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A leadership model and supervisory skills perceived by production employees, supervisors, and managers as important to the improvement of employee performance in manufacturing

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A LEADERSHIP MODEL AND SUPERVISORY SKILLS PERCEIVED BY PRODUCTION EMPLOYEES, SUPERVISORS, AND MANAGERS AS IMPORTANT TO THE IMPROVEMENT OF EMPLOYEE PERFORMANCE IN MANUFACTURING

A Dissertation

Submitted

in Partial Fulfillment

of the Requirements for the Degree

Doctor of Industrial Technology

Approved:

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ABSTRACT

The purpose of this research was to provide to industry and education a better understanding of what makes a supervisor a good supervisor of today's educated and technically skilled work force. Manufacturing firms that depend on advanced technologies and employee-technology relationships have made an impact on the role of supervision. The modern supervisor has a new role in managing production operations. The role has changed from that of directing and controlling employees to that of effectively leading the improvement of employee performance. This study builds upon previous research in an effort to further identify and authenticate a leadership model with which to view this new role, and a set of skills to fulfill it.

A leadership model and set of supervisory skills were synthesized from a review of literature in the area of human performance technology. Categorizing the supervisory skills by their use in the leadership model, a questionnaire using Likert-type rating scales was constructed to serve as the data collection instrument in this study. Three groups (employees, supervisors, and managers) that represent manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area were asked to rate the importance of each category of skill and skill within each category. The data collected were analyzed in three ways: First, a Pareto analysis was conducted to determine which categories and skills were most important. Second, a comparative analysis was conducted to measure how the three groups differed in their ratings for each category and skill. Finally, a one-way analysis of variance F-test was conducted to determine significant differences between the mean ratings of the three groups for each category and skill. Where

significant differences were discovered, a post hoc test was also conducted to assess pairwise differences.

This study was successful in identifying a leadership model and set of skills in which to fulfill a new supervisory role of improving employee performance. Although all categories and skills were rated relatively high, significant differences in the extent of their importance were discovered. Impacts on productivity strategies are discussed. Recommendations for further study and application are provided.

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CHAPTER 1

INTRODUCTION

This study is about the job of production supervisor in today's manufacturing industry. The production supervisor is the one at the bottom of the management pyramid who oversees the labor, materials, and processes used to manufacture a product (Markland, Vickery, & Davis, 1998; Stevenson, 1999). Historically, the supervisor has been viewed as one who accomplishes work through other people. During the past century, the supervisor has been given a high degree of authority over what takes place on the shop floor, and has traditionally practiced his or her supervisory skills by directing and controlling the way in which employees do their work (Drucker, 1993). If asked what a supervisor does today, most people would probably respond with an answer that implies that he or she oversees the work of employees.

However, more and more companies depend on employees who have the education and skill to use increasingly sophisticated and complex technology to do their work (Markert, 1997). Manufacturing, for example, has become so technology dependent that the impact of technology on employee performance and the role of supervision cannot be ignored. Given that today's workforce is becoming better educated and more advanced in its technical skills (Carnevale, 1991), methods used today to accomplish work through others are different than methods used in the past. Nevertheless, most would agree that the supervisor is still responsible for ensuring that employees accomplish their work. Today's supervisor still plays a key role in managing production operations, but the role has changed from that of directing and controlling when, where, and how work is accomplished to effectively leading and helping employees control the aspects of their own work (Douglas, 1997).

A supervisor must be familiar with the latest developments in production technology, and be prepared to deal with the rapid and continual changes associated with it (Goetsch, 1992; Petersen, 1989). To do so, he or she must understand technology as a concept. Technology is more than simply electronic and mechanical objects. In more holistic terms, technology is used to describe the study of many different practical matters. This includes the application of procedures to solve practical problems, whether derived from scientific research or practical experience (Clark & Sugrue, 1990; Mitcham, 1994). A supervisor must realize how technology can impact an employee's work. That is, to promote good technology-employee relationships and know how to deal with technology-employee relationship problems. A supervisor must be able to bring out the best from both employee and technology. In short, the modern supervisor must be a technically oriented team coach (Deeprose, 1995).

Considering the changing role of today's production supervisor, two questions come to mind: What leadership model should supervisors use to fulfill this new role? Moreover, what skills should a supervisor acquire to effectively lead and improve the performance of today's better-educated and more technically skilled workforce? The primary contributions of this research are a leadership model and a taxonomy of supervisory skills for leading and improving employee performance.

Statement of the Problem

The problem of this study was four-fold. As a result of this research, the researcher expected to:

1. Construct a three-phase leadership model for improving employee performance.

2. Categorize and list the Taxonomy of Supervisory Skills needed to apply the leadership model.

3. Identify which categories of supervisory skills and which individual skills within their categories are most important.

4. Determine differences in opinion between employees, supervisors, and managers as to the importance of each category of skills, and the importance of individual skills within each category.

Statement of Purpose

The purpose of this research is to provide to industry and education a better understanding of what makes a supervisor a good supervisor of today's educated and technologically skilled work force. More and more employees are using sophisticated and complex technology to do their work. The dependency on employee-technology relationships by manufacturing has made an impact on the role of supervision, an impact that cannot be ignored. Although the need for direct control over the production worker has lessened, the supervisor still plays a key role in ensuring that employees are able to accomplish their work. The supervisor fulfills this role by leading and improving employee performance.

Theoretical Background

A theoretical framework in which to view supervisory skills for leading and improving employee performance can be established from literature in the field of human performance technology (HPT). HPT is a relatively new field of study that has evolved over the past 30 years from research and practice in human resource specialties such as behavioral psychology and programmed instruction (Gilbert, 1996; Rosenberg, Coscarelli, & Hutchison, 1992; Stolovitch & Keeps, 1992). Over the years, from the work of Skinner (1954, 1958), Gilbert (1996), and Mager (1970) major theoretical advancements have been made in managing what Rummler and Brache (1995, p. 71) refer to as the "human performance system"; the physical, motivational, educational, and organizational needs for improving human performance. Rosenberg et al. (1992) credit Skinner, Gilbert, and Mager with theoretical concepts in: (a) systems thinking, (b) learning psychology, (c) instructional design, (d) problem analysis, (e) cognitive engineering, (f) information technology, (g) ergonomics, (h) psychometrics, (i) feedback systems, (j) organizational development and change, and (k) intervention. The practical application of these theoretical concepts can be modeled after a three-phase Performance Improvement Cycle: Phase A--*measurement/evaluation*, Phase B--*cause/needs assessment*, and Phase C--*improvement implementation* (Gayeski, 1995; International Society of Performance Improvement [ISPI], 1997; Mager, 1995; Rosenberg, 1995; Stolovitch & Keeps, 1992). These concepts along with the Performance Improvement Cycle provide the theoretical underpinnings of the research design.

Statement of Need

Authors like those mentioned previously offer theoretical ways to view the role of the supervisor, and textbooks and other literature suggest what makes the modern supervisor a good supervisor (Douglas, 1997, Goetsch, 1992; Gupta, 1994; Skinner, 1996). However, since the classic studies of Walker and Guest, (1952) and Walker, Guest, and Turner, (1956) there has been very little descriptive research regarding opinions of production supervisors, their employees, and their managers as to what they think supervisors should do to fulfill their new role of leading and improving employee performance.

Authors such as Dean (1995), Rothwell (1996) and Stolovitch, Keeps, and Rodrique (1995) have conducted separate studies to assess skills for improving human performance. Through their studies, it is possible to identify a set of skills that have been used mainly by consultants and specialists for applying HPT. The authors acknowledge, however, that to improve performance of production employees, supervisors should practice many of the skills they assessed. They state a need to further refine the skills they assessed by clarifying how they match up to the roles of supervisors, who traditionally have been in charge of employee performance.

Dean (1995), Gayeski (1995), Rothwell (1996), Stolovitch et al. (1995), and Weiss (1997) proposed that many production supervisors are unfamiliar with a model for improving employee performance, that is at least as a three-phase cycle, and therefore, with good intentions practice only singular parts of the three-phases, and thus often fail to realize significant performance improvement. Equally important are implications that due to differences in educational achievement and work experiences, there are perceived differences in familiarity with one or more parts of the three-phase cycle between employees, supervisors, and second-level managers. Employees, supervisors, and managers have different viewpoints and therefore favor supervisors to practice the singular parts in which the employees, supervisors, or managers are most familiar.

For an example, Dean, Dean, and Rebalsky (1996) and Deming (1994) argue that employees can usually identify what it is they need to help them improve their performance, but do not have the resources and authority to obtain them. It is reasonable to suggest employees prefer their supervisors to be competent in skills that fall into the categories of *cause/needs assessment* and *improvement implementation* (Phases B and C of the Performance Improvement Cycle). Moreover, Deming (1990) notes that it is management's natural reaction to blame employees for poor performance. Perhaps this is due to lack of proper design, implementation, and/or interpretation of the measurements by management and not a result of employee performance. Consequently, employees prefer that their supervisors not practice skills in the *measurement/evaluation* category (Phase A of the cycle).

As another example of opinion research, Crutchfield (1998) and Mager (1995) suggest that supervisors usually require a quick solution to performance problems, and assume skills in the *improvement implementation* category as the answer to their problems (i.e., training). In addition, supervisors typically prefer to practice the *measurement/evaluation* category of skills because they are exposed to these types of skills during supervisor training initiated by their managers (Chen et al., 1987).

A third example demonstrates a difference of opinion when managers often invest much of their time providing instruction to their supervisors in the *measurement/evaluation* category of skills in order to monitor and control the achievement of business goals (Chen et al., 1987). In addition, Dean (1995) and Gayeski (1995) imply that managers typically receive some graduate level education, and are exposed to skills in the *improvement implementation* category through courses in project management. Crutchfield (1998) and Mager (1995) suggest that managers, like supervisors, want quick solutions to performance problems and usually assume to solve them through training interventions.

Upon reflection of these examples, three conclusions were made. The first conclusion was that employees favor their supervisors to be competent in skills categorized in the area of *cause/needs assessment* and *improvement implementation*, but do not favor their supervisors to practice skills in the *measurement/evaluation* category. The second conclusion was that supervisors favor skills in the area of *improvement implementation*, and *measurement/evaluation* categories, but rarely practice skills in the category of *cause/needs assessment*. The third conclusion was that managers favor their supervisors to be competent in the *measurement/evaluation* and *improvement implementation* categories, but rarely expect them to practice skills in the category of *cause/needs assessment*.

It also followed to reason that a lack of a systems approach to practicing all three phases of the leadership model by supervisors is due to the perceived differences in opinion between employees, supervisors, and managers as to what supervisory skills are most important for improving employee performance.

Research Hypotheses

Previous research and literature suggest perceived differences in opinion between employees, supervisors, and managers as to the importance of supervisory skills for improving employee performance. From direction provided by previous works and by the leadership model and taxonomy of supervisory skills constructed in this study, the following hypotheses were used to describe speculated outcomes of this study.

Hypothesis One

When rating the Taxonomy of Supervisory Skills in Category A Measurement/Evaluation (see Chapter 2), managers will rate them significantly more important than will supervisors, and supervisors will rate them significantly more important than will employees.

Hypothesis Two

When rating the Taxonomy of Supervisory Skills in Category B Cause/Needs Assessment (see Chapter 2), employees will rate them significantly more important than will supervisors, and there will be no significant difference between the ratings made by managers and supervisors.

Hypothesis Three

When rating the Taxonomy of Supervisory Skills in Category C Improvement Implementation (see Chapter 2), there will be no significant differences between the ratings made by employees, supervisors, and managers.

Hypothesis Four

When rating the Taxonomy of Supervisory Skills in Category D Other General Skills (see Chapter 2), there will be no significant differences between the ratings made by employees, supervisors, and managers.

Null Hypotheses

When rating the taxonomy of supervisory skills in any of the four Categories there will be no significant differences between the ratings made by employees, supervisors, and managers.

H_{01}: $= \mu_1 = \mu_2 = \mu_3$.

H_{02}: $= \mu_1 = \mu_2 = \mu_3$.

H_{03}: $= \mu_1 = \mu_2 = \mu_3$.

H_{04}: $= \mu_1 = \mu_2 = \mu_3$.

Preview of Methods

Theoretical concepts of human performance technology (HPT) and the application of a three-phase Performance Improvement Cycle (see Chapter 2) served as a framework for this study. Through review of the HPT literature and 20 years of manufacturing experience, a leadership model for improving employee performance was constructed. In addition, a taxonomy of 30 supervisory skills needed to put the Performance Improvement Cycle into motion was synthesized from the literature. The 30 skills were categorized by their use in the three-phase cycle (*measurement/evaluation*, *cause/needs assessment*, and *improvement implementation*) with an additional fourth category of *other general skills* that are used in all three phases.

The taxonomy of skills was used to construct a questionnaire and serve as the data collection instrument in this study. Using a set of Likert-type scales, production employees, production supervisors, and second-level production managers that represent manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area were asked to rate the importance of each skill listed on the questionnaire. The data collected were analyzed in three ways: The first was a Pareto analysis of the total ratings for each of the four categories of skill, and for individual skills within each category. The second was a comparative analysis of the differences in ratings for each of the four categories of skill and individual skills within each category. The third was a one-way analysis of variance (ANOVA) F-test of the mean ratings for each the four categories of skill, and for individual skills within each category followed by post hoc tests to assess whether differences in mean ratings between the three groups were significant.

Implications

Supervisory skills that surface from the data analysis ranging from "considerable" to "very great" importance contribute to a benchmark for future studies in establishing a standard practice for supervisors, and in planning and developing four-year college programs in industrial technology management. This study contributes to a knowledge base for better understanding the skills required of production supervisors to improve the performance of today's educated and technologically literate workforce.

Assumptions

The following assumptions were made in pursuit of this study.

1. The need that exists for supervisors to be competent in employee performance improvement will continue into the near and distant future.

2. The taxonomy of supervisory skills synthesized from previous research provided an accurate summation of skills for improving employee performance.

3. Employees, supervisors, and managers chosen to participate in this study were able to correctly interpret the data collection instrument.

4. Responses provided by all survey participants in this study were sincere and straightforward.

Biases and Limitations

Anticipated generalizations, decisions, or judgments from the results of this study were made with the following biases and limitations in mind.

1. Nine companies were selected by availability to represent the population. Samples of managers in the larger companies of more than 1000 employees were also selected by availability. However, the sample size consisted of more than 50% of the managers employed by the larger companies.

2. The researcher collected data by personally administering the questionnaire to participants. Although the researcher used pre-constructed notes for explaining the purpose of the study and the instructions for completing the data collection instrument (see Appendix B), there remains a slight possibility of contamination and experimenter bias due to the researcher's practical familiarity with the subjects.

3. The population for this study was limited to employees, supervisors, and managers of manufacturing firms listed in the Cedar Valley Directory of Manufacturers, classified as Manufacturing, Standard Industrial Classification (SIC) Major Groups 23, 24, 34, 35, 36, 37, and 38 with 100 or more employees (Cedar Valley Economic Development Corp., 1999).

4. The data collected were limited to forced response questionnaire methods and quantitative data analysis. No attempt was made to elicit qualitative input from participants regarding supervisory skills that may be alternatives or additions to what skills were identified on the questionnaire.

5. The study was limited to an investigation of only those supervisory skills needed for improving employee performance. No attempt was made to investigate skills that supervisors may need for other responsibilities.

Definition of Terms

For the purpose of this study, the following paragraphs provide definition of terms commonly used in this study.

Cause/Needs Assessment

During a cause/needs assessment one considers four factors of need (job definition, incentives, materials and processes, and instruction) and relates them to a group's (or one's) degree of competence and commitment to perform within their current system of work. It is usually the case that more than one and perhaps all of the four factors of need exist (Deterline & Rosenberg, 1992; Mager & Pipe, 1984; Rossett, 1992; Rothwell, 1996).

Improvement Implementation

An improvement implementation is a systems approach to providing a solution to the performance needs of a group (or individual) found during a cause/needs assessment. By obtaining the necessary resources, the solution can be designed, developed, and integrated so that they work together to provide for the specific, and sometimes unique, needs of the group (Mager & Pipe, 1984; Stolovitch & Keeps, 1992).

Line Functions

Line functions are those organizational functions in manufacturing which directly contribute to the production of product (Berliner, 1979; Martinich, 1997; Stevenson, 1996).

Line Organization

When referring to a group in this study that includes all three positions of production employees, supervisors, and managers, the term line organization is used.

Pareto Analysis

A Pareto analysis utilizes a bar chart arranged in a descending order of size or importance from left to right to separate and display the critical few from the trivial many issues/problems. It is named after Vilfredo Pareto who, in the late 1800s, hypothesized the 80/20 rule (also known as the Pareto principle), which states that 80% of an issue or concern is due to 20% of its causes. The Pareto bar chart may also illustrate the cumulative percentage for each cause on the chart. Typical applications for a Pareto analysis are to (a) prioritize potential causes of a problem, (b) establish and verify cause and effect, (c) reach consensus on what needs to be addressed first, (d) identify improvement opportunities, and (e) measure success of corrective action (Hanke & Reitsch, 1994: Michalski, 1998).

Performance

Performance is a term used to measure the worthiness of a one's effort with respect to the accomplishment of that effort. That is, the worth of one's performance is not solely derived from the amount of effort put forth. Likewise, the worth of one's performance is not solely derived from the value accomplished. True worthy performance is obtained when the value of one's accomplishment exceeds the cost of effort put forth to achieve the accomplishment (Gilbert, 1996). Quality, productivity, and timeliness are terms commonly used for performance in the manufacturing industry.

Measurement/Evaluation

Performance measurement/evaluation is a means, such as through the use of a charting method, to measure, (a) what the desired performance of a group (or individual) ought to be, (b) their actual performance, and (c) the gap between the desired and actual performance. If management considers the gap significant enough to merit an intervention, the needs of the group and the system in which they work must be evaluated (Rosenberg, 1995; Rossett, 1992).

Production Employee

For the purpose of this study, an employee is defined as a person who performs production work such as operating machines and equipment that produce a product.

Production Manager

For the purpose of this study, a production manager is one who holds a management position immediately over the production supervisor.

Production Supervisor

For the purpose of this study, one who holds the management position immediately over production employees is referred to in this study as production supervisor.

Technology

The word technology means more than simply electronic and mechanical objects. In more holistic terms, technology is used to describe the study of many different practical matters. This includes the application of natural and behavioral sciences to solve practical problems, whether derived from research or practical experience (Clark & Sugrue, 1990; Mitcham, 1994).

Description of Subsequent Chapters

The subsequent chapters of this study are about the job of production supervisor in today's manufacturing industry. The production supervisor has traditionally practiced his or her management skills by directing and controlling the work of their employees. However, supervisor's role has changed from that of directing and controlling the work of employees to effectively leading and helping employees improve their own work. The primary contribution of this research is a theoretical leadership model and taxonomy of supervisory skills for leading and improving employee performance.

The review of the literature in Chapter 2 describes a leadership model for improving employee performance constructed from a theoretical framework called human performance technology (HPT). A taxonomy of supervisory skills required to apply the leadership model was also synthesized from the literature. Chapter 3 describes the methods used in this study to select the population and sample, construct and validate a data collection instrument, and collect and analyze the data. Chapter 4 reveals the findings of the study. Data from the completed research are reported, discussed, and explained in narrative form and tables. Finally, Chapter 5 provides a summary of the major aspects of conducting the study and a compilation of major findings, conclusions that relate to the hypotheses of the study, and recommendations based upon the review of literature and findings of the study.

CHAPTER 2

REVIEW OF LITERATURE

The organizational structure of a manufacturing company is commonly divided into two distinct functions, those of line and those of staff. Berliner (1979) defines line functions as those that directly contribute to the production of product, and staff functions as those that support line functions. Three job positions that are key to line functions of a manufacturing organization are: the *first-level production supervisor*, the *production wage employee*, and the *second-level production manager* (Markland et al., 1998; Stevenson 1999).

The *first-level production supervisor* (from here on referred to as supervisor) is a position that directly oversees production wage employees. This position is at the bottom of the management pyramid—the one that has direct authority over production wage employees. In some companies, the supervisor may be referred to by different job titles. Men traditionally held the position of supervisor in the past (Marcus & Segal, 1989; Walker & Guest, 1952; Walker et al., 1956), and it is common to see that some companies still refer to their supervisors as "foremen." Some refer to the position as "first-*line* supervisor." With a growing trend toward a teaming philosophy for wage employees, a more recent term is "team leader" (personal observation).

Those who report directly to the supervisor are *production wage employees* (from here on referred to as employees), members of the work force who hold nonmanagerial positions. They operate machines and equipment, use tools and other production technologies to produce a product. The term employee is synonymous for "operator," "hourly worker," "production worker," "blue-collar worker," or more recent terms of "team member," or "production associate" (personal observation).

One management position above that of the supervisor is the *second-level manger* (from here on referred to as manager), the supervisor's boss. Some manufacturing firms refer to this position as "general foreman," "unit manager," or "production manager." In some smaller companies where there are fewer levels of management, the manager may be the "plant manager" (personal observation). The distinction between the responsibilities of the manager and the supervisor is a matter of degree and emphasis. Both are management positions concerned with the direct operations of the company. While the supervisor spends much time overseeing the work of wage employees, the manager is more of a departmental-type manger who does the strategic planning, organizing, and making of decisions that concern the work of the entire department (Berliner, 1979; Markland et al., 1998; Stevenson 1999).

