

**A CRITICAL ANALYSIS OF THE LEAN PRODUCTION SYSTEM USING
EMPLOYEE FEEDBACK**

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**In Partial Fulfillment
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**by
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Increasing numbers of manufacturing companies are implementing the lean philosophy, and many manufacturing shop-floor workers are facing job alterations that will help their companies to conform to this philosophy. Companies, for the most part, are increasing profits and intensifying competition by implementing lean; however, it is important to recognize long-term success can be, and already has been, in some cases, stalled because of a lack of consideration of how employees are affected by, and perceive, the lean production system. A lack of employee

satisfaction with the system can affect employees' decisions to remain with their companies in the future. This makes assessment of employee satisfaction a critical tool.

Long-term benefits brought about by lean include both employee needs and product quality and profit factors. Therefore, it is important to be able to assess the job satisfaction of employees in lean manufacturing organizations. The creation of a survey to evaluate employee satisfaction would be a helpful tool to evaluate whether lean is being appropriately carried out. It could also be a useful tool in revealing what aspects of lean employees find disagreeable, and are thereby likely to hinder the lean effort.

Data for this study was collected through the administration of the employee satisfaction feedback survey to front line employees at Cooper-Standard Automotive in Mt. Sterling, Kentucky. Thirty-six surveys were returned, and thirty-five surveys were complete and therefore contained usable data.--The instrument used in this study was a twelve-statement survey (Appendix B). Participants were asked to respond to each of the twelve statements using a Likert Scale ranging from one (1) to five (5), in which a one (1) equaled a response of "Strongly Disagree" and a five (5) equaled "Strongly Agree". Once data was collected and unusable data had been discarded, all numbers were tabulated, and then analyzed, through the application of MINITAB statistical analysis software. It was determined that a mean score of greater than 3.5 for the survey items representing a particular research question allowed for rejection of the null hypothesis. T-tests were carried out on four groups of survey items

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Effective Employee Involvement in a Lean Organization

A common misconception is the belief that simply training employees to carry out lean manufacturing practices will, in itself, bring about a change toward lean manufacturing within the organization, as Rother (1998) explains:

Communication will not result in the adoption of lean manufacturing. The problems with mass production are fundamental, and shop-floor operators and supervisors are simply not in a position to change them. Shop-floor personnel have a perspective that naturally emphasizes their own work area, while lean manufacturing concerns itself with the entire production flow, or the “production system.” Operators are also busy, making a new part every 60 seconds or so. Asking operators to improve when the system is the problem generally just causes people to work harder, faster, and longer, which is even encouraged by our tradition of rewarding overproduction. Expecting the shop-floor personnel to lead the lean change results in suboptimization at best. (Rother, 1998, p. 490)

Rother (1998) emphasizes in this statement the importance of management taking a leadership role in implementing lean, and using employee input as a tool to improve upon these efforts – as opposed to leaving the entire process up to the front line employees themselves.

Importance of Employee Input

Buckingham and Coffman (1999) recognize the importance of effective employee surveys. In working with the Gallup Organization to create effective employee surveys, particularly the Gallup Twelve Question Survey, they conducted

focus groups to answer open-ended questions pertaining to work (Buckingham and Coffman). Based on answers from over one million employees, analyses were performed to find frequently recurring factors within the data, and five were discovered – *Work/Environment Procedures, Immediate Supervisor, Team/Co-workers, Overall Company/Senior Management, and Individual Commitment/Service Intention* (Buckingham and Coffman). While the former four factors assess employees' stances on issues pertaining to work environment and supervisory/management practices, the *Individual Commitment/Service Intention* factor takes a look at how the employees are being affected internally by these factors, and what it can mean for the company (Buckingham and Coffman):

This factor addressed issues relating to the employees' sense of their own commitment to the company and to the customers – issues such as the employees' pride in the company, likelihood to recommend the company to friends as a place to work, likelihood to stay with the company for their whole career, and desire to provide excellent service to customers. (Buckingham and Coffman, 1999, p. 253)

This *Individual Commitment/Service Intention* factor (Buckingham and Coffman, 1999) accounts for one-fifth of the recurring issues revealed by employees and categorized in the Gallup study – which emphasizes the importance of understanding employees' perceptions of their jobs and workplaces.

Connections Between Employee Opinion and Performance

Upon gathering information for Gallup's Twelve Question Survey, Buckingham and Coffman (1999) discovered several "links between employee opinion and business unit performance" (p. 30). In terms of productivity and profitability, Buckingham and Coffman reached the following conclusions:

Eight of the twelve questions showed a link to the "profitability" measure. That means employees who answered these eight questions more positively than other employees also worked in more *profitable* banks, restaurants, hotels, factories, or departments. To some people this might seem a little surprising. After all, many believe that profit is a function of factors that lie far beyond the control of individual employees: factors like pricing, competitive positioning, or variable-cost management. But the more you think about it, the more understandable this link becomes. There are so many things one employee can do to affect profit – everything from turning off more lights, to negotiating harder on price, to avoiding the temptations of the till. Simply put, these will happen more often when each employee feels truly engaged. (Buckingham and Coffman, 1999, p.33)

The findings of Buckingham and Coffman (1999) reinforce the importance employee involvement and employee input can have upon the organization as a whole. Buckingham and Coffman revealed that positive employee opinion tends to have a direct link with employee characteristics, such as productivity and an organization's profitability as a whole. This emphasizes the importance of both

obtaining employee opinion and achieving/maintaining positive opinions from employees.

