturing productivity measurements. The second training cycle took place during the week of July 10, 2000, and those manufacturing data were not used because the individuals receiving the treatment were unavailable for work during that time period. Participant assessment sheets were completed to determine participants' reaction to the training. No negative comments were noted concerning the appropriateness of the material, and overall, the participants' responses were positive.

Research Question 1 used a Solomon four-group design and is designated as treatment cycle 1. The pre-treatment manufacturing productivity data were collected during the three weekly periods prior to the training. The posttreatment manufacturing data were collected during the three weekly periods after the training was completed for treatment cycle 1. The pre-treatment LAI data were collected on the first day of the training program, and the posttreatment LAI data were collected the third week after the training program for cycle 1 was completed.

For Research Question 2, a pretest-posttest design was utilized. The two experimental groups that did not receive training during treatment cycle 1 were the subjects of treatment cycle 2. The pre-treatment data were collected during the first three weekly periods prior to the training, and the posttreatment data were collected during the three weekly periods after the training was completed for treatment cycle 2. The LAI data were collected prior to the training for treatment cycle 2 and the third week after the training was completed for treatment cycle 2.

For Research Question 3, the data were analyzed using a dependent t-test. This research question measured the overall difference between the pre- and posttreatment means.

Results

Manufacturing productivity data were analyzed using an ANOVA procedure to determine whether a statistically significant difference existed after the first treatment cycle was completed at the .05 level of significance. Descriptive data are shown in Table 6.

The LSD post hoc analyses indicated certain statistically significant differences. Experimental Group 3 productivity data were statistically significantly higher than those for Groups 1 and 2, and Group 4 data were statistically significantly higher than those for Group 1. Group 4 was the control group for treatment cycle 1. This suggested that some bias concerning manufacturing productivity was introduced by the pre-treatment. The null hypothesis for research question 1 was rejected.

Table 6
Posttreatment Manufacturing Data – Treatment Cycle 1

Group	Mean	SD	Obs.	N
1	.95	.28	27	9
2	1.00	.30	33	11
3	1.24	.34	15	5
4	1.14	.38	33	11
Totals	1.07	.34	108	36

Note: Mold Productivity Mean is a percentage of standard measurement. A measurement of 1.24 would indicate a 24% increase over the base measurement of 100.

The production data taken for the second treatment cycle were analyzed using a paired samples t-test. The correlation between pre- and posttreatment scores was .53. The data indicate a statistically significant difference in the pre-treatment and posttreatment means for treatment cycle 2. The posttreatment mean (1.21) was significantly higher than the pre-treatment mean (.97) indicating a positive effect on the measured outcome, manufacturing productivity. For research question 2, the null hypothesis was rejected.

Data for manufacturing productivity were also analyzed after both treatment cycles were completed, using a paired samples t-test. The correlation between pre- and posttreatment scores was .56, the posttreatment mean was 1.21, and the pre-treatment mean was 1.00. This difference was statistically significant and related to a twenty-one percent increase in manufacturing productivity. The data indicated an overall positive change in manufacturing productivity in all four groups after treatments were complete. For research question 3, the null hypothesis was rejected.

The research hypotheses predicted that there would be no significant increase in manufacturing productivity after the treatment. Based upon the data analysis for the three research questions, the manufacturing productivity measurement comparison after both treatment cycles indicated a statistically significant positive change; therefore, the null hypothesis was rejected in all three cases.

Study Recommendations

The following recommendations are made based on the findings of this study:

1. The training should be compartmentalized to a single group or department when the Solomon approach is used in research. The facility involved in this experiment transfers workers between shifts and departments on a very frequent yet unpredictable schedule. The maintenance of the integrity of the Solomon design would have had less of an impact on the operations of the facility if the experiment had been confined to a single department.
2. Further study should be conducted to investigate the perceptions of employees towards female leaders. Females accounted for approximately 50% of the workforce at this facility. However, females accounted for less than 20% of the middle and upper management group and 50% of the first-line supervisors. The largest increase in LAI scores was noticed in male employees, but the largest gain in manufacturing productivity was noticed in female employees.
3. A follow-up study should be conducted to determine if there is a relationship between non-management employees receiving leadership training and promotion to management. Since 50% of the workforce at this facility was female, further study might show the percentage females account for in middle and upper management groups.
4. The LAI assessments should be used to help develop a 360o feedback system for supervisors and hourly employees. Newly employed supervisors should attend this training program and be integrated with non-management employees.
5. This training program should be extended to other areas of this facility and other locations within the corporation. New manufacturing programs should be introduced simultaneously with communications, diversity, and work teams training.
6. Senge (1999) and Miller (1997) stated that the successful companies of the future would be those that rapidly accept change. Those that are empowered and believe in the change will accelerate the acceptance of change (Wellins, Byham, & Wilson, 1991). Further research is recommended on how non-management

employees, who receive leadership training, influence the new culture established through the merger of several companies.

7. This study has some challenges. There was a small sample group, but the Solomon grouping helps to offset the small number. A study should be conducted with a larger sample size to determine the validity of this research.
8. A study with a longer treatment cycle should be conducted. The total time examined was nine weeks. The product cycle time in this particular manufacturing environment was very short. When the study was completed, the departments and shifts underwent realignment to support new business endeavors.
9. The use of the Solomon grouping, while useful to the researchers, was an inconvenience for the manufacturing group to maintain. Further research should consider the design type to fit corporate initiatives. The research design utilized should consider the possibility of potential Pygmalion and Hawthorne effects.
10. Consider using individual productivity measurements. The productivity measurements used in the study were those of the entire group the individual worked in, rather than the individual's productivity.

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