This review is about the production supervisor. The following four sections present an analysis of the supervisor's job by presenting the types of production technologies, work force characteristics, and supervisory skills used. The first section is a historical perspective of the supervisor's job and how it has changed over time during the 20th century. The second section is an analysis of the supervisor's job today with an emphasis on modern day complexities. The third section describes what is missing from most of the literature. Finally, the fourth section promotes a relatively new management approach for improving employee performance (called performance technology) as a theoretical framework to describe tasks and skills required of supervisors today.

Development of Production Supervision

Like most levels of production management, the job of the supervisor is not to actually build product or do production work. Yet the supervisor plays a key role in managing production operations. With reflection upon the importance of the supervisor's job, two questions come to mind: In an organization with highly skilled employees that use modern production technologies, what is it that supervisors actually do that is most important? What makes the modern supervisor a good supervisor? To answer questions such as these, it is best to understand the evolution of the supervisor's job over time. The following historical perspective includes a synopsis of the supervisor's job during the early and middle 20th century by describing the production technologies, workforce characteristics, and the features of supervision.

Early 20th Century

This was a time in which the Industrial Revolution was well on its way to creating a highly profitable system of mass production. In contrast to the relatively small job shops of the late 1800s, factories of the early 20th century were significantly larger. Production emphasized very large lot sizes. As opposed to single structures, most factories were made up of several buildings. The "American System" (Marcus & Segal, 1989, p. 72) of manufacturing now stressed precision and exactness in production so that parts could be interchanged easily during assembly. Large-scale production machine tools for sheet metal stamping, grinding, milling, or the like, and complex systems of organized mechanical assembly processes utilizing specialized jigs and fixtures characterized the early 20th century factories. However, on the down side, was the working environment.

Many rotating shafts, pulleys, and belts used for drive mechanisms in these production machines of the early 20th century were fully exposed and in close proximity to the worker who, by the way, was expected to work longer and harder than what is expected today. Worker fatigue and dangerous conditions were undoubtedly a significant safety factor to be considered in those days (Khol & Mraz, 1997; Marcus & Segal, 1989; Williams, 1987).

At the turn of the century, the face of manufacturing in the U. S. was almost universally white and male. This was because initially, highly skilled machinists and mechanics were needed to operate machinery and perform assembly processes. Minorities and women were hard-pressed to gain access to apprenticeships in these relatively high paying jobs. However, industrialists such as Henry Ford and engineers such as Frederick W. Taylor revamped ways in which production jobs were performed. Most jobs that required the performance of highly skilled workers were simplified by breaking down complex tasks into repetitively small sequential steps that could be documented and measured. The simpler tasks were then performed by lesser skilled workers (Marcus & Segal, 1989; Williams, 1987). The workforce of the early 20th century were mostly white men, working long hours in relatively unsafe conditions.

Some men who excelled at their jobs and mastered many different tasks were promoted to foremen (supervisors), responsible for performing and overseeing day-to-day production tasks on the shop floor. The early 20th century foreman was the undisputed boss of the shop, with considerable authority to make decisions regarding the work of his men. He was held responsible for increased volume and capacity and lowered unit and labor costs. He was trained in the practice of *scientific management* to methodically measure, monitor, direct, and control the production system. However, to stimulate productivity in his workers and influence efficiency in the way in which materials flowed through his shop, he at times used supervisory methods that would be thought of as backward and abusive today. The supervisor of the early 20th century sometimes revived his tired workers with "stimulants furnished for each shift, such as a good belt of whiskey" (Grasson, 1998, p. 98). To punish and/or put fear into his insubordinates he at times resorted to the use of threats and actual physical violence (Child & Partridge, 1982; National Industrial Conference Board, 1967; Patten, 1968). "So I hit him on the jaw. He knew who was boss now. He picked himself up and walked back to his job laying tracks" (Parker & Kleemeier, 1951, p. 1).

Manufacturing in the early 20th century was a highly profitable large-scale production system of specialized machines and complex mechanical assembly processes. However, long hard hours and dangerous equipment created unsafe working conditions for the highly skilled and predominately white male workers. Consequently, industrialists and engineers broke down complex jobs into smaller simplified tasks that could be performed by lesser skilled labor. Workers who excelled became supervisors, were given considerable authority over the lesser skilled workers, and became the undisputed bosses of the shop. Supervisors used methods of *scientific management* to measure, monitor, direct, and control production. Yet, to motivate their workers, they resorted to unwise and cruel methods that would be thought of as backward and unheard of today (Marcus & Segal, 1989; Parker & Kleemeir, 1951; Patten, 1968).

Middle 20th Century

The Great Depression and 1930s disappeared as manufacturing began working to support the efforts of World War II. In 1940, 28% of the machine tools in use were less than 10 years old. By 1945, 62% were less than 10 years old, the quickest advancement in capital investment known to have occurred in any developed country to this date. The rapid introduction of new production technologies into manufacturing made World War II a different kind of war from its predecessor and was undoubtedly responsible for the outcome of that war. With research generated by defense needs, new machine tools were developed that could cut, shape, and form metal faster, with greater precision and at lower cost. Materials and processes used in the assembly of auto and aerospace products continued to advance as well (Benes, 1998).

World War II likewise changed the face of the workforce of the middle 20th century. While men fought on the battlefront, women filled the millions of civilian and defense positions created as the U. S. shifted to wartime production. In 1942, women such as that illustrated in a famous poster of "Rosie the Riveter" were recruited to work in the factories. "War gave women access to skilled higher-paying industrial jobs . . . " (Baxandall & Gordon, 1995, p. 245). As the war ended, most women gave up their wartime jobs to the men coming home from the war (Amott & Matthaei, 1991). Undoubtedly, the introduction of women in the workforce and the better-educated, better-organized worker home from the war left a lasting impact on supervisory practices in American industry (Fair, 1957).

By the middle of the century the job of the supervisor continued to be that of foreman, the overseer, director and controller of employees. However, most training schemes for supervisors included considerable emphasis on human relations techniques, especially in the handling of women workers (Allen, 1957). Studies by Walker and Guest (1952) and by Walker et al. (1956) uncovered particular human relations skills in the successful supervisor. Their studies found that the best foremen were those that, in addition to directing and controlling shop operations, practiced good human relations with their wage employees. They treated employees as individuals, established personal relationships with employees apart from the job relationships, taught and promoted employees, acted as a shock absorber between employees and either the pressures implicit in the process or pressures coming from managers, stood up for employees in face of those pressures, consulted employees, and delegated responsibility to them.

World War II was the greatest factor in shaping the middle-of-the-century factory. The war's impact greatly affected developments in production technology, workforce characteristics, and supervisory methods. Technology developments resulted in newer, more precise, and more efficient machine tools. The workforce changed from predominately male to predominately female, and back again. With the introduction of working women and a war-experienced workforce, supervisors became more humanistic. They used less autocratic tactics of bullying and intimidating employees and showed more respect with a human relations perspective.

Modern Production Supervision

Late 20th century supervisory practices evolved significantly over the past century, mostly influenced by changes in production technologies and workforce characteristics. Yet, today's manufacturing organizations are composed of advanced production technologies and unique workforce characteristics that call for further reformation in production supervision. In the next section of this chapter, first, the production technologies of the late 20th century are discussed, focusing on many new developments in the area of information technology. Second, the modern-day workforce is described with a look at demographic characteristics. Finally, a perspective on production supervision is described by pointing out recommendations for practices of modern supervision. However, the extant literature primarily focuses on what academic, consulting, and human resources professionals think supervisors should be doing, rather than what they are actually doing. There is really not much empirical information about what supervisors actually do in today's manufacturing plants (Ahire, Landeros, & Golhar, 1995; Gupta & Ash, 1994).

Production Technologies

Advancements in production technology obviously affect the job of the supervisor (Dean, 1995; Deming, 1994; Douglas, 1998; Rothwell, 1996; Rummler & Brache, 1995). The supervisor must not only form team relationships with wage employees, mangers, and others (Berliner, 1979; Rue & Byars, 1996), but must also be technologically literate enough to oversee the machines, tools, equipment, and whatever other production technologies that are in place (Goetsch, 1992; Markert, 1997; Markland et al., 1998;

Stevenson 1999). To be successful in today's complex work environments, most supervisors must not only know the meaning of the latest acronyms such as CAD-CAM, CIM, FMS, JIT, MRP/MRP II, SPC, SDWT, and TQM (to name a few), he or she must also become technologically literate in one or more of the following production technologies.

Computer-aided design (CAD) is the use of computer software and hardware in interactive engineering drawing and storage of designs for manufacturing. Designers use CAD software to complete the layout, geometric dimensions, projections, rotations, magnifications, and cross section views of a part and its relationship with other parts. The software allows designers to design, build, and test (in a virtual sense) production prototypes under given parameters as three-dimensional computerized objects. It compiles parts and quantity lists for a product, outlines production and assembly procedures, and transmits the final design directly to production machinery such as milling and rolling machines (Goetsch, 1992; Markert, 1997; Markland et al., 1998; Stevenson 1999; Turban, McLean, & Wetherbe, 1996).

Computer-aided manufacturing (CAM) software uses the digital output from a CAD system to directly control programs in production equipment such as robotics and numerical control machining centers. When CAD is feeding information to CAM, the combined system is referred to as CAD-CAM. CAD-CAM encompasses the computer-aided techniques that facilitate planning, operation, and control of a production facility. Such techniques include computer-aided process planning, computer-generated work drawings and standards, MRP II, capacity requirements planning and shop floor control that are direct responsibilities of the supervisor (Goetsch, 1992; Markert, 1997; Markland et al., 1998; Stevenson 1999; Turban et al., 1996).

Computer-integrated manufacturing (CIM) is a term that originated in the 1960s, but is a recent concept in American industry that encompasses a diverse collection of production technologies in use today and implies a system where all components necessary for production of product are integrated. This includes the initial stages of planning and design, through the stages of purchasing, production, packaging, shipping, and order fulfillment. CIM is not a specific hard technology per se. It is more of a management technology that involves strategic efforts to combine all available technologies such as CAD-CAM, MRP/MRP II, JIT and other automated systems to manage and control an entire enterprise (Markert, 1997). If another factor were to be included, it would relate to the human elements between supervisor and wage employees. According to Markland et al. (1998), "many implementations of new technology, including CIM have failed because responsible parties (such as supervisors) failed to prepare the work force to accept, support, and be able to use the new technology" (p. 322).

Flexible manufacturing systems (FMS) are fully automated, computer controlled production systems that offer substantial advantages in comparison to a conventional job shop. An FMS is a set of machines linked by an automated materials handling system—all under central computer control. Flexible machining centers (called cells) can produce a variety (or family) of parts with a simple change of software. They also allow multiple operations to be performed on a piece of work (Markert, 1997).

Just-in-time (JIT) is a complete inventory control and production scheduling system that attempts to reduce costs and improve work flow by scheduling parts and materials to arrive at a manufacturing work station precisely at a time when they are needed. Such a system saves space, reduces inventories, and minimizes waste. JIT utilizes a *pull system* for moving goods (where control of materials and parts movement is established in reverse of the work flow, from the last work station to previous stations) and several other technologies and management techniques that enable production to move as fast as possible without disruption. The major components of a JIT system are few but reliable suppliers, small lot sizes, low inventories, high quality materials, fixed production rates and standardized outputs, extensive preventive maintenance and quick repairs, quick machine setups, and moderately utilized capacity. Perhaps the most significant elements to a successful JIT system are multi-skilled employees and participative supervision that encourage continuous innovation and improvements (Markland et al., 1998; Turban, McLean, & Wetherbe, 1996; Stevenson 1999).

Materials requirements planning (MRP) is a calculation technique that deals with production inventories and scheduling. It is used for planning future manufacturing lots and purchase orders according to what is required to complete a master production schedule. MRP is typically computerized because of complex interrelationships between products and their subparts, and the often need to change plans when delivery dates or order quantities are changed (Markert, 1997; Turban, McLean, & Wetherbe, 1996).

Manufacturing resource planning (MRP II) is an application software arrangement used by the line organization. Essentially, MRP II creates a closed-loop management system that integrates the regular MRP with all other major functional areas of the organization such as forecasting and sales, design engineering, purchasing and receiving, production activity planning and maintenance, distribution planning and cost accounting. Furthermore, it coordinates activities toward the goal of producing the right product just-in-time (Markert, 1997; Turban et al., 1996).

Statistical process control (SPC) is a quality control method to prevent the manufacture of defective products by statistically monitoring manufacturing processes, typically through the use of computerized charts and graphs. To manufacture products within specifications, processes producing the parts need to be stable and predictable. A process is considered to be under control when SPC charts show that variability from one product to the other is stable and predictable. If and when a process becomes unstable and about to go out of control, SPC charts will show evidence of such in far enough time so that adjustments can be made to the process before defects are produced (Deming, 1994; Grant & Leavenworth, 1988; Juran, 1988).

Self-directed work teams (SDWTs) are a functional group of employees (usually between eight and fifteen members) who share responsibilities for a particular unit of production. Technically, the team consists of individuals that are trained, empowered (with authority), and held accountable to make decisions regarding the quality, cost and scheduling requirements of their production unit, and for the safety of their production processes. Each member of a SDWT possesses a variety of technical skills and is encouraged to develop new ones to increase the job flexibility and value of the SDWT (R. Koenig, R., Schnack, & R. Marconi, personal communication with vice president of operations, director of manufacturing, and production manager (respectively), Norand Corporation, Cedar Rapids, IA, August, 10 1995; Torres & Spiegel, 1990).

Total quality management (TQM) is an integrative management approach that emphasizes continuous process and system improvement as a means to achieve customer satisfaction and long-term company success. Simply stated, TQM utilizes the strengths and expertise of everyone in the company as well as scientific methods for problem analysis and decision-making. Quality is the concern and responsibility for everyone in the organization and built into every product and business process. TQM is based on the premise that customers (internal, external or both) are the focus of all activities of an organization, and relies on all members of the organization to continuously improve everything they make and do as well as the culture in which they work. Most importantly, TQM is a philosophy for long-term, never-ending commitment to improvement, not a temporary program (Ahire et al., 1995; Summers, 1997).

Advancements in production technology such as CAD-CAM, CIM, FMS, JIT, MRP/MRPII, SPC, SDWT, and TQM have greatly affected the job of supervision. In order to be successful in today's complex work environments the supervisor must be proficiently familiar with these new technologies to assure the best possible performance from the technologies and the workforce who use them.

Workforce Characteristics

Changes in the characteristics of today's workforce obviously affect the job of the supervisor. According to Rue and Byars (1996), one of the more prevalent changes in today's work force that affect the supervisor's job is the transformation of its demographics. The following are examples of how the work force in manufacturing is rapidly changing shape. Compared to the work force in the early 1980s, Kutcher (1991) notes that the work force in the 2000s will grow more slowly. Thus there will be fewer qualified people to fill employee positions, the type of condition that can make for a labor shortage. What is most characteristic of the shrinking work force is their age. There is a disproportionate amount of wage employees under age 35. At the lowest age levels this reduction is already upon us. Over all, wage employees are getting much older very rapidly. The U.S. Department of Labor (1992) predicts 37% of the work force will be under the age of 35 by the year of 2005, as compared to 46% in the year of 1990, and 48% in the year of 1975. In contrast, the older members of the work force are taking early retirement (Gendell & Siegel, 1992). The U.S. Department of Labor also predicts that minority groups of all types will become a larger proportion of the work force. According to Redwood (1990), women—especially women under 40—have been entering the work force at an accelerated rate.

Perhaps the most significant change in the shape of the work force is that they are now expected to fulfill jobs that require more than a high school education (Carnevale, 1991; Redwood, 1990). In today's world of manufacturing, unlike other sectors in the economy, the work of wage employees is becoming increasingly complex as they find themselves having to continuously upgrade their skills to fit the latest production technologies (Carnevale, 1991; Dean et al., 1996). For example, compared to their day-to-day operations of the past, employees are now using less manual skills and more intellectual skills as required for operating automated machinery and processes. Their skills have also become more versatile in the variety of production technologies they apply (Markland et al., 1998; Stevenson, 1999). According to Gupta and Ash (1994), Carnevale (1991), and Douglas (1998), employees are being told less by their supervisors of what to do, as well as when, where, and how to do it, and are expected to autonomously make more decisions as members of self-directed work teams. Researchers agree with two of Deming's (1994) long-standing opinions regarding trends in employee performance: (a) Performance outcomes are being greatly influenced in breadth and depth by increased sophistication of manufacturing and organizational systems. (b) Employees are being empowered to make less reactive and more proactive job-related decisions.

Even in the modern age of advanced technologies, the highly diverse, highly skilled, highly motivated, productive employee is still manufacturing's greatest asset. The person best able to make the most efficient and effective use of this asset is the well-trained, knowledgeable supervisor.

Supervisor Characteristics

Historically, supervision has been viewed as a process concerned with accomplishing work through other people, and this concept is still valid. If asked what it is that a supervisor actually does today, most people would still probably respond with an answer that implies that a supervisor oversees the work of wage employees (Berliner, 1979; Dean, 1995; Deming, 1994; Drucker, 1993; Rothwell, 1996; Rummler & Brache, 1995). It has been well established that an important skill of a supervisor is to appraise and improve the performance of his or her employees. However, manufacturing has become so technology dependent that the impact of technology on productivity and on employees cannot be ignored. Supervisors are still responsible for ensuring that employees accomplished their work. Yet, more and more employees are using technology to do their work, and technology is becoming increasingly sophisticated and increasingly complex. In a symbiotic relationship, the employee depends on technology and technology depends on the employee.

Supervisors must be able to bring out the best from both employee and technology, and learn to make optimum use of the employee-technology relationship. To do so supervisors must understand technology as a concept, be familiar with the latest developments in production technology, appreciate the impact of technology on the employee's work, be familiar with employee-technology relationship problems and know how to deal with them; and be prepared to deal with the rapid and continual changes associated with modern production technology (Goetsch, 1992; Petersen, 1989). In short, the modern supervisor should be a technically oriented team coach (Deeprose, 1995).

Research Gaps

We know what the human resource, academics, and management authors think supervisors should do. However, what is missing from most of the extant literature is perspective of the line organization—what they think supervisors should actually be doing on the production floor. Ahire et al. (1995), Crutchfield, (1998), and Douglas, (1997), imply that further research is needed in identifying the leadership elements required of supervisors and their roles and responsibilities in a highly technical and complex manufacturing organization. With respect to the job of supervisor in today's work team environment, Gupta and Ash (1994) state:

> Although many operators and mechanics welcomed the promise of input into the plant's work, lower level supervisors felt extremely threatened by the changes. Of all the employees at RHK, these supervisors are experiencing the most uncertainty about the effect the work teams would have on their work and livelihood. They were told their jobs would change drastically, but no one seemed able to articulate how. (p. 198)

Skinner (1996), referring to supervision of highly skilled employees and the use of modern production technologies as a competitive advantage, wrote:

> One conclusion seems clear: we are now in a totally new industrial era in which the performance required for competitive success is orders of magnitude greater than in the past. But in the face of these heightened requirements, hard-pressed production managers appear to be trying for competitive parity principally by concentrating on adopting the latest tactical controls and planning techniques . . . (but) . . . typical industrial managers do not seem to know what to do differently . . . the urgent need (is) to improve performance. (p. 16)

In conclusion, there are many textbooks and other literature on what seems to make the modern supervisor a good supervisor. However, there is very little sound research in what people in the line organization believe supervisors actually do that is most important. Yet the supervisor plays a key role in managing today's production operations. With reflection upon the fact that employees have to enhance their performance to accommodate ever-increasing sophisticated production technologies, and given the history and evolution of the supervisor's job, from autocratic boss to human relations overseer to technical team coach, the primary responsibility of the supervisor is to improve employee performance (Berliner, 1979; Dean, 1995; Deming, 1994; Rothwell, 1996; Rummler & Brache, 1995).

The following section delineates a relatively new management approach for improving employee performance (called human performance technology) as a theoretical framework to describe tasks and skills required of supervisors today.

Human Performance Technology

The preceding section describes what is known about modern production supervision. This section presents literature on what experts in the academic, training and development, and management fields think supervisors should be doing. A theoretical framework for a particular leadership approach referred to as human performance technology (HPT) is used to propose what supervisors should be doing. First, is a short history of the concepts and development of HPT. Then, a way is proposed in which HPT can be incorporated onto the shop floor as a continuous cycle. Finally, the skills needed by supervisors to implement HPT are identified.

Historical Development of HPT

As a relatively new field, HPT grew from a base of scientific research and theory, and has emerged as a modern management technique to be used by professionals in industry to improve performance in the workplace (Stolovitch & Keeps, 1992). Rosenberg et al. (1992) emphasize the value of understanding the evolutionary developments of HPT. They state that it is important for those in academia who are interested in the field of HPT to be familiar with significant contributions to its foundations and origins so that they can clearly explain its practical value to managers in industry, students, and peers unfamiliar with the field. Since HPT is a relatively new field and still in an evolving state, a grounding in its foundation and origins is crucial in future attempts to define it.