Role of Surveys in the Workplace

Backstrom and Hursh (1963) emphasize the importance of gathering the appropriate information when implementing changes in the workplace. “No enlightened businessman today would consider executing a policy decision or implementing a long range program without a substantial base of intelligence with which to support his judgment,” argue Backstrom and Hursh. Vital information is often gathered through the use of surveys:

Certain kinds of knowledge can best be obtained by survey techniques. Generalizations about the characteristics of, or predictions about, the behavior of a great body of people require measurements along a broad spectrum of opinions, attitudes, feelings, beliefs, ideals, information, and understanding. (Backstrom and Hursh, 1963, p. 8)

Measuring Employee Satisfaction

Employee satisfaction can have a direct impact on an organization’s future. Brow, Brooks, and Associates (1996) state that “In a two-year longitudinal study of seven diverse occupational groups, Anderson (1969) found that workers who were both satisfactory and satisfied were much more likely to be found still on the job than those who were unsatisfactory, dissatisfied, or both”(p. 102). Further, according to Brow, Brooks, and Associates, “Tenure, the length of time workers remain or are

retained in the job, depends in large part on the workers' levels of satisfaction and satisfactoriness"(p. 82).

Brow, Brooks, and Associates (1996) note that, "With change, dissatisfaction may be experienced by worker or environment" (p. 86). Faced with dissatisfaction in the workplace, say Brow, Brooks, and Associates, a worker may try to adjust:

Adjustment behavior in either active or reactive mode can persist for some time in the face of failure. A point is reached, however, when the worker gives up adjusting and attempts to separate from the work environment, physically or psychologically. (Brow, Brooks, and Associates, 1996, p. 86)

It is important to assess the possibility of dissatisfaction of employees for signs of trouble. Obviously, when a worker has to try to adjust to his/her work environment and fails, the separation from his/her job that likely ensues has the potential to damage the organization as a whole. "It is satisfaction-dissatisfaction that drives the behavior, both the person's work behavior and the environment's organizational behavior. Satisfaction motivates "maintenance" behavior; dissatisfaction motivates adjustment behavior," according to Brow, Brooks, and Associates (p. 87).

What is Important to Employees

Liker (1998) points out that a goal of implementing lean is to either create a sense of employee satisfaction within the organization, or improve upon the existing

one. Lean is a process of improvement, and therefore its success or failure relies upon its ability to *improve* the work environment. Because, as Liker argues, employee satisfaction is a key in the success of lean, it is important to consider what characteristics of their jobs employees value most highly, in order to better utilize lean as a method of improvement within the organization:

When it comes down to the basics, there are three things people care about: 1. providing for their families, 2. getting something out of the job personally to enhance their self-esteem and gain the feeling they are making a contribution, and 3. the success of their companies. (Liker, 1998, p. 25)

Liker (1998) argues that it is, as a matter of fact, quite possible to bring about the change to lean, no matter how difficult it may seem to apply new principles and methods to employees who have adapted to old workplace patterns and philosophies. However, in order to do so, it is vital to appeal to the career elements that employees value most, particularly the three aforementioned. In doing so, true employee satisfaction is achieved, thereby contributing to the success of the lean production system as a whole. As Liker states in regard to many previous lean implementation success stories, "...one of the great changes resulting from lean is 'employee satisfaction' – workers feel that they are in a much better place than they were when they first started out in the change process" (p. 25).

Chapter III

Methodology

The purpose of this study was to gather feedback from front line employees in a lean production system within an organization, regarding their satisfaction with the lean system. The participating organization in this particular study was Cooper-Standard Automotive in Mt. Sterling, Kentucky. The tool of data collection was a twelve-statement survey (Appendix B). The items on the survey were based upon the following four research questions, which deal with various aspects of employees' experiences within the lean production system:

- 1.) What level of understanding do employees within the organization have, regarding their job skills in the lean production system?
- 2.) How rewarding do employees find their experience in the lean production system to be?
- 3.) How positively do employees of the organization rate their relationships with others within the lean production system?
- 4.) What level of confidence do employees sense, regarding the manner in which problems within the lean production system are solved?

The rationale behind three of these four particular research questions was based on research by Likert (1998), in which it was revealed through many employee assessments that the three greatest determinants of employee satisfaction include being able to provide for oneself and/or family, having a sense of achievement about one's job, and the success of one's organization. The fourth research question was

developed based on research into employee retention by Brow, Brooks, and Associates (1996), in which employee assessments indicated the importance of a smoothly-running workplace in which an employee does not feel the need to adjust oneself to counter any deficiencies in the workplace.

Hypotheses regarding each of the four research questions were as follows:

1.) H_0 : Employees do not have a thorough understanding of their job skills within the lean production system.

H_a : Employees have a thorough understanding of their job skills within the lean production system.

2.) H_0 : Employees do not find their jobs within the lean production system to be rewarding.

H_a : Employees find their jobs within the lean production system to be rewarding.

3.) H_0 : Employees in the lean production system do not have positive interpersonal relationships with those around them in the workplace.

H_a : Employees in the lean production system have positive interpersonal relationships with those around them in the workplace.