Origins of HPT. HPT has its roots in human resource specialties such as behavioral psychology and programmed instruction (Stolovitch & Keeps, 1992). It has developed over the past 30 years from major theoretical influences that Rosenberg et al. (1992) entitle as; (a) *systems*; the systems approach of thinking how smaller organizational subsystems fit into larger suprasystems, (b) *learning psychology*; perspectives on how people learn, (c) *instructional design*; the systems approach to training and education, (d) *problem analysis*; the systems approach to identifying and analyzing a problem prior to designing a solution, (e) *cognitive engineering*; designing human-to-machine interfacing for improved and faster learning, (f) *information technology*; job aids and electronic communication systems, (g) *ergonomics*; human interaction with tools and equipment, (h) *psychometrics*; measurement of human capability and achievement, (i) *feedback systems*; communication systems to inform workers of their individual effectiveness, (j) *organizational development and change*; general operational management of an organization and how to change it, and (k) *intervention*; systems approach to providing solutions to problems. These are an amalgamation of ideas from various disciplines synthesized for supervision.

Significant contributors. The following is a brief recognition of key individuals and their studies or discoveries that have made significant contributions to the field of HPT by either adding to its theoretical base or integrating new achievements.

The work of B. F. Skinner (1954, 1958) is considered by most HPT practitioners to be the origin of their field. Skinner proposed that learning could be greatly enhanced through small progressive steps of instruction along with extensive feedback. His ideas led to the first teaching machines that utilized a format known as programmed instruction. Research and practice in this area led to important concepts in educational psychology regarding feedback and reinforcement (Rosenberg et al., 1992).

Thomas F. Gilbert was a student of Skinner and is noted for his early work in instructional systems design (Rosenberg et al., 1992). He is famous for his development of diagnostic models for measuring performance discrepancies, comparing exemplary performance to typical performance, and linking performance analysis to the bottom line (Rossett, 1992). Gilbert (1996) described *performance* as a product of both human effort and the accomplishment of that effort. The relationship between performance, accomplishment, and effort can be stated as a mathematical formula: performance = accomplishment / effort. Much like the common measure for productivity (Berliner, 1979), the variables in Gilbert's formula are measures of value. However, the values in Gilbert's formula may or may not be measures of labor, overhead, or materials cost. For example, accomplishment may be a measurement of employee satisfaction, or effort may be a measurement of mental stress, or either may be intangible values. In any case, according to Gilbert, the way we improve performance is to "increase the value of our accomplishments while reducing the energy we put into the effort" (p. 18). He states that the true worth of any performance is not derived from the amount of effort put into it, but from the value of its outcome.

Robert F. Mager (1970) developed early easy-to-use tools for writing instructional objectives (Mager & Beach, 1967). He is also noted for his work in developing a decision process model for analyzing and determining the root cause of performance discrepancies (Rosenberg et al., 1992). The model prescribes specific interventions according to particular answers to closed-ended questions (Mager & Pipe, 1984).

HPT is a theoretical framework for improving employee performance. With its roots in human resource specialties such as behavioral psychology and programmed instruction, HPT is a relatively new field. Over the past 30 years, researchers such as Skinner, Gilbert, and Mager have been major influences in the shaping and developing of practical HPT applications for theoretical concepts in: systems thinking, learning psychology, instructional design, problem analysis; cognitive engineering; information technology; ergonomics; psychometrics; feedback systems; organizational development and change intervention.

HPT as a Cycle

The term *technology* is not only interpreted as electronic and mechanical objects or materials and processes, because it also means the scientific study of practical matters (Mitcham, 1994). In recent terms, technology is increasingly referred to as the application of procedures derived from scientific research and practical experience to solve practical problems (Clark & Sugrue, 1990). When performance is joined with the word technology, it suggests the application of behavior science (management), as well as natural science (electronic and mechanical objects or materials and processes), to increase the value of accomplishments and reduce the cost of effort in the workplace. HPT is the application of a systems approach to improving the worker, the work and the workplace (Rosenberg, 1995).

The aim of HPT is to improve human performance in the workplace by analyzing the gaps between where employees are and where they need to be to accomplish their goals and objectives (Rosenberg, 1994). Human performance can be improved by making changes in the appropriate areas of the system in which employees work, such as their job definitions, incentives, instruction, and material and processes (Stolovitch & Keeps, 1992).

To help explain the supervisor's role of improving employee performance, a leadership model called the Performance Improvement Cycle is synthesized from previous work of Deterline and Rosenberg (1992) and Rothwell (1996) and presented in Figure 1. The cycle consists of three phases: Phase A Measurement/Evaluation, Phase B Cause/Needs Assessment, and Phase C Improvement Implementation.

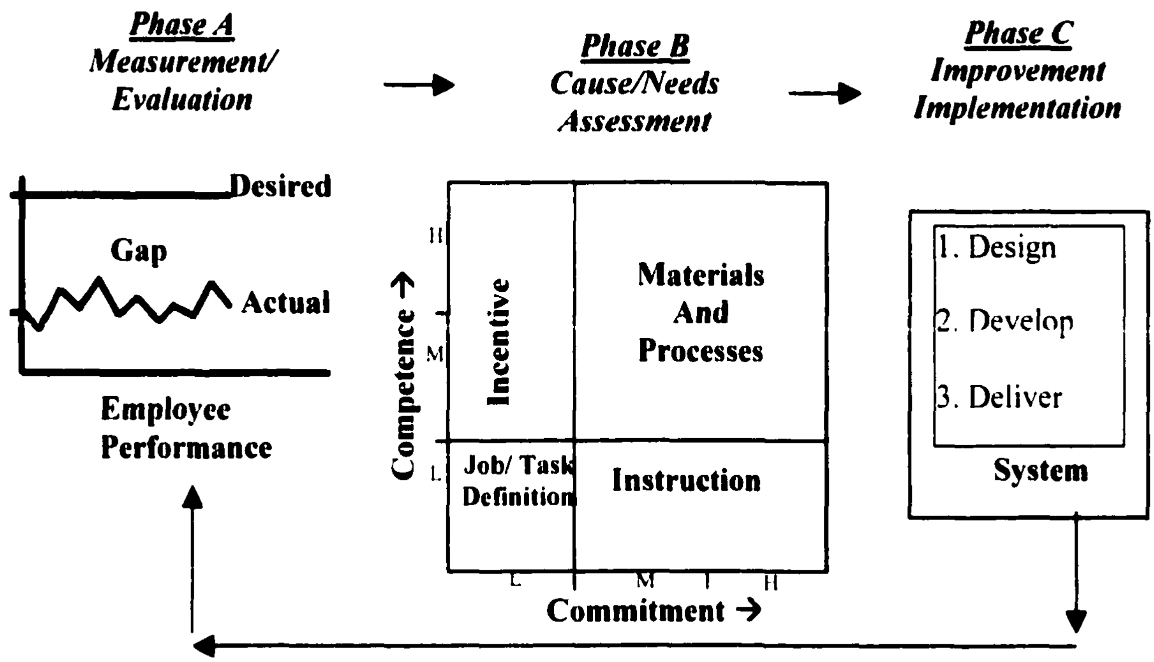

Figure 1. The Performance Improvement Cycle: A systems approach to improving human performance in the workplace. The Performance Improvement Cycle consists of three continuous phases: Phase A Measurement/Evaluation, Phase B Cause/Needs Assessment, and Phase C Improvement Implementation.

Phase A Measurement/Evaluation

Measurement is the foundation for improving employee performance because it is the primary tool used for monitoring and evaluating employee performance in relation to organizational goals. The correct selection of performance measures that support organizational goals is critical. For without proper selection of measures, performance improvement efforts are likely to result in a collection of unrelated and unmanageable goals (Rummler & Brache, 1995; St. Clair & Sharp, 1998). A performance measurement chart, such as that illustrated in Phase A Measurement/Evaluation of Figure 1, is used to measure, (a) what the desired performance of a group (or individual) ought to be, (b) their actual performance, and evaluate (c) the gap between the desired and actual performance. If management considers the gap significant enough to merit an intervention, its cause or needs of the group and the system in which they work must be assessed (Rosenberg, 1995; Rossett, 1992).

Phase B Cause/Needs Assessment.

The diagram in Phase B Cause/Needs Assessment of Figure 1 shows how four factors (job/task definition, incentives, materials and processes, and instruction) are correlated to a group's (or one's) degree of competence and commitment to perform within a current system of work. One example could be for a group (or individual) whose competence and commitment is low, there may exist a need for job/task definition. A second example might be for those whose competence is medium but whose commitment is low, there may be a need for incentives. On the other hand, for those whose commitment is high but whose competence is low, there is a need for instruction. A fourth example could be that for whose competence and commitment are both high, the cause of their performance gap is in their materials and processes. In any case, when common causes and/or general needs are identified, their contributing factors must be further assessed (Hersey, Blanchard, & Hambleton, 1988; Rossett, 1992).

The contributing factors for common causes and/or general needs can be found in one or all of the following areas:

1. Job/Task Definition
2. Incentive
3. Materials and Processes
4. Instruction

Job/Task Definition. Deming (1994) states that jobs and tasks should be well defined so that a concept of the performance desired of employees can be developed and agreed upon (by supervisors and employees) for translation into measurement of some kind. Specific needs in the area of job/task definition can be obtained by looking for a lack of definition of desired performance. By reviewing organizational strategic plans (goals, objectives, initiatives, etc.) and company documents (job descriptions, quality manuals, work standards, agreements, etc) supervisors can determine the desired performance of their wage employees (Kirkham, 1992; Mager, 1984a; Mager 1984b). Those who struggle with how they are to do their work, why they need to do it, or who they are doing it for, are suffering from specific needs in the area of job/task definition.

Incentive. At times people need an incentive to optimize their performance (Hersey et al., 1988). Specific incentive needs can be determined by surveying wage employees with questions designed to uncover a lack of: (a) feedback, (b) positive or negative consequences, and (c) good working relationships among peers and management, that affect the desired performance (Deming, 1990; Mager & Pipe, 1984; Stolovitch & Keeps, 1992; Yaney, 1997).

Rummler and Brache (1995) define feedback as something that tells people that they either need to improve their performance or that they don't need to improve their performance. They propose that to keep good performance from deteriorating and bad performance from remaining unimproved, feedback should be provided on a regular basis. Feedback should consist of relevant, accurate, timely, and specific information that is easy to understand. Everyone is deserving of feedback, particularly people who are not aware of how well they are performing (Mager, 1992).

Mager (1992) and Deming (1990) state that negative and positive consequences can be very powerful tools for improving performance. People who are positively rewarded for good performance will likely continue to perform well. On the other hand, people will most likely discontinue doing something if they are punished for doing it, or receive no reward for doing it. However, negative consequences can have a bad impact on performance if people are being punished for doing the right thing. Examples of this may be when a person is branded as a "whistleblower" for reporting hazardous conditions, or warned by colleagues to "slow down" or face increased quotas. An example of appropriate incentive by negative consequences is when people are brought to the realization that if they do not perform well, a competitor may capture more of their company's market share.

Good working relationships are a trait of high-performing employees because they feel they can express their differences of opinions to their peers and managers without fear. They also tend to be willing to receive feedback about their strengths and weaknesses from those same people. Employees who perform well are usually driven by incentives and supported by good working relationships of mutual trust and respect (Blanchard, Carew, & Parisi-Carew, 1996).

Materials and processes. Specific needs in the area of materials and processes can be determined through measurements and testing of quality, quantity, capability, capacity, and ergonomics. Materials can be deficient in either quality or quantity or both. Processes may need better capability, capacity, or ergonomic soundness.

To do any job right, an employee's performance greatly depends on having the right quality and the right quantity of materials on hand. It is not uncommon for an employee to be under the stress of a production deadline and wondering if his or her materials are going to show up from the supplier. Gitlow, Gitlow, Oppenheim, and Oppenheim (1989), Bhote (1989) and Deming (1982) convey the well-known fact that a correct quality and quantity of materials are prerequisite for successful performance.

People also need the processes within their workplace (their tools, machines, and workstations) to be capable of performing as expected. In regards to process capability, Deming (1990) states that "once a process has been brought into a state of statistical control, it has a definable capability. It will show sustained satisfactory performance . . ." (p. 339). In regards to process ergonomics, Grandjean (1990) states that a manufacturing process should be designed to fit the person, as opposed to fitting the person to the process. Ostrom (1993) and Smith (1996) cite statistics that show how industry can improve employee performance and avoid the high costs of cumulative trauma disorders (muscle and skeletal injuries and illnesses) by providing sound ergonomic practices in the workplace.

Instruction. Information, knowledge, and skill acquisition are specific needs in the area of instruction. Instruction can be in the form of either job aids or training or both.

Training can improve knowledge and skills. Job aids can provide for informational needs (Mager & Pipe, 1984; Stolovitch & Keeps, 1992).

In regards to training, Deming (1982) states that management should stop their "dependence on unintelligible printed instructions . . . (and) . . . institute modern methods of training on the job" (p. 31). In the same regard, Schonberger (1986) says that training "must somehow be streamlined so that it doesn't keep progress on hold" (p. 208). When good training design and development can be coupled with subject matter expertise, training becomes more streamlined and effective. While training design and delivery skill usually resides in an organization's human resource development department (Rummler & Brache, 1995), subject matter expertise usually resides within the line functioning departments.

Job aids are tools for streamlining instruction. They provide assistance for people during their work (Sugar & Schwen, 1995). Mager (1992) says that job aids are things that people use on the job everyday that remind them of what they already know but don't bother to memorize. Job aids can be such things as checklists, telephone books, setup sheets, work orders, work instructions and working drawings. He promotes the use of well designed job aids as a cost effective alternative to training.

Electronic performance support systems (EPSS) are a recent technological innovation used for instructional job aids. EPSS are a combination of computer software and hardware linked as a system of interactive instructional technology advancements that directly support a person's performance when, how, and where the support is needed (Gery, 1991; Raybould, 1995). An EPSS can quickly instruct employees so that they may make timely decisions and solve problems (Reynolds, 1993). According to Raybould (1995) and Levin (1994), EPSS can: (a) accelerate on-the-job learning, (b) significantly reduce training time and cost, (c) give workers more flexibility in their job tasks, (d) help train difficult-to-reach workers, (e) decrease paper documentation, and (f) help capture and store knowledge from various experts.

Expert systems are an enhancement to EPSS. With integrated expert systems software, an EPSS can be designed to help users solve problems by providing "expert" instruction in specific areas quickly and accurately whenever and wherever the instruction is needed. By interacting with an expert system, a user can be provided with the experience of human experts (who have had their knowledge input into the system) without incurring the time and cost of actually meeting them (Milheim, 1990; Rasmus, 1989; Wilson & Welsh, 1986).

Phase C Improvement Implementation

A group of employees may have specific needs that require implementing one or more improvement efforts to support their needs. The illustration in Phase C Improvement Implementation of Figure 1 shows that by obtaining the necessary resources, improvement efforts should be designed, developed, and implemented to solve specific causes of problems and to provide for the unique needs of the group (or individual). When multiple efforts are implemented to solve different causes and cover various areas of need, they should work together like components of a system (Mager & Pipe, 1984; Stolovitch & Keeps, 1992). Once an improvement effort has been implemented, it is important to evaluate its effectiveness by returning to Phase A

Measurement/Evaluation to see if the original gap between the desired performance and actual performance has been closed.

In today's sophisticated world of manufacturing with modern production technologies, employee performance issues are becoming increasingly complex. Rather than solely providing training, supervisors should apply the Performance Improvement Cycle to improve employee performance. Through a theoretical framework like the Performance Improvement Cycle, supervisors can take a more complete approach to analyzing employees, their work, and their workplace environment, discover what underlying issues may exist, and ultimately provide solutions that encourage peak performance.

Taxonomy of Supervisory Skills for Applying the Performance Improvement Cycle

The three-phase framework of the Performance Improvement Cycle is but a concept, synthesized from previous literature, and used as a leadership model to describe the theoretical practice of HPT. However, the responsibility of transferring this concept into actual practice falls upon various positions within a manufacturing organization. One key position for the practice of this concept may be the supervisor. Berliner, 1979; Dean, 1995; Deming, 1994; Rothwell, 1996; Rummler and Brache, 1995 state that to fulfill his or her job responsibilities in today's complex work environments, supervisors must be competent in the skills required to put the three phases of the Performance Improvement Cycle into motion.

To perform well in today's world of complex manufacturing, supervisors need skills to apply the Performance Improvement Cycle to their own job responsibilities. This review combines the results of three recent studies into a synthesized Taxonomy of Supervisory Skills for improving employee performance (see Appendix A). The following is a brief review of the three studies.

In one study, Stolovitch et al. (1995) conducted a literature search in effort to help fulfill a need for an established standard repertoire of professional skills in the growing field of HPT. They found the literature did not offer much in the way of formally documenting required skills for a practitioner of HPT. However, they justified referencing many competencies for an *instructional* technologist, a highly related profession, since many HPT practitioners use instruction as an effort to solve performance problems. Basic skill requirements for all HPT practitioners were reported. Skills were categorized by "technical skills" in the areas of analysis, observation, and design, and by "people skills" in the areas of communication and management (p. 44).

In a second study, Dean (1995) proposed to better articulate the ideal practice of HPT by surveying a random sample of 45 academics, internal practitioners, and external consultants who are members of the International Society for Performance Improvement (ISPI). The survey asked the respondents, "What factors have . . . contributed to . . . successful implementation (of HPT)?" (p. 69). His study extends the research of Stolovitch et al. (1995) by refining the basic "technical skills" in the areas of analysis, observation, and design, and basic "people skills" in the areas of management and communication (pp. 82-83).

In a third study, Rothwell (1996) conducted a three-phase approach in which he also identified competencies needed by practitioners of HPT. Phase 1 was a research of literature resulting in a lengthy list of competencies compiled from books, articles, or reports. In Phase 2, the list was circulated to a panel of 22 experts in the human resource development profession and in the headquarters of the American Society for Training and Development (ASTD). The experts then selected from the list the competencies they believed were the most relevant and specific to HPT. Phase 3 was a type of reverse Delphi procedure where a panel of experts was assembled to review and verify those competencies selected in Phase 2. Rothwell's study identified 15 competencies associated with HPT work and 38 competencies associated with HPT "roles" such as analyst, intervention specialist, change manager, and evaluator (pp. 18-19).

The following combines the results of the three studies into a synthesized list of 30 specific skills entitled Taxonomy of Supervisory Skills for improving employee performance, and believed to be what is required by supervisors to put the Performance Improvement Cycle into motion. The 30 skills are categorized by three phases of the Performance Improvement Cycle with an additional fourth category of other general skills that are used in all three phases.

<u>Category A Measurement/Evaluation</u>

A1. <u>Setting goals and objectives:</u> defining desired results of work groups, processes, or individuals; helping others to establish work standards and define their performance expectations.

A2. <u>Measuring actual performance:</u> measuring an organization's actual performance in relationship to its goals; helping others to measure their actual performance pertaining to their goals.

A3. Identifying performance issues: finding gaps that exist between desired results and actual performance; to identify problems or opportunities for improvement.

A4. Providing feedback: collecting information about actual performance (good or bad) and feeding it back clearly, specifically, and on a timely basis to appropriate employees.

A5. Evaluating impacts of improvement efforts: determining how well an effort to improve performance went according to plan; examining the effects of problems that exist and the efforts to correct them; relying on shared beliefs and assumptions about "right" and "wrong" ways of doing things.

A6. Company awareness: understanding the vision, strategy, goals, and objectives of the company; linking them to departmental performance measurements.

A7. Understanding human performance: distinguishing between results and effort; recognizing the amount of effort used to achieve results.

A8. Relating to goals of others: looking beyond details to see how a particular effort to achieve departmental goals will effect (or not effect) higher organizational goals and the goals of other departments.

Category B Cause/Needs Assessment

B9. Identifying skills: defining the skills required of people to perform their jobs, and evaluating their actual work skills.

B10. Determining commitment: defining the ethics and motivation required of people to perform their jobs, and evaluating their actual work ethics and motivation.

B11. <u>Surveying techniques:</u> observing or preparing written surveys in a way that gathers useful information to determine the needs of people; to identify the root cause(s) of performance problems.

B12. <u>Questioning techniques:</u> gathering information, or stimulating insight in people through the use of the right questions at the right time (e.g., questions that draw out explanations vs. single word answers).

B13. <u>Evaluating incentives:</u> examining issues such as positive or negative reasons for the way people are performing; considering factors such as rewards or punishments, good or bad working relations, and/or use of appropriate feedback.

B14. <u>Determining instructional needs:</u> exploring the most appropriate and cost effective means of instruction; that is, providing information, knowledge, and/or skills (e.g., writing a memo, vs. holding a meeting, vs. providing on-the-job training).

B15. <u>Evaluating materials:</u> examining issues such as material quality and quantity that are affecting performance, considering factors such as the appropriate use and disposal of hazardous materials.

B16. <u>Evaluating processes:</u> examining issues such as process capability and capacity that are affecting performance; considering safety and ergonomic factors.

<u>Category C Improvement Implementation</u>

C17. <u>Action planning:</u> organizing what action steps should be taken to support the needs of people; to eliminate or address the root cause(s) of performance problems.

C18. <u>Predicting effects of single and multiple actions:</u> analyzing the positive and/or negative consequences of one or more actions intended to correct a performance problem; the effects on different departments within the company, as well as on the company's customers, suppliers, and employees.

C19. Obtaining resources: identifying and justifying the appropriate resources (e.g., money, people) for implementing plans to eliminate or address the root cause(s) of performance problems.

C20. Initiating action plans: Organizing, scheduling, and overseeing the planned actions for supporting the needs of employees; to address the root cause(s) of performance issues.

C21. Stick-to-itiveness: coping with stress resulting from change and from multiple meanings or possibilities; getting desired results despite conflicting priorities, lack of resources, and uncertainty.

C22. Influencing others: knowing how to influence others positively to achieve desired work results.

C23. Maintaining formal and informal communication channels: knowing the various means in which information is communicated throughout the company, and using those various means to implement improvements.

C24. Maintaining working relationships: recognizing how different groups of people function; influencing group members so that their individual needs are addressed as well as their common goals; observing individuals and groups for their interactions and the effects of their interactions with others; helping groups and individuals to discover new insights and points of view.

Category D Other General Skills

D25. Organizational culture awareness: seeing different departmental organizations as dynamic, political, economic, and social systems that have multiple goals; using this larger perspective as a framework for understanding and influencing events and change.

D26. Computer use: using existing or new computer technology and different types of software and hardware; understanding computer systems and applying them as appropriate.

D27. Communication techniques: communicating effectively in visual, oral, and written form (e.g., reports, work instructions).

D28. Understanding the company's business: demonstrating awareness of the inner workings of the company's functions and how financial business decisions can affect people's performance.

D29. Maintaining a "systems" viewpoint: identifying inputs, throughputs, and outputs of the company, its production processes and jobs; applying that information to implement improvements.

D30. Practical know-how: Understanding the results that are desired from a production process, and having the skill to perform certain manufacturing operations that will efficiently and effectively achieve those results.

The preceding section is a list of skills necessary for first line supervisors to implement HPT. The skills are itemized into four categories: Category A

Measurement/Evaluation, Category B Cause/Needs Assessment, Category C Improvement Implementation, and Category D Other General Skills.

As a relatively new field, HPT has emerged as a complete approach to improving employee performance in the workplace. HPT is a theoretical framework with its roots in human resource specialties such as behavioral psychology and programmed instruction. Over the past 30 years, application research in theoretical concepts such as: systems thinking, learning psychology, instructional design, problem analysis; cognitive engineering; information technology; ergonomics; psychometrics; feedback systems; organizational development and change intervention have been major influences in the shaping and developing of practical HPT. The aim of HPT is to improve employee performance by analyzing performance gaps and making changes in the appropriate areas of the system in which employees work such as their: job definitions, incentives, instruction, and material and processes. The Performance Improvement Cycle is used as a model to help explain the supervisor's role of improving employee performance. The cycle consists of three phases: Phase A Measurement/Evaluation, Phase B Cause/Needs Assessment, and Phase C Improvement Implementation. There are 30 Supervisory Skills for Improving Employee Performance that are categorized by the three phases in the Performance Improvement Cycle with a fourth category for other general skills.

Conclusion

If supervisors knew everything about today's complex production technologies they could tell wage employees what to do, how to do it, and when to do it. They could get by with the traditional supervisory skills of directing and controlling employees, making all of the decisions. But when supervising a diverse group of wage employees who are highly skilled in modern production technologies, such an approach would be a mistake. To perform well in today's world of complex manufacturing, supervisors need skills to apply the Performance Improvement Cycle to their own job responsibilities.

With the modern production technologies and different types of highly skilled employees in mind, what are the most important skills to have in order for a supervisor to perform well in today's complex work environments? An increase in breadth and depth of employee performance both on the factory floor and in business decision making has called for a transformation of skills used by supervisors, from that of directing and controlling employees, to that of supporting and improving employee performance (Carr, 1997; Dean, 1995; Deming, 1994; Polakoff, 1990). Studies by Crutchfield (1998), Douglas (1997), and Hynds (1997) show that in order for supervisors to make the transformation, it is important for them to obtain certain skills in leading and improving human performance. Many authors in the field of training and development believe that the primary skills of a supervisor today are in managing what Rummler and Brache (1995, p. 71) refer to as the "human performance system." Supervisors need to do more than simply train wage employees. They need to work a continuous cycle of improving the performance of wage employees by managing the system in which they work (Gayeski, 1995; Hotek & White, 1999; International Society of Performance Improvement [ISPI], 1997; Mager, 1995; Rosenberg, 1995; Stolovitch & Keeps, 1992).

CHAPTER 3

METHOD OF STUDY

This study is of a descriptive research design utilizing a questionnaire as the data collection instrument. The questionnaire was developed by the researcher from the Taxonomy of Supervisory Skills (refer to Appendix A), and Likert-type rating scales. The skills were divided into three categories according to their use in the leadership model, the three phases of the Performance Improvement Cycle, with an additional fourth category for the "other general skills" used in all three phases.

To validate the questionnaire, a pilot study was conducted. Both qualitative and quantitative methods were used to analyze the data collected in the pilot study. The two analyses of data showed that the questionnaire was reasonably valid and reliable enough to be used for the data collection instrument in this study.

For the overall study, a sample of employees, supervisors, and managers were selected from a population of manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area. They were asked to rate the importance of each skill listed on the questionnaire. The resulting data were analyzed in four ways: First, a split-half reliability coefficient was performed to further validate the instrument. Second, a Pareto analysis was conducted to identify which categories and skills are most important. Third, a comparative analysis was conducted to determine differences in opinion between employees, supervisors, and managers. Finally, a one-way analysis of variance (ANOVA) F test of significance was conducted, followed by a post hoc test where appropriate, to determine if differences in opinion between the three groups were significant. The following provides a more detailed description of the methods used in this study.

Population Characteristics

The population represented in this study consisted of industrial firms in the Waterloo/Cedar Falls, Iowa metropolitan area that employ a total of 50 or more people[1]. To be more specific, the population could be classified by the U. S. Office of Management and Budget as: Manufacturing, Standard Industrial Classification (SIC) Major Groups 23, 24, 34, 35, 36, 37, and 38 (Cedar Valley Economic Development Corp., 1999). Based upon convenience of access by the researcher, nine companies were sampled from the population with characteristics described in Table 1.

Access to the Population

Initially, the researcher needed access to one company as a sample of the population for a pilot study. By sending a letter to the plant manager of one company (from here on referred to as Company I), the researcher requested the company's participation in this study. (See Appendix E for an example of the letter requesting initial access.) The plant manager responded to the letter by granting the researcher a visit to Company I. During the visit, the researcher explained to the plant manager and to the president of the company the purpose of the research, a need for a pilot study, and the anticipated benefits

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[1] A criterion of 200 or more people was originally proposed. However, the researcher found that most of the manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area employ fewer than 200 people. Therefore, to gain a better representation of the firms in the area, the criterion was changed to 50 or more people.

for both the researcher and the company. As a result, Company I agreed to participate in the pilot study.

Table 1

Manufacturing, SIC Major Group Classifications Represented in this Study.

Manufacturing, SIC Major Group Classification	Products Manufactured
23	Apparel and Other Finished Products Made from Fabrics and Similar Materials
24	Lumber and Wood Products except Furniture
34	Fabricated Metal Products except Machinery and Transportation Equipment
35	Industrial and Commercial Machinery and Computer Equipment
36	Electronic and Other Electrical Equipment and Components, except Computer Equipment
37	Transportation Equipment
38	Measuring, Analyzing and Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks

A show of appreciation to Company I was in order. During a follow up meeting, the researcher thanked the operations manager and president of Company I, and presented to them a report summarizing the findings of the pilot study and specific implications relevant to the company's goals and objectives. As a supportive gesture, the president offered to write a letter recommending to senior executives of other companies their participation in this study. The researcher gratefully accepted the president's offer.

To gain access to more companies for the overall study, the researcher sent letters to senior executives of 21 different companies requesting their participation in this study.

(See Appendix H for an example of the letter requesting access.) Moreover, a letter of recommendation from the president of Company I accompanied each letter. (See Appendix G for an example of the letter of recommendation.) Of the 21 executives solicited, eight granted the researcher a visit to their companies and an opportunity to present the purpose and benefits of the study. As a result of the visits and researcher's presentations, all eight[2] agreed to participate in this study. (From here on the eight are referred to as Companies II, III, IV, V, VI, VII, VIII, and IX).

Sampling Procedure

A sample of three groups (employees, supervisors, and managers) was selected from the companies who agreed to participate. Individual employees, supervisors, and managers were selected by either a company representative or by the researcher from their company's personnel listing. However, once selected, their participation was voluntary.

Of the six smaller companies (Companies I through VI that employed about 200 or less people), when selected and informed of the purpose and procedures of the survey, no one refused to participate. Most all of the managers and supervisors of the smaller companies were selected for the study, with a random sample of approximately 20% of their employees.

In the three larger companies (that employed approximately 1000 or more people), different degrees of representation were provided. In Company VII, about half of the

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[2] A criterion of three companies was originally proposed. However, the researcher found that a sampling of nine companies was required to obtain a representative sample of at least 22 managers, a number approved by the statistician of the researcher's advisory committee.

managers, 10 randomly selected supervisors, and 20 randomly selected employees chose to participate. It was not made known to the researcher the total number of production supervisors and employees at Company VII. In Company VIII, all of the managers and supervisors participated, as well as a random selection of 38 employees. In Company IX, approximately 30% of the managers and at least 80% of the supervisors participated, along with 18 randomly selected employees. Table 2 displays the total sample size of the three groups consisting of 154 employees, 66 supervisors, and 25 managers. Job experience of the study participants is depicted in Appendix I.

Table 2

Sampling Procedure for this Study

Population
21 Cedar Valley Manufacturers that employ 50 or more people, and classified as SIC Major Groups 23, 24, 34, 35, 36, 37, 38

Company	SIC Major Group Classification	n_1 Employees	n_2 Supervisors	n_3 Managers
I	35, 37	19	4	1
II	35	15	4	1
III	35,36,38	16	3	2
IV	34	5	2	1
V	23	13	12	2
VI	35	10	5	1
VII	35	20	10	12
VIII	24	38	22	4
IX	35	18	4	1
Total		154	66	25

Note: From a population of 21 Cedar Valley Manufacturers, three sample groups were selected (n_1 = 154 employees, n_2 = 66 supervisors, and n_3 = 25 managers).

Instrumentation

The preceding section provided a description of the size and major characteristics of the population and samples associated with this study. A description of the sampling procedure was also reported. The following section provides a rationale for the instrumentation used in this study. The instrument is described here in terms of its purpose and content. Procedures involved in developing the instrument are discussed, as well as procedures for validating the instrument.

Rationale

As stated previously in Chapter 2, there is very little sound research in what people who work in manufacturing line organizations believe supervisors should do that is most important. Consequently, there is not much extant instrumentation designed to collect this type of data from factory people. For this reason, the researcher developed a questionnaire as the instrumentation for this study with a purpose of collecting the opinions of employees, supervisors, and managers as to what they believe supervisors should do that is most important in the area of improving employee performance.

Description and Development

Skills used by academic, consulting, and human resource professionals in the area of HPT have been identified in previous research (Dean, 1995; Rothwell, 1996; Stolovitch et al., 1995). A synthesis of those studies was used to establish the Taxonomy of Supervisory Skills. The skills were numbered (30 in all) and positioned as items on the instrument according to their respective categories of use in the three phases of the Performance Improvement Cycle: measurement/evaluation, cause/needs assessment, and improvement implementation, with an additional fourth category of the "other general skills" used in all three phases. Using a design similar to that used by the U.S. Merit Systems Protection Board (1992), a set of Likert-type rating scales were constructed so that respondents could rate on a scale of one to five, the importance of each supervisory skill listed on the instrument. (See Appendix C for an example of the instrument.) Each skill could then be given a total rating score and a mean rating score.

Human Subjects Review

A description of the study and example of the instrument was submitted for human subjects review. The study and instrument was determined to be exempt from further review by the University of Northern Iowa Institutional Review Board, and the researcher was given permission to commence participation of human subjects (N. M. Durham, personal communication with Chair, UNI Institutional Review Board, July 9, 1999).

Validation

A pilot study was performed to validate the instrument and estimate its reliability. Upon completion of the pilot study, qualitative estimating procedure was used to determine if all members of the three groups could easily understand the written instructions, skill statements, and rating procedures on the questionnaire. A quantitative procedure was used to estimate the instrument's internal consistency reliability, that is, how each item on the survey relates to all other items on the survey and to the total instrument.

The pilot was conducted at Company I, a company that employs a total of more than 100 people. A sample of 24 people who work in the company's production department was selected to validate the instrument. The sample consisted of the company's plant manager, all four of their production supervisors, and 19 production employees who were chosen at random. Figure 2 displays the number of pilot study participants and their years of experience at their current job positions.

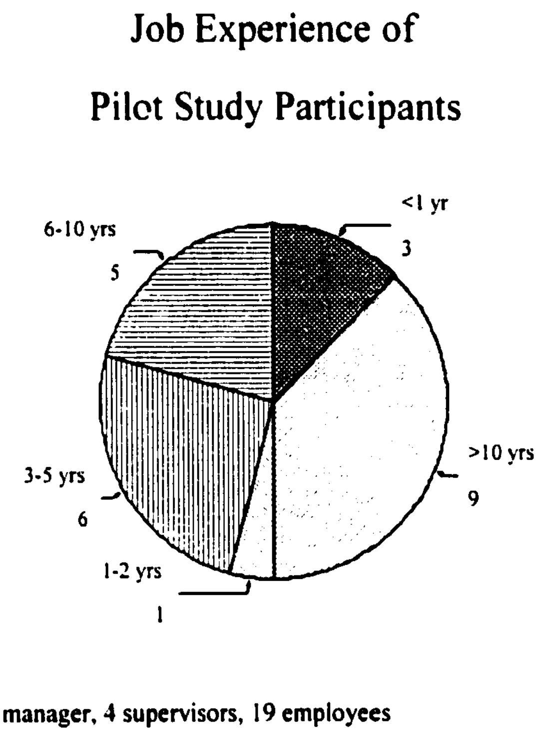


Figure 2. Job experience of pilot study participants. A pie chart displays the number of pilot study participants and their years of experience at their current job positions.

Data collection for the pilot study took place during four different meetings at Company I. The first meeting was in a small conference room with all four of the company's supervisors. The second and third meetings took place in a vacant lunchroom with a sample of first shift and second shift employees. The fourth meeting was with the plant manager in his office. In each case, the researcher personally administered the instrument. Also in each case at the beginning of the survey, the researcher verbally explained to the groups the purpose of the study, and was present during the completion of the survey. To determine if each participant could easily complete the questionnaire, an additional comments sheet was distributed with the questionnaire to collect feedback about how well they understood the written instructions, skill items, and the rating procedures. Upon completion of the survey, the participants returned the questionnaires and the comment sheets to the researcher.

Qualitative analysis. Of the 24 people who participated in the pilot study, four chose to complete the comments sheet. The following were their responses to each question on the comment sheet:

1. Are the written directions understandable? How could they be written better?

    "Yes."
    "Excellent. No problems with the directions."
    "The directions are very easy to read and straight forward."
    "Yes, the directions were clear."

2. How convenient are the marking (fill-in-the-dot) procedures? Is there a better way?

    "Good. No."
    "No problem."
    "The fill in the dot is very good, but the circles are a little large."

3. Are there any items that are unclear? How might they be written more clearly?

"No."
"Every item was easy to understand. Alot (sp) of thought put into it."
"All of the questions are very clear."
"Some of the questions tended to have to (sp) many commas. These can be difficult to understand for the layman."

All of the above comments were taken into consideration for estimating and improving the participants' understanding of the written instructions, skill items, and the rating procedures on the questionnaire. As a result of the comments, the circles used for filling in the dots on the rating scales were made a bit smaller, and unnecessary commas were removed from some of the text in the skill items. However, the qualitative estimating procedure described above showed that for all practical purposes, the questionnaire was appropriate in its original form.

Internal consistency. Using SPSS for Windows (Green, Salkind, & Akey, 2000) a split-half reliability coefficient was computed for each of the skill items on the questionnaire according to their four respective categories in the Taxonomy of Supervisory Skills (A, B, C, and D). Care was taken to assure the best split of items in each category produced equivalent halves. This was accomplished by assigning odd numbered items to one half and even numbered items to the second half. Since each category had an even number of items, they were each split into two equal halves. For example, survey items in Category A: Measurement/Evaluation were split into two halves for the purpose of reliability analysis in the following fashion:

Half 1: item A1, item A3, item A5, and item A7

Half 2: item A2, item A4, item A6, and item A8

In each category, descriptive statistics in the results of the analyses were checked to confirm that data had no major anomalies. For example, all the means were within the range of possible values of 1 to 5. There were no unusually large variances that might indicate that a value had been mistyped, and the correlations among the variables were generally positive, confirming that the data was entered and scaled appropriately. Using the Spearman-Brown correlation formula, the internal consistency reliability results for Categories A, B, C, and D were .83, .88, .89, and .78 respectively, all of which are measures of reasonable reliability. Fraenkel and Wallen state that "for research purposes, a useful rule of thumb is that reliability should be at least .70 and preferably higher" (p. 179). See Appendix F for Tables 37, 38, 39, and 40 that show specific descriptive statistics, correlation matrices, and reliability coefficients for all questionnaire items in Categories A, B, C, and D.

Conclusion. Since the qualitative analysis of data collected from comments sheets showed reasonable validity of the instrument, and the split-half coefficients showed reasonable reliability of the instrument, the instrument was assumed to be reasonably valid and reliable. Furthermore, since there were no revisions made to the instrument that would affect the validity and reliability of the data collected during the pilot, the pilot data was included in the bank of data for the overall study.

Data Collection

With a supply of pencils, copies of the questionnaire for each participant, and pre-composed notes for consistently communicating the purpose and instructions for the questionnaire (refer to Appendix B), the researcher personally administered the survey to participants on site at their respective companies. With the only exception being Company VII where the questionnaires were not completed in the presence of the researcher, meetings were scheduled in rooms provided by the participating companies and at a convenient time for the participants. Some meetings were held on day shift, some on night shift, and others on graveyard shift, depending on when participants were able to take a break from their work. The survey was administered to employees separate from their supervisors. That is to say, employees met with other employees and supervisors with other supervisors. Everyone was allowed whatever time they needed to complete their questionnaires, averaging around 20 minutes. They were instructed to place their completed questionnaires in a box provided by the researcher, assuring them that the researcher was the only one to see all individual responses.

Managers completed their questionnaires separately and at their own convenience. Some completed the questionnaire in the presence of the researcher; others mailed them to the researcher. A potentially confounding variable in this administrative procedure was the fact some participants, particularly those from Company VII, did not complete the questionnaire in the presence of the researcher. Ordinarily, this would be a suitable method for administering a survey. However the original design was to have all participants complete their questionnaires in the presence of the researcher. Those who did were assured consistent information of the purpose and instructions for their participation in the survey, over and above those provided on the cover page of the questionnaire. The potential effect on the study was no doubt slight. Nevertheless, this was one variable the researcher was unable to control. Another uncontrolled variable was the sampling by availability of the managers of Company VII. However, since the sample included about half of their total managers, the potential of sampling bias was minimal.

Data Analysis

Data collected in this study were scores on a scale of 1 to 5 by employees, supervisors, and managers for the importance of each skill item on the questionnaire. The following four methods were used to analyze the rating scores.

First, to solve problem statement 3 (see Chapter 1): "Identify which categories of supervisory skills and which individual skills within each category are most important," a Pareto analysis of the total mean scores for each of the four categories of skill and for individual skills within each category was conducted. The Pareto analysis utilized a bar chart by arranging the mean scores of each category and/or skill in a descending order of importance from left to right to separate and display the most important skills from the least important. The Pareto analysis was applied to help prioritize the skills needed by a supervisor and hence determine what skills should be acquired first. For example, Figure 3 shows a Pareto analysis of the total mean scores for the four categories of the Taxonomy of Supervisory Skills.

Second, to solve problem statement 4: "Determine differences in opinion between employees, supervisors, and managers as to the importance of each category of skills, and the importance of individual skills within each category," a comparative analysis was conducted. The comparative analysis utilized a cluster-type bar chart of the mean scores to compare how groups rated the importance of each category and/or skill. For example,

Figure 4 displays mean rating scores across the three groups as a comparative analysis for the four categories of the Taxonomy of Supervisory Skills.