4.) H_0 : Employees are not confident about the manner in which problems within the lean production system are solved.

H_a : Employees are confident about the manner in which problems within the lean production system are solved.

Design

Data was collected through the administration of the employee satisfaction feedback survey to front line employees at Cooper-Standard Automotive. Thirty-six surveys were returned.

Instrumentation

The instrument used in this study was a twelve-statement survey (Appendix B), with three statements apiece assessing each of the four research questions. Participants were asked to respond to each of the twelve statements using a Likert Scale ranging from one (1) to five (5), in which a one (1) equaled a response of “Strongly Disagree” and a five (5) equaled “Strongly Agree”.

Population

The population of this study consisted of thirty-five front line employees from Cooper-Standard Automotive in Mt. Sterling, Kentucky, out of approximately 270 employees total, for 13% participation. Thirty-six surveys were initially returned, but one survey was incomplete, and therefore eliminated from analysis. A return rate of 100% was achieved, with 97% of surveys being fully completed and thereby included in analysis.

Data Collection Methods

The surveys, accompanied by consent forms (Appendix A) to be signed by all participants, were created by the researcher and delivered to the human resources department at Cooper-Standard Automotive. From there, the surveys were distributed to thirty-six consenting participants, completed, and collected by a human resources

employee, who in turn gave the completed surveys and signed consent forms to the researcher to be analyzed. Participants signed the consent forms upon reading them and agreeing to the terms of the study; however, these consent forms were kept separate from the surveys, thereby preventing employees' names from being associated with their survey responses. No personal identification information was asked for in any part of the survey. No individual surveys were published, only the computer-tabulated results of all of the surveys.

Data Analysis

Once data was collected and unusable data had been discarded, all numbers were tabulated, and then analyzed, through the application of MINITAB statistical analysis software. The survey items were rated by respondents based on a Likert Scale from one (1) to five (5), with a one (1) equaling a response of "Strongly Disagree," and a five (5) equaling "Strongly Agree." It was determined that a mean score of greater than 3.5 for the survey items representing each research question allowed for rejection of the null hypothesis, or:

$$H_0 = 3.5$$

$$H_a > 3.5$$

Backstrom and Hursh (1963) state that in a survey, there should always be an option for each question that allows subjects to remain unsure or undecided in their responses. In the survey used for this particular study, a score of three (3) indicated a response of "I Don't Know." An overall score of three (3) for a given question on the survey used in this particular study would only indicate the indecisiveness of subjects

and would not indicate a trend one way or the other, and a score too close to three (3) would not indicate a significant trend. Therefore, 3.5 was selected as the score for hypothesis testing because rejection of the null hypothesis in this case would require that at least some responses to a given question be higher than a score of three (3). Backstrom and Hursh note that it is important for a researcher administering a survey to establish numbers in survey rating scales and in data analysis that clearly and accurately represent the data for the purposes of the survey.

The first step of analysis was to obtain descriptive statistics for responses to each of the twelve questions for all thirty-five surveys. Descriptive statistics for Research Question One were then gathered by calculating the cumulative descriptive statistics for survey items one (1) through three (3). Research Question Two's descriptive statistics were gathered by calculating the descriptive statistics for survey items four (4) through six (6), Research Question Three's descriptive statistics were gathered by calculating descriptive statistics for survey items seven (7) through nine (9), and Research Question Four's descriptive statistics were gathered by calculating descriptive statistics for survey items ten (10) through twelve (12).

Descriptive Statistics for all Twelve Survey Items

Survey Item	Mean	St. Dev.	Min. Score	Med. Score	Max. Score
1	4.371	0.646	2	4	5
2	4.371	0.646	3	4	5
3	4.314	0.718	2	4	5
4	3.657	0.906	1	4	5
5	3.600	1.035	1	4	5
6	3.114	1.022	1	3	5
7	3.629	1.087	1	4	5
8	3.200	0.964	1	3	5
9	3.971	0.985	2	4	5
10	4.029	0.923	2	4	5
11	3.371	1.087	1	4	5
12	3.486	1.147	1	4	5

n=35

Descriptive Statistics for Survey Items Pertaining to Research Question One

Survey Item	Mean	St. Dev.	Min. Score	Med. Score	Max. Score
1-3	4.3524	0.6648	2	4	5

$n=105$

Descriptive Statistics for Survey Items Pertaining to Research Question Two

Survey Item	Mean	St. Dev.	Min. Score	Med. Score	Max. Score
4-6	3.4571	1.0098	1	4	5

$n=105$

Descriptive Statistics for Survey Items Pertaining to Research Question Three

Survey Item	Mean	St. Dev.	Min. Score	Med. Score	Max. Score
7-9	3.600	1.052	1	4	5

$n=105$

Descriptive Statistics for Survey Items Pertaining to Research Question 4

Survey Item	Mean	St. Dev.	Min. Score	Med. Score	Max. Score
10-12	3.629	1.085	1	4	5

$n=105$

T-tests were carried out on the four groups of survey items corresponding to the four research questions. According to Kantowitz, Roediger, and Elmes (2001), a t-test is “A parametric statistical test for determining the significance of the difference between two groups, or between two treatments”(p. 579). The formula used for a one-sided t-test is as follows:

$$t_{\text{obs}} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

The t-test was one-tailed with a significance level of .05, and the critical value for analysis when carrying out t-tests for each of the four research questions was 1.645. This value was obtained by taking into account the degrees of freedom (df), which is represented by $N - 1$, in which N = the number of scores in the group, and the significance level. Using the significance level of .05 of and the 104 degrees of freedom, the critical value of 1.645 was located on the table of critical values of t (Kantowitz, Roediger, and Elmes, 2001, p. 538).

To analyze the breadth of scores pertaining to each research question, a one-way, un-stacked analysis of variance was carried out on the four groups of survey items corresponding to the four research questions. Kantowitz, Roediger, and Elmes (2001) define analysis of variance as “A statistical test appropriate for analyzing reliability from experiments with any number of levels on one or more independent variables”(p. 565). The formula for an f-test is as follows:

$$F = \text{Between-groups variance} / \text{Within-groups variance}$$

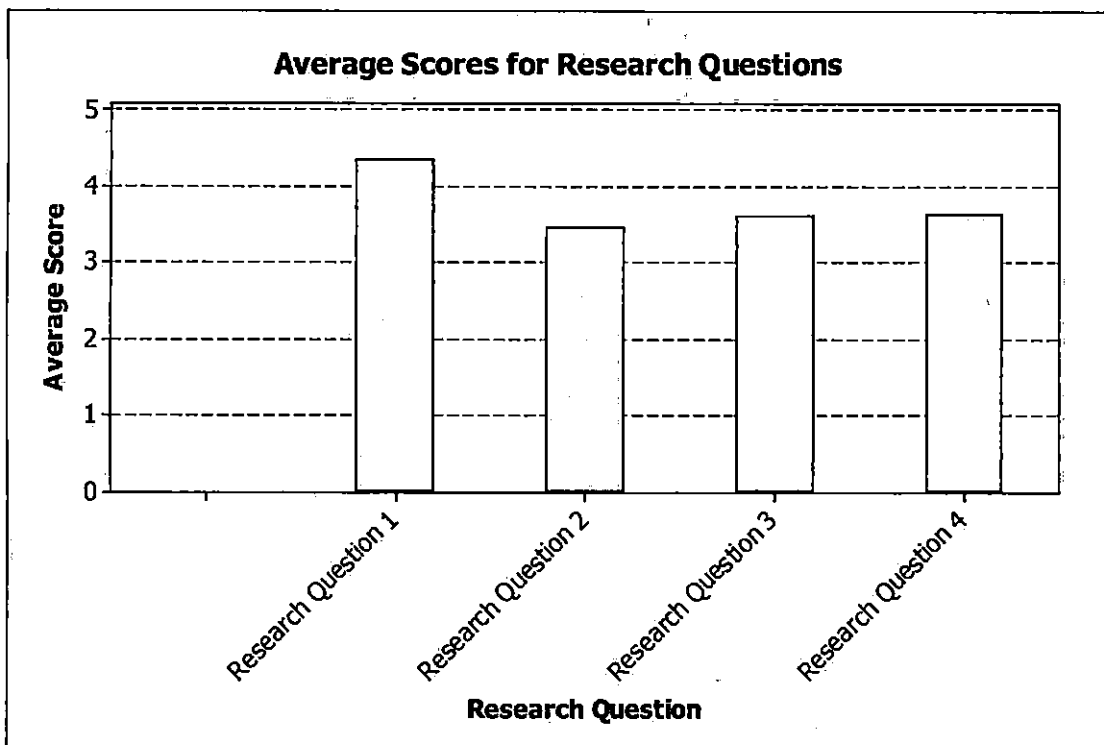
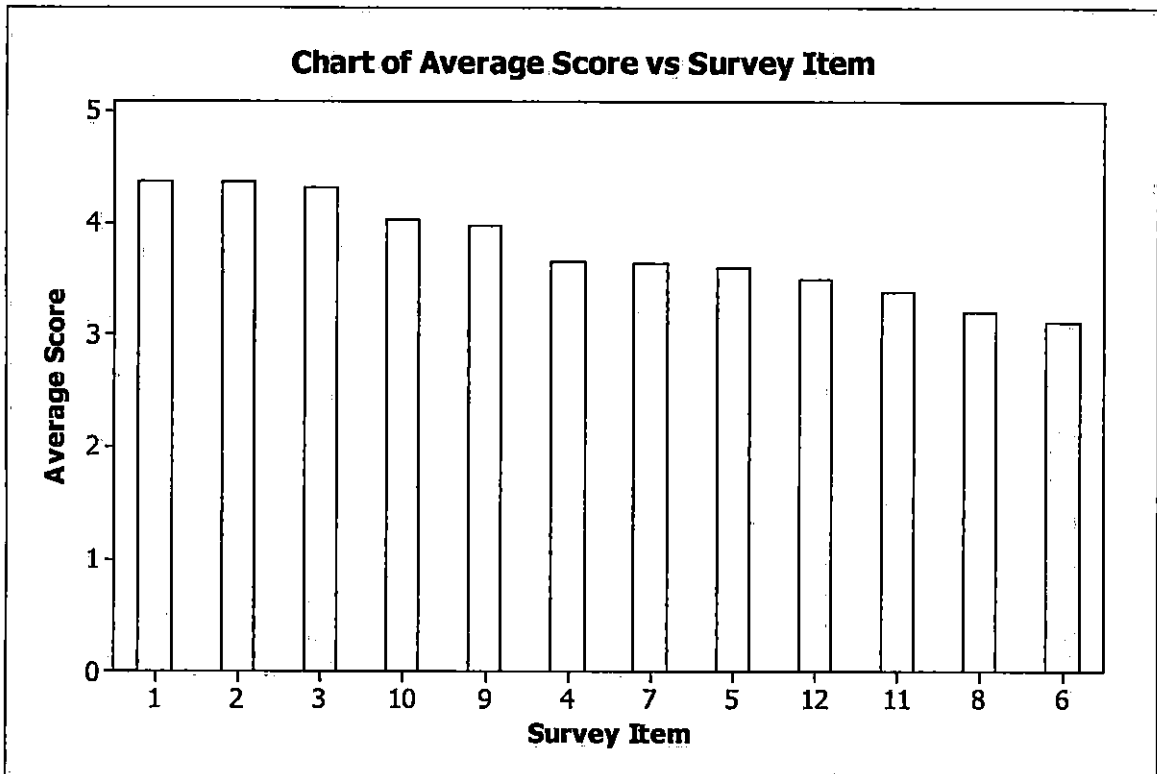
There were 420 total data collected (35 completed surveys with 12 questions apiece). There were 105 data collected for each of the four research questions (35 completed surveys with three questions apiece falling into each of the four research categories).