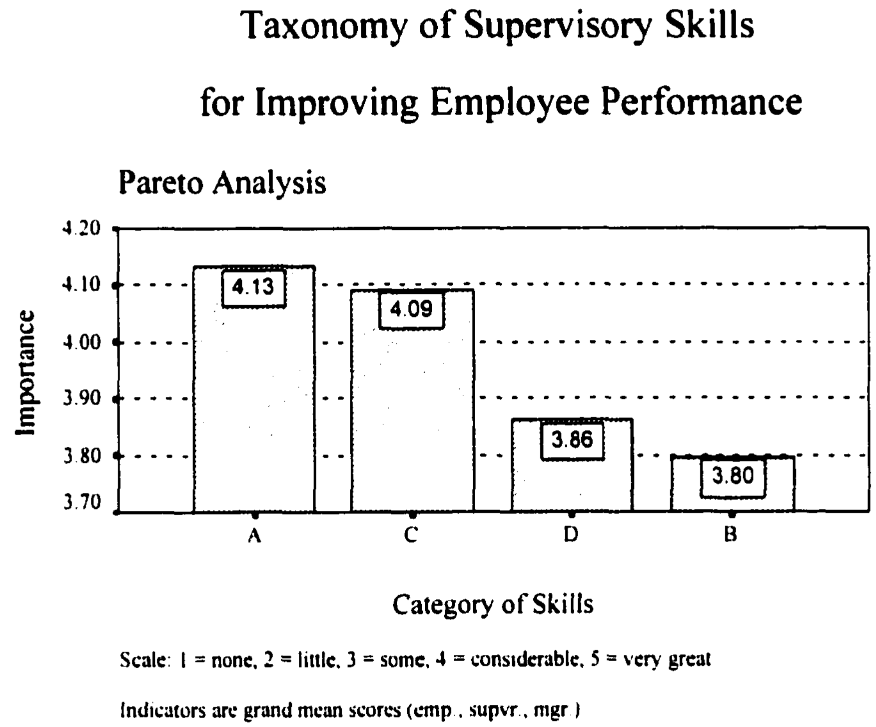


Figure 3. An example of a Pareto analysis. Utilizing a bar chart, indicators representing the grand mean rating scores of the four categories of the Taxonomy of Supervisory Skills are arranged in a descending order of importance from left to right, to separate and display the most important skills from the least important. In this example, the two most important indicators are Category A and Category C.

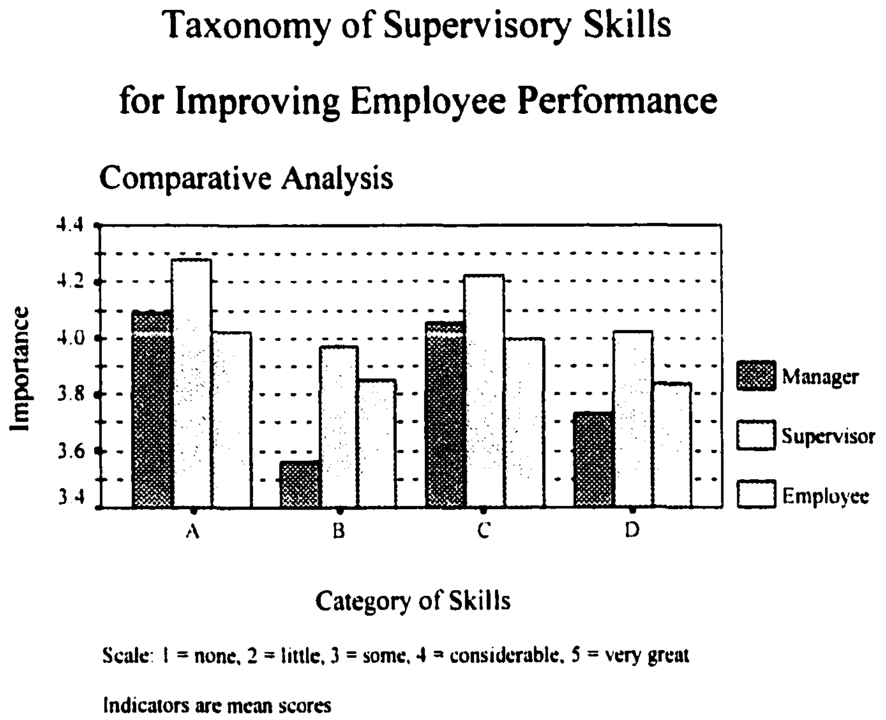


Figure 4. An example of a comparative analysis. Utilizing a cluster-type bar chart of indicators representing mean rating scores for each group, a comparative analysis displays the differences in how the three groups rated the importance of each category of the Taxonomy of Supervisory Skills.

Finally, the total mean rating scores for each of the four categories listed in the Taxonomy of Supervisory Skills, and the mean score for individual skills within each category, were assessed for significant differences between employees, supervisors, and managers. The following null hypotheses were tested using a one-way analysis of variance (ANOVA) F test, and where appropriate, a follow up post hoc test.

Null Hypothesis One

When rating the Taxonomy of Supervisory Skills in Category A: Measurement/Evaluation, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{01}: $\mu_1 = \mu_2 = \mu_3$.

Null Hypothesis Two

When rating the Taxonomy of Supervisory Skills in Category B: Cause/Needs Assessment, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{02}: $\mu_1 = \mu_2 = \mu_3$.

Null Hypothesis Three

When rating the Taxonomy of Supervisory Skills in Category C: Improvement Implementation, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{03}: $\mu_1 = \mu_2 = \mu_3$.

Null Hypothesis Four

When rating the Taxonomy of Supervisory Skills in Category D: Other General Skills, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{04}: $\mu_1 = \mu_2 = \mu_3$.

The level of significance was chosen at .05. According to Hurlburt (1994), "the scientific community rather arbitrarily chooses $\alpha = .05$ . . . as an acceptable probability of reporting false (Type I error) results" (p. 171). There were three groups that yielded two degrees of freedom. Figure 5 illustrates the criterion for rejecting the four null hypotheses.

The between-subjects factor in each case was either one of the four categories of skill, or an individual skill within a category. The levels for each factor were three groups identified by their job positions (employees, supervisors, and managers). Where a category of skill was the factor, the dependent variable was the total mean rating scores for all individual mean scores within that category. Where an individual skill was the factor, the mean rating score for that skill became the dependent variable.

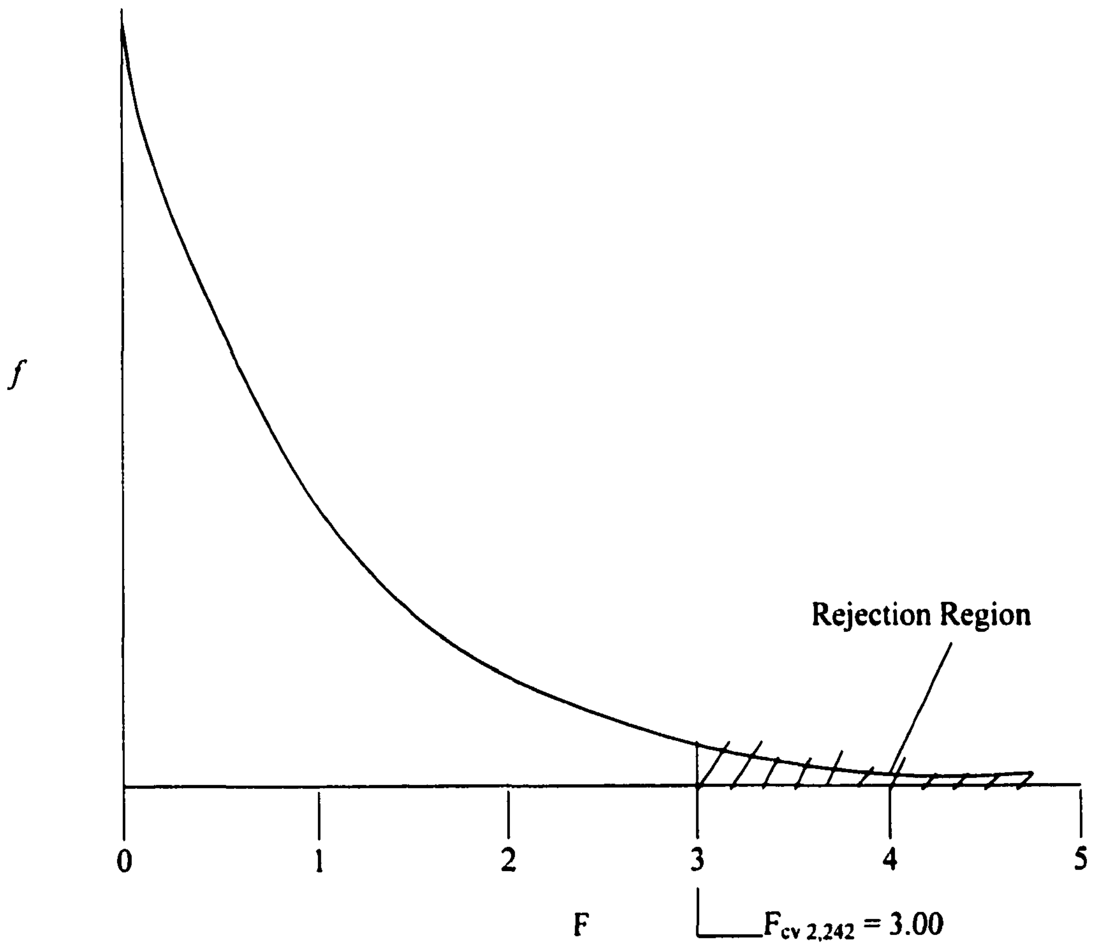


Figure 5. The ANOVA F test statistic (2 and 242 degrees of freedom) with rejection region shaded.

The one-way ANOVA F test of significance was chosen for the following reasons. First, a test of significance was needed for evaluating whether mean scores of the three groups significantly differ from each other. Since there are three factors in each case, a one-way ANOVA F test was "more convenient" in determining significance than performing multiple t-tests of significance (Gay & Airasian, 2000, p. 491).

Secondly, the following assumptions taken in this study fit the "assumptions underlying one-way ANOVA" (Green et al., 2000, p. 159):

1. By observing separate histograms of the four categories, the researcher determined that the dependent variable is normally distributed for each of the populations.

2. To the extent that variances of the dependent variable may be unequal because the sample sizes differ among the groups, it was deemed appropriate to choose a Dunnett's C procedure for conducting post hoc multiple comparison tests, because it is reasonably robust to violations of homoscedasticity.

3. The ANOVA F would yield accurate p values since the independence assumption would not be violated. The researcher used a randomization procedure for choosing samples. The questionnaire was personally administered separately to the groups. So in that sense, they were independent and did not talk to each other. There is somewhat of a violation of independence because the subjects were clustered within companies. However, the procedures used were assumed reasonably robust to this violation.

In all, there were four methods of data analysis used in this study. They were: a split-half reliability estimate, a Pareto analysis, a comparative analysis, and a one-way ANOVA.

Summary of Methods

Utilizing a questionnaire as the data collection instrument, this study is of a descriptive research design. The questionnaire was developed from the Taxonomy of Supervisory Skills and Likert-type rating scales. The skills were divided into three categories according to their use in the three phases of the Performance Improvement Cycle, with an additional fourth category for the "other general skills" used in all three phases.

A pilot study was conducted to validate the questionnaire. The qualitative and quantitative methods were used to analyze the data collected in the pilot study showed that the questionnaire was reasonably valid and reliable enough to be used for the data collection instrument in this study.

A sample of employees, supervisors, and managers from a population of manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area were selected as participants in this study. On a scale of 1 to 5, they rated the importance of each skill listed on the questionnaire. The data were analyzed in four ways: First, a split-half reliability estimate was performed to further validate the instrument. Secondly, a Pareto analysis was conducted to identify which categories and skills are most important. Third, a comparative analysis was conducted to determine differences in opinion between employees, supervisors, and managers. Finally, a one-way analysis of variance

(ANOVA) $\underline{F}$ test of significance was conducted, of the differences in rating scores of each of the four categories and of skills within their categories followed by a post hoc test where appropriate, to test for significant differences in opinion between the three groups.

CHAPTER 4

FINDINGS

The purpose of this study was to provide to industry and education a better understanding of what makes a production supervisor a good supervisor of today's highly educated and technically skilled workforce. From a dependency on employee-technology relationships in manufacturing, a new role for supervision has emerged, the role of improving employee performance.

Human performance technology (HPT) is a theoretical framework for improving employee performance. With its roots in human resource specialties such as behavioral psychology and programmed instruction, HPT is the application of theoretical concepts in: systems thinking, learning psychology, instructional design, problem analysis; cognitive engineering; information technology; ergonomics; psychometrics; feedback systems; organizational development and change intervention. The aim of HPT is to improve performance in the workplace by analyzing the gaps between where employees are and where they need to be to accomplish their goals and objectives (Rosenberg, 1994). Employee performance can be improved by making changes in the appropriate areas of the system in which they work, such as their job definitions, incentives, instruction, and material and processes (Stolovitch & Keeps, 1992).

Findings of Problem Statements One and Two

The first two problem statements of this study were formulated to provide a theoretical framework in which to help explain the supervisor's new role of improving employee performance.

Restatement of Problem One

The first problem statement of this study was to construct a three-phase leadership model for improving employee performance.

A synthesis of the literature in the area of HPT resulted in the construction of a three-phase leadership model as explained and referred to in Figure 1 of Chapter 2 as the Performance Improvement Cycle. It is presented here again in Figure 6.

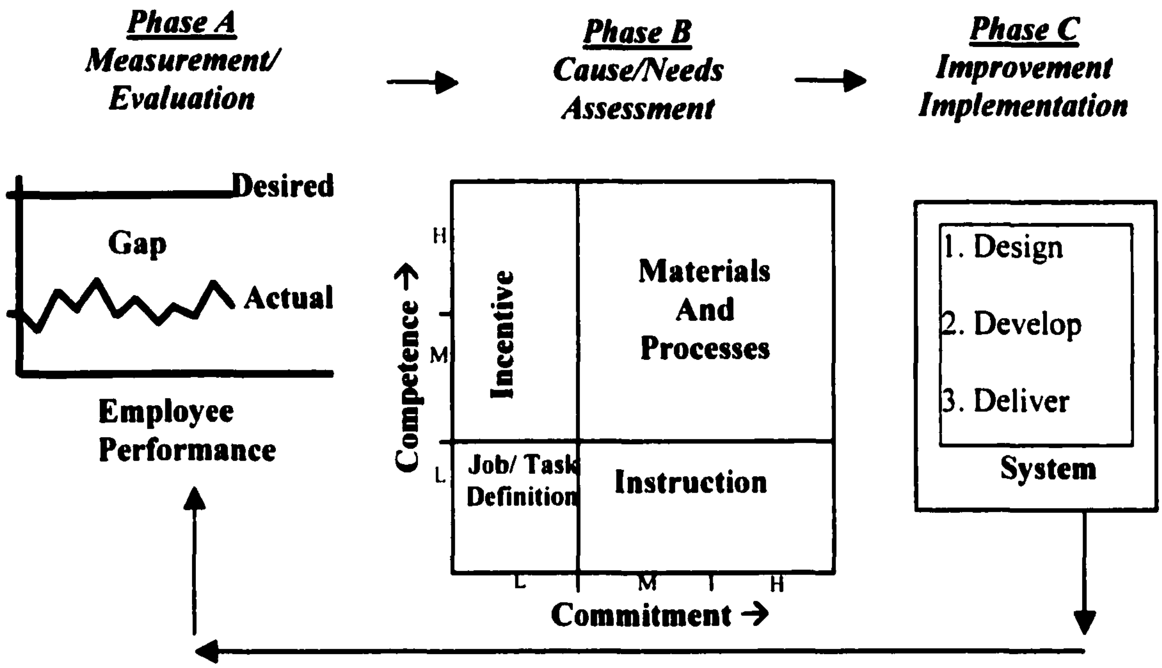


Figure 6. The Performance Improvement Cycle: A systems approach to improving human performance in the workplace. The Performance Improvement Cycle consists of three continuous phases: Phase A Measurement/Evaluation, Phase B Cause/Needs Assessment, and Phase C Improvement Implementation.

Restatement of Problem Two

The second problem statement of this study was to list a Taxonomy of Supervisory Skills needed to apply the leadership model.

A synthesis of the HPT literature also resulted in the construction of the following Taxonomy of Supervisory Skills. A more detailed description of each skill is provided in Chapter 2 and in Appendix A.

Category A Measurement/Evaluation

A1. Setting goals and objectives

A2. Measuring actual performance

A3. Identifying performance issues.

A4. Providing feedback

A5. Evaluating impacts of improvement efforts

A6. Company awareness

A7. Understanding human performance

A8. Relating to goals of others

Category B Cause/Needs Assessment

B9. Identifying skills

B10. Determining commitment

B11. Surveying techniques

B12. Questioning techniques

B13. Evaluating incentives

B14. Determining instructional needs

B15. Evaluating materials

B16. Evaluating processes

Category C Improvement Implementation

C17. Action planning

C18. Predicting effects of single and multiple actions

C19. Obtaining resources

C20. Initiating action plans

C21. Stick-to-itiveness

C22. Influencing others

C23. Maintaining formal and informal communication channels

C24. Maintaining working relationships

Category D Other General Skills

D25. Organizational culture awareness

D26. Computer use

D27. Communication techniques

D28. Understanding the company's business

D29. Maintaining a "systems" viewpoint

D30. Practical know-how

The Performance Improvement Cycle and the Taxonomy of Supervisory Skills set the theoretical framework in which to view the supervisor's new role of improving employee performance, and thus satisfied problem statements one and two.

The remainder of this chapter is written to present the findings of problem statements three and four.

Findings of Problem Statement Three

The following section disseminates the findings for the third problem statement of this study.

Restatement of Problem Three

The third problem statement of this study was to identify which categories of supervisory skills and which individual skills within their categories are most important.

To find a solution to problem statement three a Pareto analysis of the grand mean scores for each of the four categories of skill and for individual skills within each category was conducted. The Pareto analysis was applied to help prioritize the skills needed by a supervisor and hence identify which categories and skills are most important.

The most important categories of supervisory skills, and most important skills within their categories are identified in the following paragraphs.

Order of Importance by Category

A Pareto analysis of the grand mean scores for all four categories was conducted. The Pareto analysis utilized a bar chart by arranging the grand mean rating scores for each category in a descending order of importance from left to right to separate and display the most important category from the least important. Figure 7 illustrates the four categories of skill in their descending order of importance. The reader may observe that Category A Measurement/Evaluation and Category C Improvement Implementation appear to stand out over Category D Other General Skills and Category B Cause/Needs Assessment.