1	2	3	4	5	6	7	8	9	10	11	12
4	5	4	1	1	1	3	3	4	5	2	2
2	3	2	3	4	5	3	3	2	3	3	3
4	4	3	3	4	3	4	4	4	3	3	3
4	4	4	4	3	3	3	4	4	4	4	4
5	5	5	5	5	3	5	5	2	5	5	5
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	3	4	3	3	3	4	4	3	3
4	4	5	4	3	2	4	3	2	2	4	4
4	4	4	3	2	4	4	4	5	5	4	3
4	3	4	3	3	2	4	3	4	3	3	4
4	5	4	4	3	3	3	2	4	4	3	4
4	4	4	3	4	3	3	3	4	4	3	4
4	3	3	3	4	3	3	3	3	4	3	4
4	4	4	4	4	3	3	2	4	2	1	3
4	4	4	4	4	3	4	3	4	4	4	4
5	5	4	3	4	4	4	3	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	3	4	4	5	3	5	5	3	4
5	5	4	3	4	3	5	4	5	5	3	4
5	5	5	5	5	5	4	4	5	5	5	5
4	4	4	5	5	3	5	4	5	5	4	4
5	4	5	5	4	4	5	4	4	4	4	5
5	5	5	4	4	3	3	4	4	4	4	4
4	4	5	4	4	4	5	4	5	5	4	4
5	5	5	4	4	4	4	3	5	4	4	4
4	4	4	4	4	4	4	4	4	5	5	5
5	5	5	3	2	1	1	1	5	3	1	1
5	5	5	4	5	4	5	4	5	5	5	4
5	5	5	2	2	2	3	4	3	5	4	5
5	5	5	5	4	4	2	2	2	4	2	2
4	4	4	4	2	2	2	2	4	2	3	1
5	5	5	3	2	1	1	1	5	3	1	1
5	5	4	5	5	3	3	2	2	4	3	2
4	4	5	3	2	3	4	2	4	4	2	2
5	5	5	4	4	2	5	4	5	5	4	3

Chapter IV

Findings

The purpose of this study was to examine front line employee feedback regarding the lean production system within Cooper-Standard Automotive. More specifically, this feedback was gathered to gain an overall understanding of how employees within this particular organization perceive the success or failure of the lean effort in four specific areas. The results of this study could be used to indicate weaknesses within the lean production system of this particular company and to spot problem areas within the system.



Discussion of Research Question One

Research Question One analyzed the overall understanding the employees within the organization have about their roles within the lean system. Survey items pertaining to this research question were:

- 1.) I understand the principles of the lean production system.
- 2.) I understand my individual role within the lean system.
- 3.) I have received proper training that allows me to perform my job effectively.

For the first survey item, the mean score of the thirty-five total calculated responses was 4.371. For the second survey item, the mean score was also 4.371, and for the third survey item, the mean score was 4.314.

T-tests were used to test the hypothesis for Research Question One, using the formula:

$$t_{\text{obs}} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

The null and alternative hypotheses were:

H_0 : Employees do not have a thorough understanding of their job skills within the lean production system.

H_a : Employees have a thorough understanding of their job skills within the lean production system.

For survey items one (1) through three (3), $n=105$, the mean was 4.3524. This mean is greater than three (3), which was important because:

$$H_0 = 3$$

$$H_a > 3$$

A significance level of .05 was established, and a t-value of 13.14 was calculated. Based on the table of critical values of t (Kantowitz, Roediger, and Elmes, 2001, p. 538), a critical value of 1.645 was obtained.

Survey Item	N	Mean	T	P
1-3	105	4.35238	13.14	0.000

Because the established t-value of 13.14 is higher than the critical value of 1.645, the null hypothesis was rejected. The alternative hypothesis, which states that the surveyed Cooper-Standard Automotive employees do have a thorough understanding of their job skills within the lean production system, was accepted.

In carrying out an analysis of variance for Research Question One, it was found that there was very little variance among responses to this research question. An f-value of 0.08 was established.

Source	DF	SS	MS	F	P
Factor	2	0.076	0.038	0.08	0.919
Error	102	45.886	0.450		
Total	104	45.962			

This finding reflects the fact that there were no responses of “1” pertaining to any three of the survey items pertaining to this research question, but instead, all of the answers fell between 2 and 5. This helps to explain the high overall score for Research Question One.

Discussion of Research Question Two

Research Question Two analyzed how rewarding front line employees found their work within the lean production system to be. Survey items pertaining to this research question were:

- 4.) I enjoy working in the lean system.
- 5.) The lean system leads to product quality.
- 6.) I am rewarded adequately for on-the-job accomplishments.

T-tests were used to test the hypothesis for Research Question Two, using the formula:

$$t_{\text{obs}} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

The null and alternative hypotheses were:

H_0 : Employees do not find their jobs within the lean production system to be rewarding.

H_a : Employees find their jobs within the lean production system to be rewarding.

For survey items four (4) through six (6), $n=105$, the mean was 3.45714. This mean is greater than three (3), which was important because:

$$H_0 = 3$$

$$H_a > 3$$

A significance level of .05 was established, and a t-value of -0.43 was calculated. Based on the table of critical values of t (Kantowitz, Roediger, and Elmes, 2001, p. 538), a critical value of 1.645 was obtained.

Survey Item	N	Mean	T	P
4-6	105	3.45714	-0.43	0.067

Because the established t-value of -0.43 is much lower than the critical value of 1.645, the null hypothesis was not rejected. The null hypothesis states that the surveyed Cooper-Standard Automotive employees do not find their jobs within the lean production system to be rewarding.

In carrying out an analysis of variance, an f-value of 3.18 was calculated.

Source	DF	SS	MS	F	P
Factor	2	6.229	3.114	3.18	0.046
Error	102	99.829	0.979		
Total	104	106.057			

This finding reveals considerable variation in the survey responses for survey items four (4) through six (6).

Discussion of Research Question Three

Research Question Three analyzes the interpersonal relationships among employees and members of management within the lean production system in the organization. Survey items pertaining to this question were:

- 7.) The lean system encourages positive employee/employee relations.
- 8.) The lean system encourages positive employee/management relations.
- 9.) I am part of a fully functioning work team.

T-tests were used to test the hypothesis for Research Question Three, using the formula:

$$t_{\text{obs}} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

The null and alternative hypotheses were:

H_0 : Employees in the lean production system do not have positive interpersonal relationships with those around them in the workplace.

H_a : Employees in the lean production system have positive interpersonal relationships with those around them in the workplace.

For survey items seven (7) through nine (9), $n=105$, the mean was 3.60000. This mean is greater than three (3), which was important because:

$$H_0 = 3$$

$$H_a > 3$$

A significance level of .05 was established, and a t-value of 0.97 was calculated. Based on the table of critical values of t (Kantowitz, Roediger, and Elmes, 2001, p. 538), a critical value of 1.645 was obtained.

Survey Item	N	Mean	T	P
7-9	105	3.60000	0.97	0.17

Because the established t-value of 0.97 is lower than the critical value of 1.645, the null hypothesis was not rejected. The null hypothesis states that the surveyed Cooper-Standard Automotive employees do not rate their interpersonal relationships with those around them in the lean production system as being positive.

In carrying out an analysis of variance, an f-value of 5.09 was calculated.

Source	DF	SS	MS	F	P
Factor	2	10.46	5.23	5.09	0.008
Error	102	104.74	1.03		
Total	104	115.20			

This finding reveals considerable variation among responses to survey items seven (7) through nine (9).

Discussion of Research Question Four

Research Question Four analyzes the efficiency of the lean production system within the organization. More specifically, it assesses the level of employee confidence regarding the manner in which problems with the lean production system are solved. Survey items pertaining to this question were:

- 10.) I have ample opportunity to express any concerns regarding my job.
- 11.) If I report a conflict/problem regarding my job, it will be handled appropriately.
- 12.) Management takes my feedback seriously.

T-tests were used to test the hypothesis for Research Question Four, using the formula:

$$t_{\text{obs}} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

The null and alternative hypotheses were:

H_0 : Employees are not confident regarding the manner in which problems within the lean production system are solved.

H_a : Employees are confident regarding the manner in which problems within the lean production system are solved.

For survey items ten (10) through twelve (12), $n=105$, the mean was 3.62857.

This mean is greater than three (3), which was important because:

$$H_0 = 3$$

$$H_a > 3$$

A significance level of .05 was established, and a t-value of 1.21 was calculated. Based on the table of critical values of t (Kantowitz, Roediger, and Elmes, 2001, p. 538), a critical value of 1.645 was obtained.

Survey Item	N	Mean	T	P
10-12	105	3.62857	1.21	0.11

Because the established t-value of 1.21 is lower than the critical value of 1.645, the null hypothesis was not rejected. The null hypothesis states that the surveyed Cooper-Standard Automotive employees are not confident regarding the manner in which problems within the lean production system are solved.

In carrying out an analysis of variance, an f-value of 3.86 was calculated.

Source	DF	SS	MS	F	P
Factor	2	8.63	4.31	3.86	0.024
Error	102	113.89	1.12		
Total	104	122.51			

This finding reveals considerable variation among responses to survey items ten (10) through twelve (12).