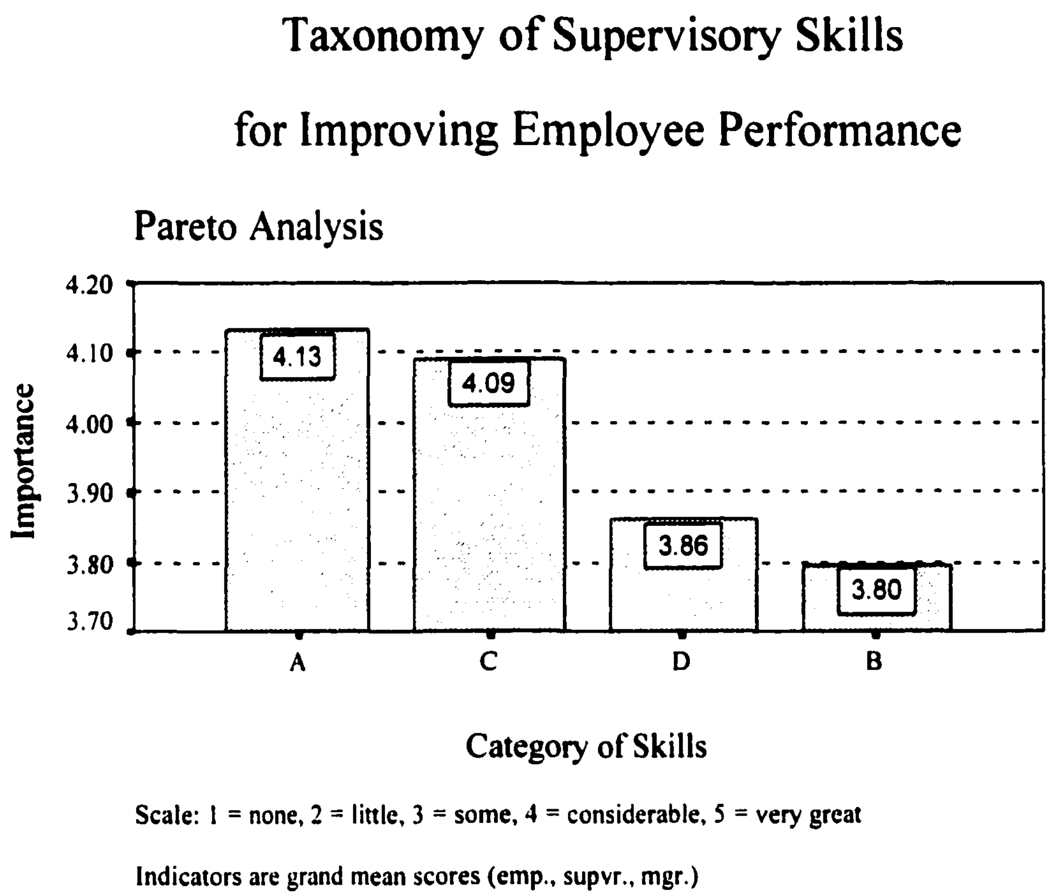
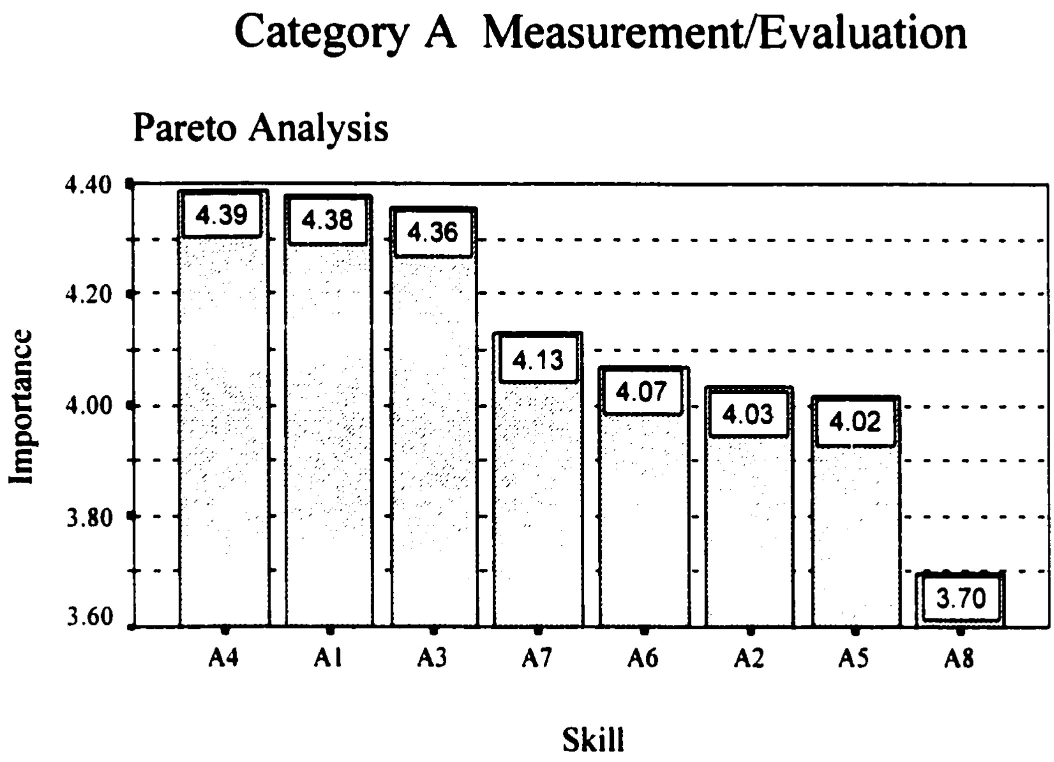


Figure 7. A Pareto analysis of the four categories of Taxonomy of Supervisory Skills. Utilizing a bar chart, the grand mean rating scores of the four categories of the Taxonomy of Supervisory Skills are arranged in a descending order of importance from left to right, to separate and display the most important skills from the least important. Note that the

researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

Category A Measurement/Evaluation. Figure 8 illustrates the Category A skills in their descending order of importance. It should be noted that all the skills were rated somewhat important, for the even the lowest rating in this category was a 3.70. On the rating scale a 3.70 is a measure of "considerable" importance. As can be observed, Skills A4 Providing feedback, A1 Setting goals and objectives, and A3 Identifying performance issues are the most important, followed in descending order by A7 Understanding human performance, A6 Company awareness, A2 Measuring actual performance, and A5 Evaluating impacts of improvement efforts. Skill A8 Relating to goals of others was rated as the least important.

Category B Cause/Needs Assessment. Figure 9 illustrates Category B skills in their descending order of importance. As in Category A, all the skills were rated somewhat important, for the even the lowest rating was a 3.07. On the rating scale a 3.07 is a measure of "some" importance. Skills B9 and B16 are the most important, followed in descending order by B10 Determining commitment, B15 Evaluating materials, B13 Evaluating incentives, B14 Determining instructional needs, B12 Questioning techniques, and the least important was B11 Surveying techniques.



Scale: 1 = none, 2 = little, 3 = some, 4 = considerable, 5 = very great

Indicators are grand mean scores (emp., supvr., mgr.)

Figure 8. A Pareto analysis of the Taxonomy of Supervisory Skills in Category A Measurement/Evaluation. Utilizing a bar chart, the grand mean rating scores of the skills in Category A are arranged in a descending order of importance from left to right, to separate and display the most important skills from the least important. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

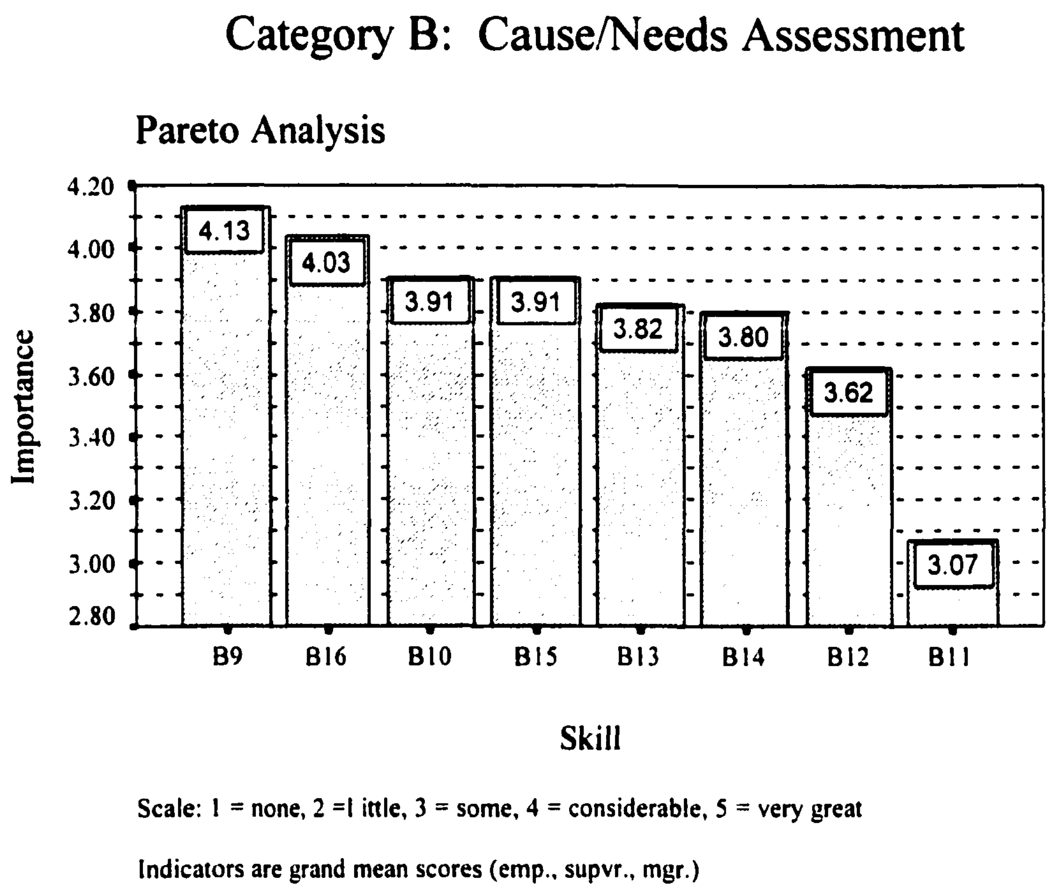


Figure 9. A Pareto analysis of the Taxonomy of Supervisory Skills in Category B Cause/Needs Assessment. Utilizing a bar chart, the grand mean rating scores of the skills in Category B are arranged in a descending order of importance from left to right, to separate and display the most important skills from the least important. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

Category C Improvement Implementation. Figure 10 illustrates Category C skills in their descending order of importance. As were in Category A and Category B, all skills in Category C were rated somewhat important, for the even the lowest rating was a 3.74. On the rating scale a 3.74 is a measure of "considerable" importance. The reader can see that Skills C22 and C23 stand out as the most important, followed in descending order by C24 Maintaining working relationships, C21 Stick-to-itiveness, C20 Initiating action plans, and C17 Action planning. Skills that standout as the least important are C19 Obtaining resources and C18 Predicting effects of single and multiple actions.

Category D Other General Skills. Figure 11 illustrates Category D skills in their descending order of importance. Similar to that of skills in the other three categories, all skills in Category D were rated somewhat important, for the even the lowest rating was a 3.34. On the rating scale a 3.34 is a measure of "some" importance. Note that Skills D27 and D30 are obviously the most important, followed in descending order by D28 Understanding the company's business, D29 Maintaining a "systems" viewpoint, and D26 Computer use. Skill D25 Organizational culture awareness is the least important.

The preceding section disseminated the findings of problem statement 3 by identifying which categories of supervisory skills and which individual skills within their categories are most important. The next section provides outcomes of problem statement four.

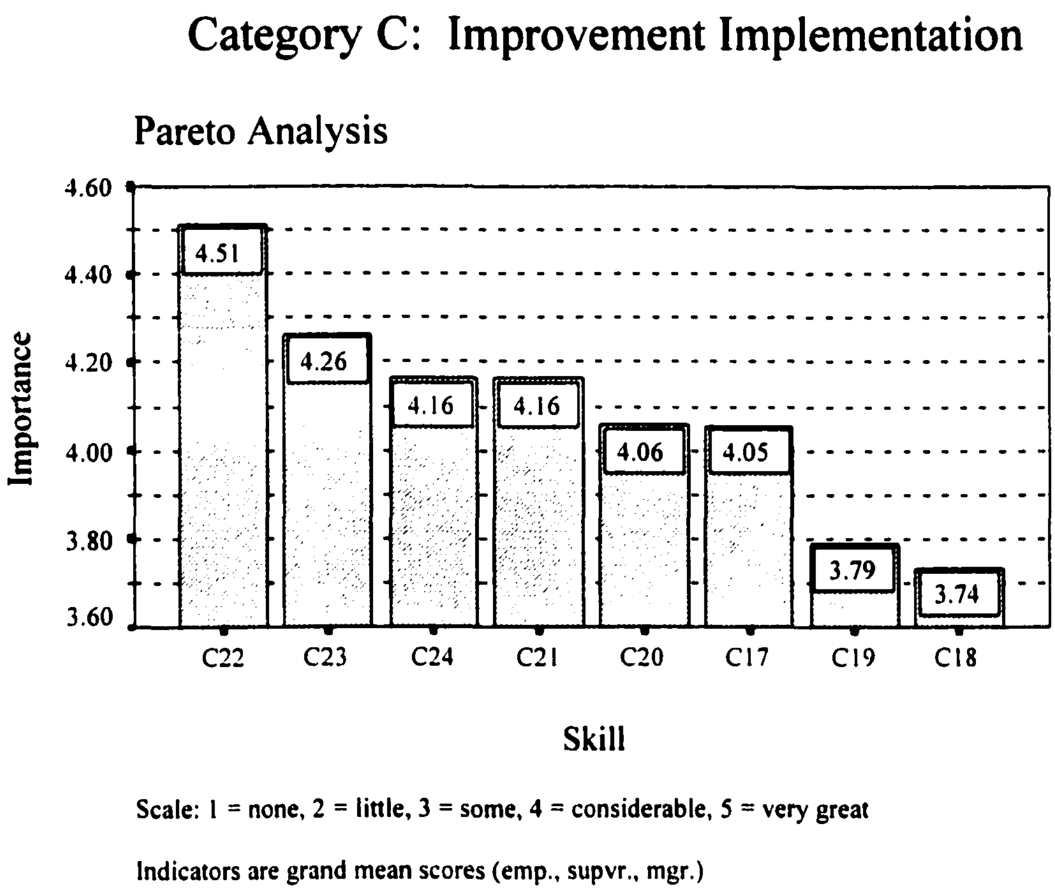
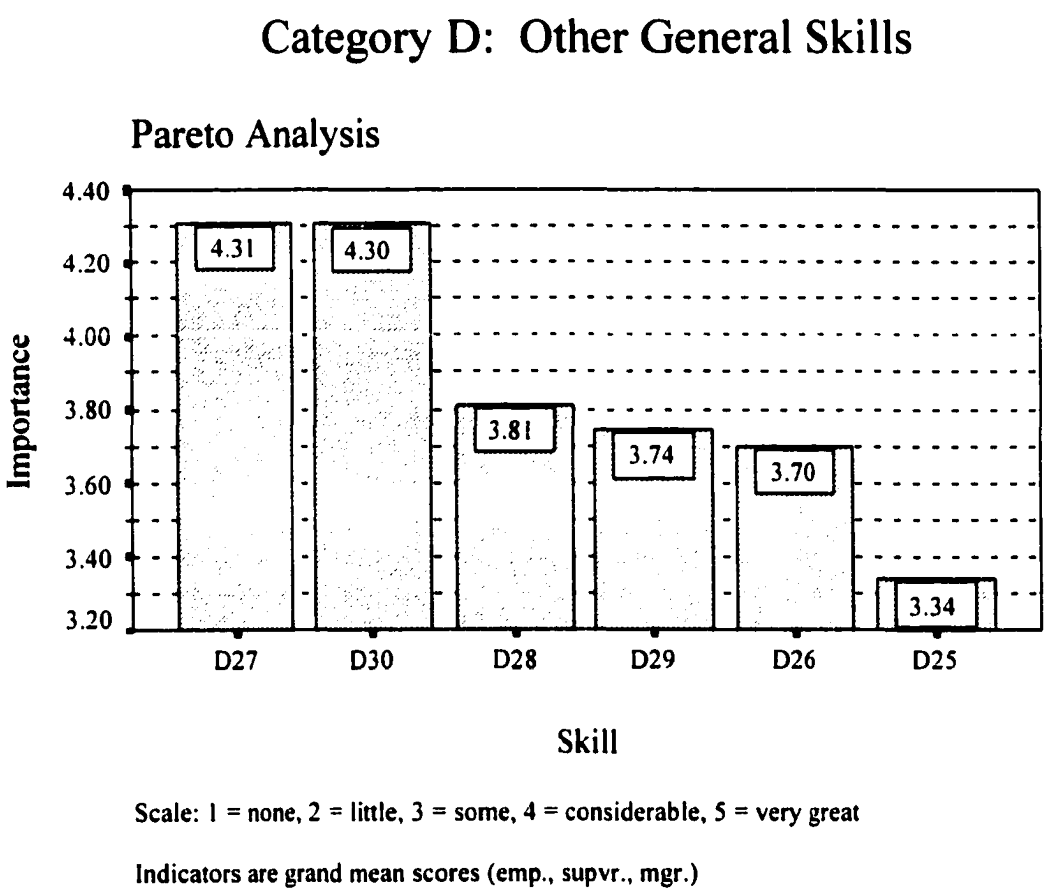


Figure 10. A Pareto analysis of the Taxonomy of Supervisory Skills in Category C Improvement Implementation. Utilizing a bar chart, the grand mean rating scores of the skills in Category C are arranged in a descending order of importance from left to right, to separate and display the most important skills from the least important. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.



<u>Figure 11.</u> A Pareto analysis of the Taxonomy of Supervisory Skills in Category D Other General Skills. Utilizing a bar chart, the grand mean rating scores of the skills in Category D are arranged in a descending order of importance from left to right, to separate and display the most important skills from the least important. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

<u>Findings of Problem Statement Four</u>

The following section provides findings for the fourth (final) problem statement of this study.

Restatement of Problem Four

The fourth problem statement of this study was to determine differences in opinion between employees, supervisors, and managers as to the importance of each category of skill, and the importance of individual skills within each category.

The findings in this section are subdivided into two parts. The first part provides a measurement of the differences in opinion between employees, supervisors, and managers through a series comparative analyses of the mean rating scores of each category, and skill within each category. The comparative analyses provide a picture of how the three groups rated the Taxonomy of Supervisory Skills. The second part of this section is a test of the null hypotheses for the four research hypotheses (noted in Chapter 1). Using a one-way analysis of variance (ANOVA) F test, and where appropriate a follow up post hoc test, an assessment is provided of the significant differences in opinion between employees, supervisors, and managers.

Differences in Category Ratings

A comparative analysis of the mean rating scores for all four categories of the Taxonomy of Supervisory was conducted to determine differences in opinion between employees, supervisors, and managers. The comparative analysis in Figure 12 utilized a cluster-type bar chart of the mean scores to compare how each of the three groups rated the importance of each of the four categories. One can observe from the bar chart the range of differences in ratings for each of the following categories:

Taxonomy of Supervisory Skills

for Improving Employee Performance

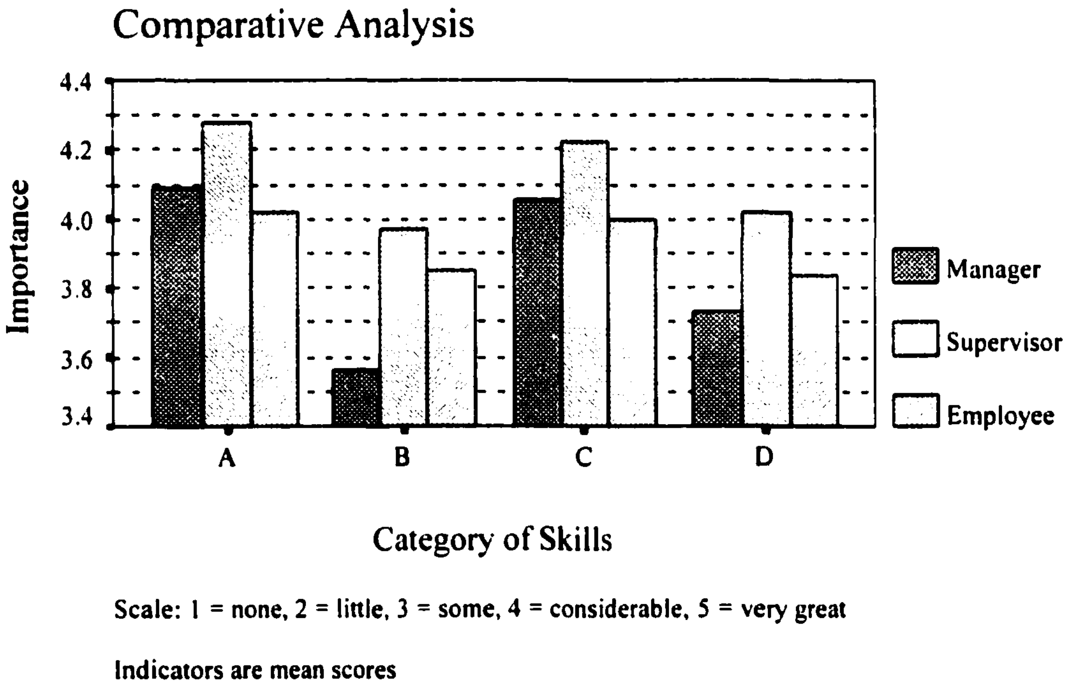


Figure 12. A comparative analysis of the four categories of the Taxonomy of Supervisory Skills. Utilizing a cluster-type bar chart of mean rating scores, a comparative analysis displays the differences in how the three groups rated the importance of Category A Measurement/Evaluation, Category B Cause/Needs Assessment, Category C Improvement Implementation, and Category D Other General Skills. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

Category A Measurement/Evaluation

Category B Cause/Needs Assessment

Category C Improvement Implementation

Category D Other General Skills

It can be observed from this analysis that supervisors rated the highest in every category.

Differences in Skill Ratings Within Each Category

Comparative analyses of the mean rating scores for the skills within each category were conducted to further investigate the differences in opinion between employees, supervisors, and managers. These analyses utilize a cluster-type bar chart of the mean scores to compare how each of the three groups rated the importance of each skill.

Category A skills. Figure 13 displays the mean rating scores for the three groups as a comparative analysis of the Taxonomy of Supervisory Skills in Category A Measurement/Evaluation. One can observe from the bar chart the range of differences in how employees, supervisors and managers rated the following eight skills in Category A:

A1: Setting goals and objectives

A2: Measuring actual performance

A3: Identifying performance issues

A4: Providing feedback

A5: Evaluating impacts of improvement efforts

A6: Company awareness

A7: Understanding human performance

A8: Relating to goals of others

In the majority of the Category A skills, it appears that the supervisors tend to rate them the highest.