Chapter V

Conclusions

This study involved gathering employee satisfaction data from workers in a lean production system. In particular, this study was carried out within the Cooper-Standard Automotive plant in Mt. Sterling, Kentucky. Of the thirty-five employees whose responses were calculated, it was found that, overall, they rated all of the survey items highly on the one (1) to five (5) Likert Scale, thereby revealing no significant discrepancies within the lean production system of their particular organization.

The items on the survey were based upon the following four research questions, which deal with various aspects of employees' experiences within the lean production system:

- 1.) What level of understanding do employees within the organization have, regarding their job skills in the lean production system?
- 2.) How rewarding do employees find their experience in the lean production system to be?
- 3.) How positively do employees of the organization rate their relationships with others within the lean production system?
- 4.) What level of confidence do employees sense, regarding the manner in which problems within the lean production system are solved?

Research Question One

To assess the level of understanding Cooper-Standard Automotive employees had regarding their jobs skills in the lean production system, survey items one (1) through three (3) were used. These survey items were:

- 1.) I understand the principles of the lean production system.
- 2.) I understand my individual role within the lean system.
- 3.) I have received proper training that allows me to perform my job effectively.

For the first survey item, the mean score of the thirty-five total calculated responses was 4.371. For the second survey item, the mean score was also 4.371, and for the third survey item, the mean score was 4.314. The mean scores of the responses to the three survey items involved with Research Question One were the three highest scores of all of the survey (Figure 2), making the overall mean score pertaining to Research Question One, 4.3524, the highest mean out of the four research question means. Thus, it can be concluded that, of the four areas of research investigated in this study, the surveyed employees of Cooper-Standard Automotive agreed most strongly with how they had been prepared for their jobs.

It was revealed through the t-test that the results of the t-test for Research Question One that the null hypothesis that employees did not find their jobs in the lean system to be rewarding could be rejected. The alternative hypothesis, which states that the surveyed Cooper-Standard Automotive employees do have a thorough understanding of their job skills within the lean production system, was accepted.

Research Question Two

To assess how rewarding Cooper-Standard Automotive employees found their experience of working within the lean production system, survey items four (4) through six (6) were used. These survey items were:

- 4.) I enjoy working in the lean system.
- 5.) The lean system leads to product quality.
- 6.) I am rewarded adequately for on-the-job accomplishments.

For the fourth survey item, the mean score of the thirty-five total calculated responses was 3.657. For the fifth survey item, the mean score was 3.600, and for the sixth survey item, the mean score was 3.114. The overall mean for Research Question Two, 3.4571, was the lowest mean among the means of the four research questions. Survey item six (6) received the lowest mean of all of the survey items (Figure 1). Thus, it can be concluded that of all of the survey items, surveyed employees of Cooper-Standard Automotive disagreed most with survey item statements implying that they enjoyed working in the lean system, particularly in terms of how they were rewarded for on-the-job accomplishments. This made Research Question Two the lowest-scoring research question of all (Figure 2); This is consistent with the results of the t-test for Research Question Two, which indicated that the null hypothesis that employees did not find their jobs in the lean system to be rewarding could not be rejected.

Research Question Three

To assess how positively Cooper-Standard Automotive employees rated their relationships with others within the lean production system, survey items seven (7) through nine (9) were used. These survey items were:

- 7.) The lean system encourages positive employee/employee relations.
- 8.) The lean system encourages positive employee/management relations.
- 9.) I am part of a fully functioning work team.

For the seventh survey item, the mean score of the thirty-five total calculated responses was 3.629. For the eighth survey item, the mean score was 3.200, and for the ninth survey item, the mean score was 3.971. The overall mean for Research Question Three was 3.600. This mean is greater than 3.5; however, based on the results of the t-test for Research Question Three, it can be concluded that, overall, the surveyed Cooper-Standard Automotive employees did not agree with statements indicating that they had positive relationships with others within the lean system, managers and co-workers alike, and that they did not feel that teamwork within the lean system was efficient. Results of the analysis of variance supported acceptance of the null hypothesis.

Research Question Four

To assess the level of confidence Cooper-Standard Automotive employees had, regarding the manner in which problems within the lean production system were solved, survey items ten (10) through twelve (12) were used. These survey items were:

10.) I have ample opportunity to express any concerns regarding my job.

11.) If I report a conflict/problem regarding my job, it will be handled appropriately.

12.) Management takes my feedback seriously.

For the tenth survey item, the mean score of the thirty-five total calculated responses was 4.029. For the eleventh survey item, the mean score was 3.371, and for the twelfth and final survey item, the mean score was 3.486. The overall mean for Research Question Four was 3.629. This mean is greater than 3.5; however, based on the results of the t-test for Research Question Four, it can be concluded that, overall, the surveyed Cooper-Standard Automotive employees did not agree with statements indicating that they are confident in how problems and concerns within the lean production system are dealt with. Results of the analysis of variance supported acceptance of the null hypothesis.

Implications

The results of the employee satisfaction survey that was distributed to, and completed by, thirty-five Cooper-Standard Automotive front line employees within the lean production system revealed some employee dissatisfaction in three of four research areas. This feedback could be used by the organization to improve upon these areas, particularly the area of Research Question Two, in which the lowest overall scores were received. However, this survey could be administered to employees within other organizations and the findings could be quite different.

There are several ways in which this study could be used by organizations. The gathering of employee feedback regarding satisfaction in the lean production system could be carried out periodically to detect possible problems before they interfere with productivity and hinder the lean effort, or as a tool to pinpoint the source of a problem that is already impacting the lean production system and potentially the organization as a whole.

This study could be expanded to encompass a larger number of employees, or the survey could be administered to several organizations and used as a tool to compare employee satisfaction levels across different organizations that use the lean production system. Even further, results of this study could be compared with productivity or profit of one company, or several companies, and monitored over time to determine the effects of employee satisfaction as they relate to the success of the organization.

If this same study were to be replicated using the same population and instrumentation, the limitations would need to be considered. The administration of the survey by human resources employees may help to ensure a high return rate due to the familiarity of a human resources employee from the same organization compared to that of a researcher from another institution; however, it needs to be taken into consideration that researcher control becomes somewhat limited by administering the survey in such a manner. Because, in this instance, only one specific human resources employee handled survey administration using the specifications set forth by the researcher, it is not thought that this factor had a

significant, if any, impact; however, there is still the possibility that this could be an issue that impacts the study results. Depending on the use of survey results, these factors would need to be considered and weighed accordingly to establish which method would be most beneficial to the researcher for his/her purposes. Further, it may be useful to become familiar with any circumstances within the organization at the time of survey administration that may impact employee state of mind, and ultimately, the accuracy of responses. While it may not be possible to eliminate all adverse effects on employee responses, this step could help to limit any potential inaccuracies.

References

Backstrom, C.H. & Hursh, G.D. (1963). Survey research. United States of America: Northwestern University Press.

Besterfield, D.H., Besterfield-Michna, C., Besterfield, G.H., & Besterfield-Sacre, M. (1999). Total quality management. New Jersey: Prentice-Hall, Inc.

Brow, D., Brooks, L., & Associates (1996). Career choice and development. San Francisco, California: Jossey-Bass Inc.

Buckingham, M. & Coffman, C. (1999). First, break all the rules: what the world's greatest managers do differently. New York: Simon & Schuster.

Choi, T.Y. (1998). The successes and failures of implementing continuous improvement programs: cases of seven automotive parts suppliers. In J.K. Likert (Ed.), Becoming lean: inside stories of U.S. manufacturers. Portland, Oregon: Productivity, Inc.

Kantowitz, Roediger, & Elmes (2001). Experimental psychology. United States of America: Wadsworth.

Likert, J.K. (1998). Conclusion: What we have learned about becoming lean. In J.K. Likert (Ed.), Becoming lean: inside stories of U.S. manufacturers. Portland, Oregon: Productivity, Inc.

Lopez, F.M. (1968). Evaluating employee performance. Chicago, Illinois: Public Personnel Association.

Rother, M. (1998). Crossroads: which way will you turn on the road to lean?
In J.K. Likert (Ed.), Becoming lean: inside stories of U.S. manufacturers. Portland,
Orgeon: Productivity, Inc.

Appendix A:
Consent Form

Form of Consent

My name is Katie Campbell, and I am conducting thesis research in order to fulfill the requirements for the Master of Science degree in the Industrial Education & Technology Department at Morehead State University. The thesis research, "A Critical Analysis of the Lean Production System Using Employee Feedback," involves the analysis of feedback from front line employees who work in the lean production system. This feedback will be gathered by means of a survey, which will require no identifiable information.

If you choose to participate in this study by completing the survey, I would like to thank you for your time and dedication. I also ask you to please read the following paragraph, and sign below indicating that you agree with the stated terms of consent:

I understand that this study is not affiliated with Cooper-Standard Automotive. The survey is being administered by a graduate student to fulfill the requirements of a master's degree program. Should I choose to participate, I understand that my individual survey responses will remain strictly confidential. I understand that on the survey, I will not be asked for my name or any other personal identification information. I understand that although the research results will be published as a thesis, my individual survey responses will in no way be made public. I understand that I may choose to discontinue participation in this study at any time. Finally, I understand that this signed form of consent will be kept separate from my completed survey and will in no way be connected with my survey.

Sign & Date Here _____

Appendix B:

Survey

Survey

Please respond to each of the following items by circling a number on a scale from 1-5, in which: 1 = Strongly DISAGREE, 2 = DISAGREE, 3 = Don't Know, 4 = AGREE, and 5 = Strongly AGREE.

- 1.) I understand the principles of the lean production system.
1 2 3 4 5
- 2.) I understand my individual role within the lean system.
1 2 3 4 5
- 3.) I have received proper training that allows me to perform my job effectively.
1 2 3 4 5
- 4.) I enjoy working in the lean system.
1 2 3 4 5
- 5.) The lean system leads to product quality.
1 2 3 4 5
- 6.) I am rewarded adequately for on-the-job accomplishments.
1 2 3 4 5
- 7.) The lean system encourages positive employee/employee relations.
1 2 3 4 5
- 8.) The lean system encourages positive employee/management relations.
1 2 3 4 5
- 9.) I am part of a fully functioning work team.
1 2 3 4 5
- 10.) I have ample opportunity to express any concerns regarding my job.
1 2 3 4 5
- 11.) If I report a conflict/problem regarding my job, it will be handled appropriately.
1 2 3 4 5
- 12.) Management takes my feedback seriously.
1 2 3 4 5