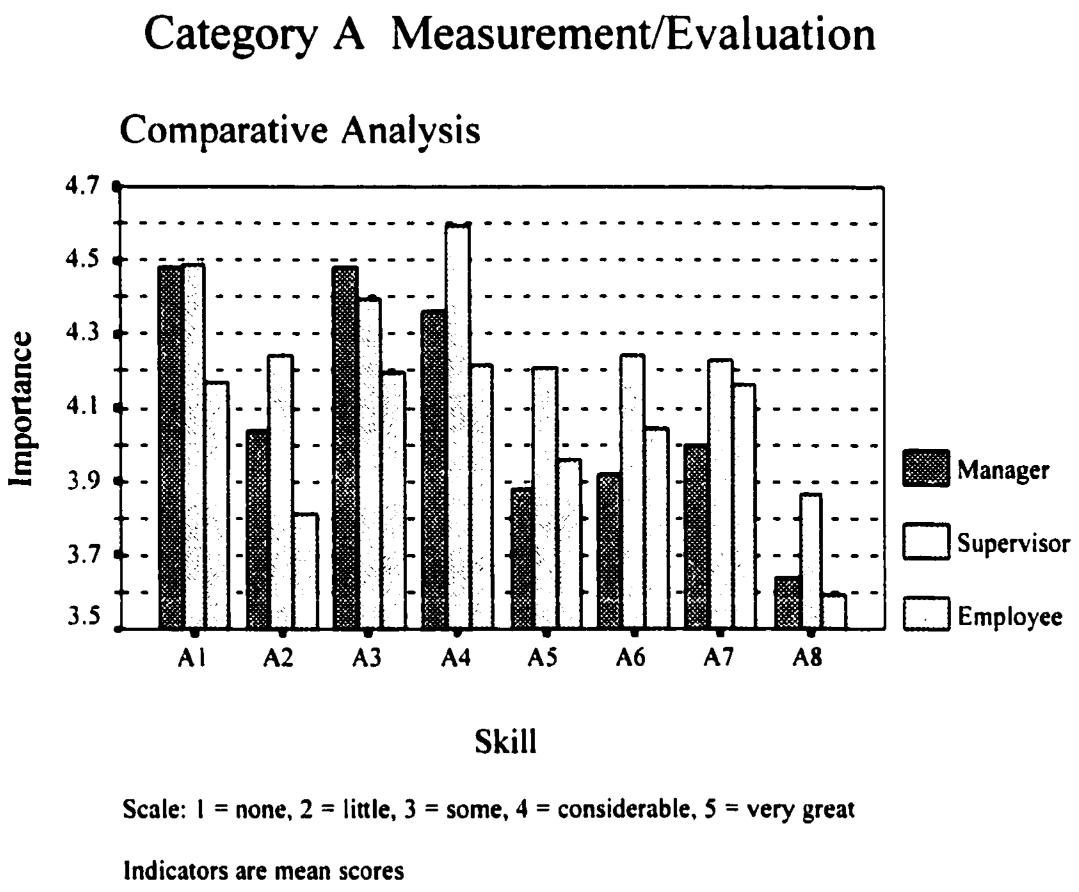


Figure 13. A comparative analysis of the Taxonomy of Supervisory Skills in Category A Measurement/Evaluation. Utilizing a cluster-type bar chart of mean rating scores, a comparative analysis displays the differences in how the three groups rated the importance of each skill. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

Category B skills. Figure 14 displays the mean rating scores for the three groups as a comparative analysis of the Taxonomy of Supervisory Skills in Category B Cause/Needs Assessment. One can observe from the bar chart the range of differences in how employees, supervisors and managers rated the following eight skills in Category B:

B9: Identifying skills

B10: Determining commitment

B11: Surveying techniques

B12: Questioning techniques

B13: Evaluating incentives

B14: Determining instructional needs

B15: Evaluating materials

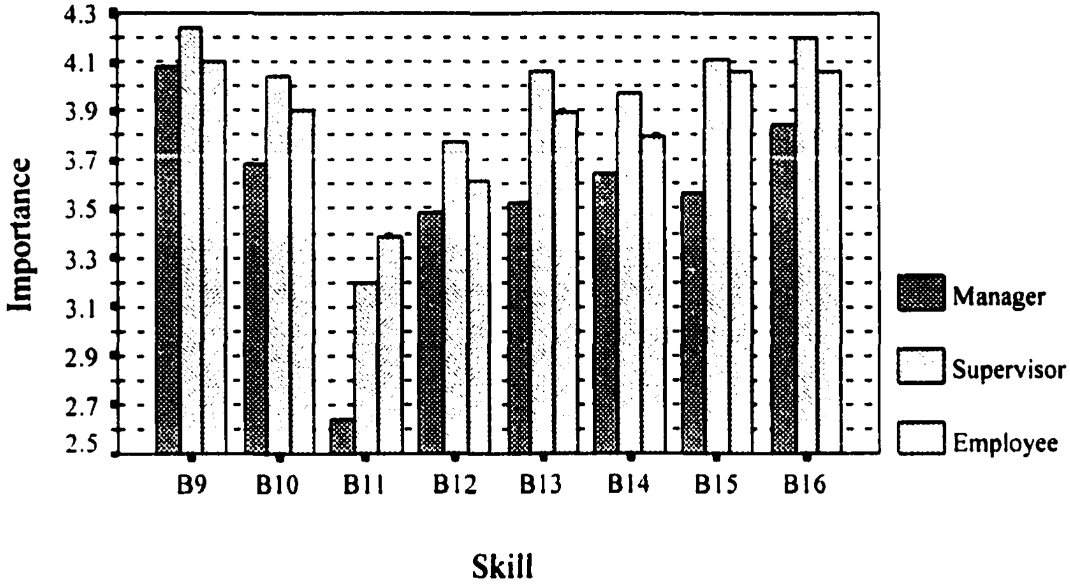
B16: Evaluating processes

As is the case with Category A skills, in the majority of the Category B skills the supervisors tend to rate them the highest. However, it should be noted that managers rated the lowest in every Category B skill.

Category C skills. Figure 15 displays the mean rating scores for the three groups as a comparative analysis of the Taxonomy of Supervisory Skills in Category C Improvement Implementation. One can observe from the bar chart the range of differences in how employees, supervisors and managers rated the following eight skills in Category C:

Category B: Cause/Needs Assessment

Comparative Analysis



Scale: 1 = none, 2 = little, 3 = some, 4 = considerable, 5 = very great

Indicators are mean scores

Figure 14. A comparative analysis of the Taxonomy of Supervisory Skills in Category B Cause/Needs Assessment. Utilizing a cluster-type bar chart of mean rating scores, a comparative analysis displays the differences in how the three groups rated the importance of each skill. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

C17: Action planning

C18: Predicting effects of single and multiple actions

C19: Obtaining resources

C20: Initiating action plans

C21: Stick-to-itivenes

C22: Influencing others

C23: Maintaining formal and informal communication channels

C24: Maintaining working relationships

The supervisors did not rate the highest in every skill. However, they did rate two skills particularly high, Skills C22 and C23. Managers rated Skill C22 very high as well. There appears to be significant differences between the ratings of Skills C22 and C23 between supervisors and employees.

Category D skills. Figure 16 displays the mean rating scores for the three groups as a comparative analysis of the Taxonomy of Supervisory Skills in Category D Other General Skills. One can observe from the bar chart the range of differences in how employees, supervisors and managers rated the following eight skills in Category D:

D25: Organizational culture awareness

D26: Computer use

D27: Communication techniques

D28: Understanding the company's business

D29: Maintaining a "systems" viewpoint

D30: Practical know-how

Again, supervisors rated highest in every Category D skill. There appears to be a significant difference in the rating of Skill D30 between supervisors and managers.

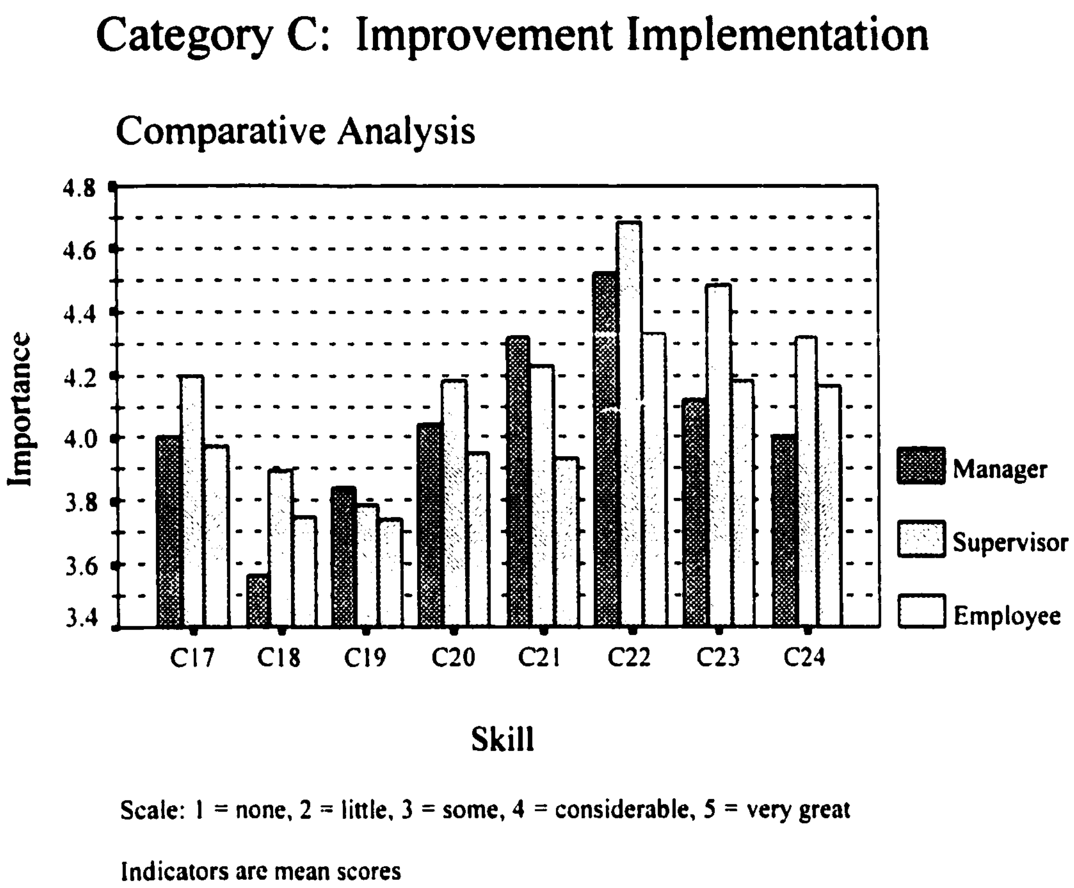
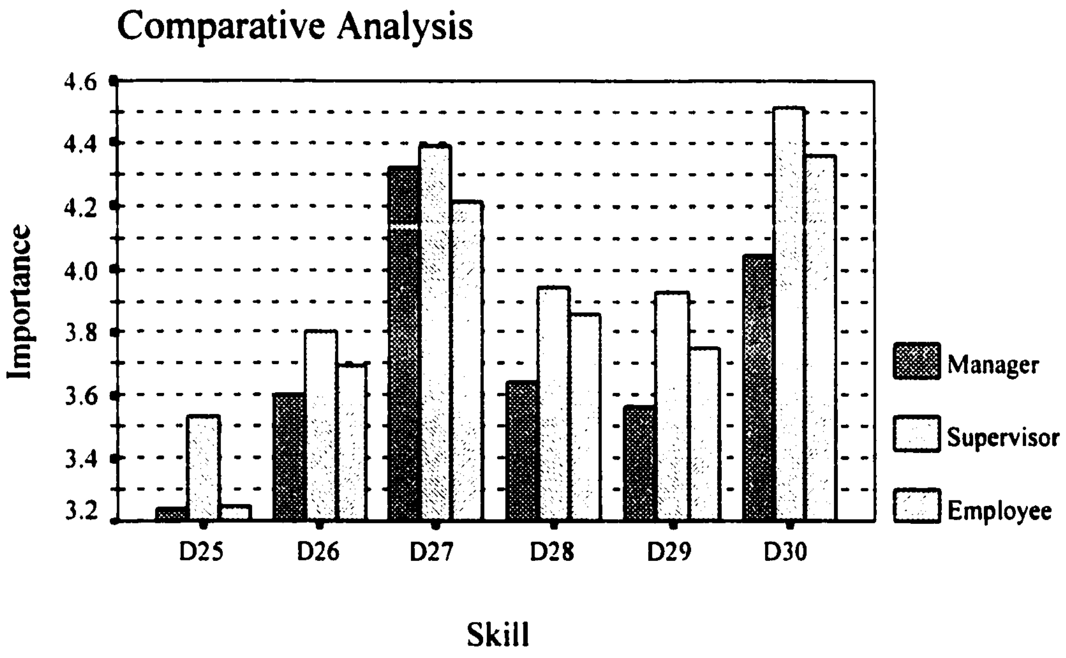


Figure 15. A comparative analysis of the Taxonomy of Supervisory Skills in Category C Improvement Implementation. Utilizing a cluster-type bar chart of mean rating scores, a comparative analysis displays the differences in how the three groups rated the importance of each skill. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

Category D: Other General Skills



Scale: 1 = none, 2 = little, 3 = some, 4 = considerable, 5 = very great

Indicators are mean scores

Figure 16. A comparative analysis of the Taxonomy of Supervisory Skills in Category D Other General Skills. Utilizing a cluster-type bar chart of mean rating scores, a comparative analysis displays the differences in how the three groups rated the importance of each skill. Note that the researcher did not intend to magnify the differences, but the lower scales of the chart have been removed to save space.

The preceding comparative analyses provided a picture of how the three groups rated the Taxonomy of Supervisory Skills. In addition they provided a measurement of the differences in opinion between employees, supervisors, and managers as to how they rated each category and each skill within their categories. The next part of this section is an assessment of the significant differences that were illustrated in the previous comparative analysis charts.

ANOVA Test for Significant Differences Between the Means

A one-way analysis of variance ANOVA was conducted to test for significant differences between the three job positions and their opinions on the importance of the Categories of Taxonomy of Supervisory Skills. The one-way ANOVA F test of significance was chosen for the following reasons. First, a test of significance was needed for evaluating whether mean scores of the three groups significantly differ from each other. Since there are three factors in each case, a one-way ANOVA F test would be more convenient for determining significance than performing multiple t-tests of significance.

In each case the independent variable was the three job positions: employee, supervisor, and manager, and the dependent variable was their opinions (mean rating scores). Also in each case, a p value of less than .05 was chosen as the level of significance of the one-way ANOVA. According to Gay and Airasian (2000), and Hurlburt (1994), the scientific community generally chooses $\alpha = .05$ as an acceptable probability of reporting false (Type I error) results. The criterion for rejecting the four null hypotheses was $F_{cv\ 2,\ 242} = 3.00$. That is, the rejection region was the area under the curve greater than 3.00.

Post hoc tests. Where overall F tests were significant, follow-up tests were conducted to evaluate pairwise differences among the means. A decision was made whether to use a post hoc procedure that assumes equal variances, or one that does not assume equal variances, to control for Type 1 error across the multiple pairwise comparisons. Because there may be a lack of power associated with the relatively small sample size of managers, a homoscedasticity test may not necessarily imply that there are no differences in the population variances. Therefore, the prudent choice for these data would be to use the Dunnett C post hoc test, a multiple comparison procedure that does not require the population variances to be equal (Green et al., 2000).

Tests of the Research Hypotheses

The following are the tests for four research hypotheses (noted in Chapter 1): three concerning the skills as applied to their respective phases in the leadership model (Performance Improvement Cycle), and one concerning the skills used in all three phases of the model.

Test of Hypothesis One

The following are test findings of research Hypothesis One: When rating the taxonomy of supervisory skills in Category A Measurement/Evaluation, managers will rate them significantly more important than will supervisors, and supervisors will rate them significantly more important than will employees.

Restatement of Null Hypothesis One. When rating the Taxonomy of Supervisory Skills in Category A Measurement/Evaluation, there will be no significant differences in mean rating scores between employees, supervisors, and managers. $H_{01}: \mu_1 = \mu_2 = \mu_3$.

To test the null hypothesis, the means of the eight items were computed. ANOVA F tests for significance were conducted between the means of the three job positions. The first was an ANOVA in how they rated the importance of Category A Measurement/Evaluation. Eight more individual ANOVA tests were conducted of to determine significant differences in how employees, supervisors, and managers rated the eight skills within Category A.

Test of significant differences in rating Category A Measurement/Evaluation. For Category A the ANOVA was significant. Because the value of the F test was greater than the critical value of 3.00, a Dunnett C follow up test was conducted to evaluate the pairwise differences among the means. The Dunnett C test showed significant differences in mean scores between employee and supervisor. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 3.

Table 3

Descriptive Statistics and Test Results for Significant Differences in Rating Category A Measurement/Evaluation

Job Position	M	SD	Difference
Employee	4.02	0.59	* (Supervisor)
Supervisor	4.28	0.46	* (Employee)
Manager	4.09	0.39	NS

F (2, 242) = 5.46, p = .005
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance at the .05 level using the Dunnett C procedure.

Test of significant differences in rating Skills A1 through A8. An ANOVA F test was conducted for Skills A1 through A8. Where the F test was greater than critical value of 3.00, a Dunnett C follow up test was conducted to evaluate the pairwise differences among the means. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 4 through Table 11.

Table 4

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A1 Setting Goals and Objectives

Job Position	M	SD	Difference
Employee	4.17	0.78	* (Supervisor)
Supervisor	4.48	0.61	* (Employee)
Manager	4.48	0.65	NS

F (2, 242) = 5.34, p = .005
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 5

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A2 Measuring Actual Performance

Job Position	M	SD	Difference
Employee	3.81	0.80	* (Supervisor)
Supervisor	4.24	0.77	* (Employee)
Manager	4.04	0.89	NS

F (2, 242) = 6.88, p = .001
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 6

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A3 Identifying Performance Issues

Job Position	M	SD	Difference
Employee	4.19	0.91	NS
Supervisor	4.39	0.68	NS
Manager	4.48	0.65	NS

$F(2, 242) = 2.17, p = .117$

Note: NS = nonsignificant differences between pairs of means.

Table 7

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A4 Providing Feedback

Job Position	M	SD	Difference
Employee	4.21	0.89	* (Supervisor)
Supervisor	4.59	0.63	* (Employee)
Manager	4.36	0.64	NS

$F(2, 242) = 5.05, p = .007$

Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 8

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A5 Evaluating Impacts of Improvement Efforts

Job Position	M	SD	Difference
Employee	3.95	0.88	NS
Supervisor	4.21	0.71	NS
Manager	3.88	0.67	NS

$F(2, 242) = 2.64, p = .074$

Note: NS = nonsignificant differences between pairs of means.

Table 9

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A6 Company Awareness

Job Position	M	SD	Difference
Employee	4.04	0.90	NS
Supervisor	4.24	0.88	NS
Manager	3.92	0.81	NS

F (2, 242) = 1.64, p = .196

Note: NS = nonsignificant differences between pairs of means.

Table 10

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A7 Understanding Human Performance

Job Position	M	SD	Difference
Employee	4.16	0.87	NS
Supervisor	4.23	0.78	NS
Manager	4.00	0.71	NS

F (2, 242) = 0.68, p = .507

Note: NS = nonsignificant differences between pairs of means.

Table 11

Descriptive Statistics and Test Results for Significant Differences in Rating Skill A8 Relating to Goals of Others

Job Position	M	SD	Difference
Employee	3.59	1.01	NS
Supervisor	3.86	0.86	NS
Manager	3.64	0.57	NS

F (2, 242) = 1.99, p = .139

Note: NS = nonsignificant differences between pairs of means.

Test of Hypothesis Two

The following are test findings of research Hypothesis Two: When rating the taxonomy of supervisory skills in Category B Cause/Needs Assessment, employees will rate them significantly more important than will supervisors, and there will be no significant difference between the ratings made by managers and supervisors.

Restatement of Null Hypothesis Two. When rating the Taxonomy of Supervisory Skills in Category B Measurement/Evaluation, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{02}: $\mu_1 = \mu_2 = \mu_3$.

To test null hypothesis, ANOVA F tests for significance were conducted between the means of the three job positions. The first was an ANOVA in how they rated the importance of Category B Cause/Needs Assessment. Eight more individual ANOVA tests were conducted of to determine significant differences in how employees, supervisors, and managers rated the eight skills within Category B.

Test of significant differences in rating Category B Cause/Needs Assessment. For Category B the ANOVA was significant. Because the value of the F test was greater than the critical value of 3.00, a Dunnett C follow up test was conducted to evaluate the pairwise differences among the means. The Dunnett C test showed significant differences in mean scores between manager and supervisor and between manager and employee. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 12.

Table 12

Descriptive Statistics and Test Results for Significant Differences in Rating Category B Cause/Needs Assessment

Job Position	M	SD	Difference
Employee	3.85	0.64	* (Manager)
Supervisor	3.97	0.62	* (Manager)
Manager	3.56	0.41	* (Employee and Supervisor)

F (2, 242) = 4.01, p = .019
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Test of significant differences in rating Skills B9 through B16. As was for the skills in Category A, an ANOVA F test was conducted for Skills B9 through B16. Where the F test was greater than critical value of 3.00, a Dunnett C follow up test was also conducted to evaluate the pairwise differences among the means. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 13 through Table 20.

Table 13

Descriptive Statistics and Test Results for Significant Differences in Rating Skill B9 Identifying Skills

Job Position	M	SD	Difference
Employee	4.10	0.88	* (Supervisor)
Supervisor	4.42	0.72	* (Employee)
Manager	4.08	0.70	NS

F (2, 242) = 3.83, p = .023
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 14

<u>Descriptive Statistics and Test Results for Significant Differences in Rating Skill B10 Determining Commitment</u>

Job Position	M	SD	Difference
Employee	3.90	0.98	NS
Supervisor	4.04	0.88	NS
Manager	3.68	0.69	NS

F (2, 242) = 1.47, p = .232

Note: NS = nonsignificant differences between pairs of means.

Table 15

<u>Descriptive Statistics and Test Results for Significant Differences in Rating Skill B11 Surveying Techniques</u>

Job Position	M	SD	Difference
Employee	3.38	1.11	* (Manager)
Supervisor	3.20	0.98	* (Manager)
Manager	2.64	0.95	* (Employee and Supervisor)

F (2, 242) = 5.38, p = .005

Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 16

<u>Descriptive Statistics and Test Results for Significant Differences in Rating Skill B12 Questioning Techniques</u>

Job Position	M	SD	Difference
Employee	3.62	0.98	NS
Supervisor	3.77	0.89	NS
Manager	3.48	0.65	NS

F (2, 242) = 1.09, p = .337

Note: NS = nonsignificant differences between pairs of means.

Table 17

Descriptive Statistics and Test Results for Significant Differences in Rating Skill B13 Evaluating Incentives

Job Position	M	SD	Difference
Employee	3.89	1.09	NS
Supervisor	4.06	0.82	NS
Manager	3.52	0.65	NS

F (2, 242) = 2.74, p = .066
Note: NS = nonsignificant differences between pairs of means

Table 18

Descriptive Statistics and Test Results for Significant Differences in Rating Skill B14 Determining Instructional Needs

Job Position	M	SD	Difference
Employee	3.79	0.99	NS
Supervisor	3.97	0.96	NS
Manager	3.64	0.81	NS

F (2, 242) = 1.29, p = .277
Note: NS = nonsignificant differences between pairs of means

Table 19

Descriptive Statistics and Test Results for Significant Differences in Rating Skill B15 Evaluating Materials

Job Position	M	SD	Difference
Employee	4.06	0.94	* (Manager)
Supervisor	4.10	0.90	* (Manager)
Manager	3.56	0.92	* Employee and Supervisor)

F (2, 242) = 3.51, p = .031
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 20

Descriptive Statistics and Test Results for Significant Differences in Rating Skill B16 Evaluating Processes

Job Position	M	SD	Difference
Employee	4.06	0.91	NS
Supervisor	4.19	0.88	NS
Manager	3.84	0.85	NS

F (2, 242) = 1.47, p = .231

Note: NS = nonsignificant differences between pairs of means

Test of Hypothesis Three

The following are test findings of research Hypothesis Three: When rating the taxonomy of supervisory skills in Category C Improvement Implementation, there will be no significant differences between the ratings made by employees, supervisors, and managers.

Restatement of Null Hypothesis Three. In this case the null hypothesis three is similar to the research hypothesis three. H_{03}: $\mu_1 = \mu_2 = \mu_3$.

To test the null hypothesis, ANOVA F tests for significance were conducted between the means of the three job positions. The first was an ANOVA in how they rated the importance of Category B Cause/Needs Assessment. Eight more individual ANOVA tests were conducted of to determine significant differences in how employees, supervisors, and managers rated the eight skills within Category C.

Test of significant differences in rating Category C Improvement Implementation. For Category C the ANOVA was significant, F (2, 242) = 3.04, p = .050. Because the value of the F test was greater than the critical value of 3.00, a Dunnett C follow up test was conducted to evaluate the pairwise differences among the means. The Dunnett C test showed significant differences in mean scores between employee and supervisor. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 21.

Table 21

Descriptive Statistics and Test Results for Significant Differences in Rating Category C Improvement Implementation

Job Position	M	SD	Difference
Employee	4.00	0.69	* (Supervisor)
Supervisor	4.22	0.37	* (Employee)
Manager	4.05	0.49	NS

F (2, 242) = 3.04, p = .050
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Test of significant differences in rating Skills C17 through C24. As was for the skills in Category A and Category B, an ANOVA F test was conducted for Skills C17 through C24. Where the F test was greater than critical value of 3.00, a Dunnett C follow up test was also conducted to evaluate the pairwise differences among the means. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 22 through Table 29.

Table 22

Descriptive Statistics and Test Results for Significant Differences in Rating Skill C17 Action Planning

Job Position	M	SD	Difference
Employee	3.97	0.99	NS
Supervisor	4.20	0.75	NS
Manager	4.00	0.71	NS

F (2, 242) = 1.42, p = .243

Note: NS = nonsignificant differences between pairs of means

Table 23

Descriptive Statistics and Test Results for Significant Differences in Rating Skill C18 Predicting Effects of Single and Multiple Actions

Job Position	M	SD	Difference
Employee	3.75	0.93	NS
Supervisor	3.89	0.86	NS
Manager	3.56	0.71	NS

F (2, 242) = 1.35, p = .260

Note: NS = nonsignificant differences between pairs of means

Table 24

Descriptive Statistics and Test Results for Significant Differences in Rating Skill C19 Obtaining Resources

Job Position	M	SD	Difference
Employee	3.74	0.99	NS
Supervisor	3.79	1.00	NS
Manager	3.84	0.62	NS

F (2, 242) = 0.145, p = .865

Note: NS = nonsignificant differences between pairs of means

Table 25

Descriptive Statistics and Test Results for Significant Differences in Rating Skill C20 Initiating Action Plans

Job Position	M	SD	Difference
Employee	3.95	1.04	NS
Supervisor	4.18	0.76	NS
Manager	4.04	0.61	NS

F (2, 242) = 1.45, p = .238

Note: NS = nonsignificant differences between pairs of means

Table 26

Descriptive Statistics and Test Results for Significant Differences in Rating Skill C21 Stick-to-itiveness

Job Position	M	SD	Difference
Employee	3.94	0.97	NS
Supervisor	4.23	0.80	NS
Manager	4.32	0.69	NS

F (2, 242) = 3.65, p = .027

Note: NS = nonsignificant differences between pairs of means

Table 27

Descriptive Statistics and Test Results for Significant Differences in Rating Skill C22 Influencing Others

Job Position	M	SD	Difference
Employee	4.33	1.00	* (Supervisor)
Supervisor	4.68	0.56	* (Employee)
Manager	4.52	0.51	NS

F (2, 242) = 3.95, p = .020

Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 28

Descriptive Statistics and Test Results for Significant Differences in Rating C23 Maintaining Formal and Informal Communication Channels

Job Position	M	SD	Difference
Employee	4.18	0.86	* (Supervisor)
Supervisor	4.48	0.66	* (Employee)
Manager	4.12	0.73	NS

F (2, 242) = 3.74, p = .025
Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Table 29

Descriptive statistics and test results for significant differences in rating skill C24 Maintaining working relationships

Job Position	M	SD	Difference
Employee	4.17	0.95	NS
Supervisor	4.32	0.84	NS
Manager	4.00	0.71	NS

F (2, 242) = 1.27, p = .283
Note: NS = nonsignificant differences between pairs of means

Test of Hypothesis Four

The following are test findings of research Hypothesis Four. When rating the taxonomy of supervisory skills in Category D Other General Skills, there will be no significant differences between the ratings made by employees, supervisors, and managers.

Restatement of Null Hypothesis Four. In this case the null hypothesis four is similar to the research hypothesis four.

H_{04}: $\mu_1 = \mu_2 = \mu_3$.

To test the null hypothesis, ANOVA F tests for significance were conducted between the means of the three job positions. The first was an ANOVA in how they rated the importance of Category D Other General Skills. Eight more individual ANOVA tests were conducted of to determine significant differences in how employees, supervisors, and managers rated the eight skills within Category D.

Test of significant differences in rating Category D Other General Skills. For Category D the ANOVA was nonsignificant. Because the value of the F test was less than the critical value of 3.00, and the p value was greater than .05 α (significance level), the researcher failed to reject the null hypothesis for Category D. The results of the test, as well as the means and standard deviations for the three job positions are reported in Table 30.

Table 30

Descriptive Statistics and Test Results for Significant Differences in Rating Category D Other General Skills

Job Position	M	SD	Difference
Employee	3.83	0.65	NS
Supervisor	4.01	0.50	NS
Manager	3.73	0.46	NS

F (2, 242) = 2.94, p = .055
Note: NS = nonsignificant differences between pairs of means

Test of significant differences in rating Skills D25 through D30. As was for the skills in Categories A, B, and C, an ANOVA F test was conducted for Skills D25 through D30. Where the F test was greater than critical value of 3.00, a Dunnett C follow up test was also conducted to evaluate the pairwise differences among the means. The results of these tests, as well as the means and standard deviations for the three job positions are reported in Table 31 through Table 36.

Table 31

Descriptive Statistics and Test Results for Significant Differences in Rating Skill D25 Organizational Culture Awareness

Job Position	M	SD	Difference
Employee	3.25	1.02	NS
Supervisor	3.53	0.88	NS
Manager	3.24	0.72	NS

F (2, 242) = 2.13, p = .121
Note: NS = nonsignificant differences between pairs of means

Table 32

Descriptive Statistics and Test Results for Significant Differences in Rating Skill D26 Computer Use

Job Position	M	SD	Difference
Employee	3.69	1.02	NS
Supervisor	3.80	0.96	NS
Manager	3.60	1.08	NS

F (2, 242) = 0.44, p = .643
Note: NS = nonsignificant differences between pairs of means

Table 33

Descriptive Statistics and Test Results for Significant Differences in Rating Skill D27 Communication Techniques

Job Position	M	SD	Difference
Employee	4.21	0.91	NS
Supervisor	4.39	0.65	NS
Manager	4.32	0.69	NS

F (2, 242) = 1.14, p = .323
Note: NS = nonsignificant differences between pairs of means

Table 34

Descriptive Statistics and Test Results for Significant Differences in Rating Skill D28 Understanding the Company's Business

Job Position	M	SD	Difference
Employee	3.86	1.11	NS
Supervisor	3.94	0.82	NS
Manager	3.64	0.81	NS

F (2, 242) = 0.80, p = .451
Note: NS = nonsignificant differences between pairs of means

Table 35

Descriptive Statistics and Test Results for Significant Differences in Rating Skill D29 Maintaining a "Systems" Viewpoint

Job Position	M	SD	Difference
Employee	3.75	0.94	NS
Supervisor	3.92	0.88	NS
Manager	3.56	0.87	NS

F (2, 242) = 1.63, p = .198
Note: NS = nonsignificant differences between pairs of means

Table 36

Descriptive Statistics and Test Results for Significant Differences in Rating Skill D30 Practical Know-how

Job Position	M	SD	Difference
Employee	4.36	0.77	NS
Supervisor	4.52	0.75	* (Manager)
Manager	4.04	0.79	* (Supervisor)

F (2, 242) = 3.51, p = .032

Note: NS = nonsignificant differences between pairs of means, while an asterisk (*) = significance using the Dunnett C procedure.

Summary of Findings

The successes of today's manufacturing firms depend greatly on the technological literacy of their employees. This dependency has created a new role for a production supervisor, the role of improving employee performance. To provide a theoretical framework in which to view this new role, a synthesis of the literature in the area of human performance technology (HPT) resulted in satisfying the first two problem statements of this study: construction of a three-phase leadership model referred to as the Performance Improvement Cycle (see Chapter 2), and construction of the Taxonomy of Supervisory Skills (see Appendix A).

The third problem statement of this study was satisfied by a Pareto analysis of the grand mean ratings of the four categories of skill and of each skill within their categories. The reader may observe that Categories A and C appear to stand out over Categories D and B in importance. Category A Measurement/Evaluation was found to be the most important. The most important skills within Category A were found to be A4 Providing feedback, A1 Setting goals and objectives, and A3 Identifying performance issues. Category C Improvement Implementation was next in the line of important categories. Skill C22 Influencing others and Skill C23 Maintaining formal and informal communication channels stand out as the most important and skills in Category C. Category D Other General Skills was the third most important category. Skill D27 Communication techniques and D30 Practical know-how are obviously considered the most important skills in Category D. Last in line of importance was Category B Cause/Needs Assessment. The most important skills within Category B were found to be B9 Identifying skills and B16 Evaluating processes. Skill B11 appeared to be considered the least important skill of all.

Finally, the fourth problem statement of this study was satisfied by (a) a comparative analysis of the mean ratings of the four categories of skill and of each skill within their categories, and (b) a one-way ANOVA test of significance of the mean ratings of the four categories and of each skill within their categories.

It can be observed from the comparative analyses that when rating the separate categories, supervisors rated the highest in every category. When rating skills within each category, it appears that supervisors tend to rate the majority of the Category A skills the highest. Likewise, supervisors tend to rate skills within Category B the highest. However, it should be noted that managers rated the lowest in every Category B skill. . Although supervisors did not rate every skill in Category C the highest, they did rate two skills particularly high, Skills C22 Influencing others and C23 Maintaining formal and informal communication channels. Managers rated Skill C22 very high as well. There appears to be significant differences between the ratings of Skills C22 and C23 between supervisors and employees. Supervisors rated highest in every Category D skill. In addition, there appears to be a significant difference between supervisors and managers in rating of Skill D30 Practical know-how.

Of the 34 ANOVA F tests conducted 12 significant differences in ratings between employees, supervisors, and managers were discovered. They were:

1. Category A Measurement/Evaluation (employees rated lower than did supervisors).

2. Skill A1 Setting goal and objectives (employees rated lower than did supervisors).

3. Skill A2 Measuring actual performance (employees rated lower than did supervisors).

4. Skill A4 Providing feedback (employees rated lower than did supervisors).

5. Category B Cause/Needs Assessment (employees and supervisors rated higher than did managers.

6. Skill B9 Identifying skills (employees rated lower than did supervisors).

7. Skill B11 Surveying techniques (employees and supervisors rated higher than did managers).

8. Skill B15 Evaluating materials (employees and supervisors rated higher than did managers)

9. Category C Improvement Implementation (employees rated lower than did supervisors).

10. Skill C22 Influencing others (employees rated lower than did supervisors).

11. Skill C23 Maintaining formal and informal communication channels (employees rated lower than did supervisors).

12. Skill D30 Practical know-how (supervisors rated higher than did managers).

This chapter presented findings for the four problem statements (referred to in Chapter 1). The next chapter presents a summary, conclusions and recommendations derived from this study.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This study was about the job of production supervisor in today's manufacturing industry, the one at the bottom of the management pyramid who oversees the labor, materials, and processes used to manufacture a product. The supervisor has traditionally been the one who oversees what takes place on the shop floor, the one who ensures that employees accomplish their work. Over the past century progressive changes in production technologies and in the work force that use them have called for changes in supervision.

The early 20th century supervisor was typically a white male who used scientific methods to measure, monitor, direct, and control production. Yet, to motivate workers, the supervisor resorted to unwise and sometimes cruel methods that would be thought of as backward and unheard of today. During the middle of the 20th century, with the introduction of working women and a war-experienced workforce, supervisors became more humanistic. They used less autocratic tactics of bullying and intimidating employees and showed more respect with a human relations perspective. Today more and more companies are investing in increasingly sophisticated production technologies, and therefore depend on employees who have the education and skill to apply those technologies. Manufacturing firms have become so dependent on technically skilled employees that the impact of technology on employee performance and the role of supervision cannot be ignored. Supervisors must be able to bring out the best from both employee and technology by making optimum use of employee-technology relationships. In short, the modern supervisor must become a technically oriented team coach.

Summary

The problem of this study was four-fold. As a result of this research, the researcher expected to:

1. Construct a three-phase leadership model as a theoretical framework for improving employee performance.

2. Categorize and list a set of supervisory skills needed to apply the leadership model.

3. Identify which categories of supervisory skills and which individual skills within their categories are most important.

4. Determine differences in opinion between employees, supervisors, and managers as to the importance of each category of skills, and the importance of individual skills within each category.

The purpose of this research is to provide to industry and education a better understanding of what makes a supervisor a good supervisor of today's educated and technologically skilled work force. Most would agree that the modern supervisor is still responsible for ensuring that employees accomplish their work. However, given that today's workforce is becoming better educated and more advanced in its technical skills, methods used by supervisors today to ensure that employees accomplish their work are different than methods used in the past. Today's supervisor has a new role in managing production operations, the role has changed from that of directing and controlling employees to that of effectively leading employees so that they may control the aspects of their own work. The supervisor fulfills this role by improving employee performance.

A theoretical framework in which to view supervisory skills for leading and improving employee performance can be established from literature in the field of human performance technology (HPT). HPT is a relatively new field of study that has evolved over the past 30 years from research and practice in human resource specialties such as behavioral psychology and programmed instruction (Gilbert, 1996; Rosenberg et al., 1992; Stolovitch & Keeps, 1992). Over the years, from the work of Skinner (1954, 1958), Gilbert (1996), and Mager (1970) major theoretical advancements have been made in managing what Rummler and Brache (1995, p. 71) refer to as the "human performance system"; the physical, motivational, educational, and organizational needs for improving human performance. The practical application of these theoretical advancements can be modeled after a three-phase Performance Improvement Cycle: Phase A Measurement/Evaluation, Phase B Cause/Needs Assessment, and Phase C Improvement Implementation. Concepts in HPT along with the Performance Improvement Cycle provided the theoretical underpinnings of the research design for this study.

Authors like those mentioned previously offer ways to view the role of the supervisor, and textbooks and other literature suggest what makes the modern supervisor a good supervisor (Douglas, 1997, Goetsch, 1992; Gupta, 1994; Skinner, 1996). However, there has been very little descriptive research regarding opinions of production supervisors, their employees, and their managers as to what they think supervisors should do to fulfill their new role of leading and improving employee performance. Authors such as Dean (1995), Rothwell (1996) and Stolovitch et al. (1995) have conducted separate studies to assess skills for improving human performance. Through their studies, it is possible to identify a set of skills that have been used mainly by consultants and specialists for applying HPT. The authors acknowledge, however, that to improve performance of production employees, supervisors should practice many of the skills they assessed. They state a need to further refine the skills they assessed by clarifying how they match up to the roles of supervisors, who traditionally have been in charge of employee performance. Due to the new role of improving performance of today's better educated and more technically skilled workforce, the supervisor needs a leadership model of which to view this new role, and of a set of skills with which to fulfill it. This study builds upon the previous work of Dean (1995), Deterline and Rosenberg (1992), Rothwell (1996) and Stolovitch et al. (1995) in an effort to further identify a leadership model and set of skills for today's supervisor.

Through a synthesis of the HPT literature and 20 years of manufacturing experience, a leadership model was constructed and referred to in this study as the Performance Improvement Cycle. A set of supervisory skills needed to put the performance improvement cycle into motion were also synthesized from the literature. The set of skills were categorized by their use in the Performance Improvement Cycle, and referred to in this study as the Taxonomy of Supervisory Skills.

Categorizing the Taxonomy of Supervisory Skills by their use in the Performance Improvement Cycle, a questionnaire using a set of Likert-type rating scales was constructed to serve as the data collection instrument for this study. Three groups (production employees, production supervisors, and second-level production managers) that represent manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area were asked to rate the importance of each skill listed on the questionnaire. The data collected were analyzed in three ways: The first was a Pareto analysis of the total ratings for each category of skill, and for individual skills within each category. The second was a comparative analysis of the differences in ratings for each category and skill. The third was a one-way ANOVA F-test to determine significant differences between the mean ratings for each category and skill. Where significant differences were discovered, a Dunnett C post hoc test was conducted to assess pairwise differences.

Conclusion

The first two problem statements of this study were formulated to synthesize and construct the Performance Improvement Cycle and Taxonomy of Supervisory Skills for the modern supervisor. Problem statements three and four were formulated to view the opinions of employees, supervisors, and managers as to the practical application of the Performance Improvement Cycle and Taxonomy of Supervisory Skills.

Resolution to Problem Statement One

This study was successful in synthesizing and constructing a leadership model (referred to as the Performance Improvement Cycle) as a theoretical framework to help view the supervisor's new role of improving employee performance. The model consists of three phases on a continuous cycle of improvement: Phase A

Measurement/Evaluation, Phase B Cause/Needs Assessment, and Phase C Improvement Implementation.

Resolution to Problem Statement Two

This study was also successful in synthesizing and constructing a set of skills (Taxonomy of Supervisory Skills) in which today's supervisor can apply the Performance Improvement Cycle and help fulfill the new role of improving employee performance. The skills were categorized by their use in the Performance Improvement Cycle: Category A Measurement/Evaluation, Category B Cause/Needs Assessment, and Category C Improvement Implementation, with an additional fourth Category D Other General Skills that are used in all three phases of the Performance Improvement Cycle.

Resolution to Problem Statement Three

To determine which categories and skills within the Taxonomy of Supervisory Skills were most important, a Pareto analysis of the grand mean scores for each of the four categories of skill and for individual skills within each category was conducted. The most important categories and skills were identified as follows:

Most important categories. According to the grand mean scores of the three groups, the two most important categories are Category A Measurement/Evaluation and Category C Improvement Implementation, respectively.

Most important skills. According to the grand mean scores of the three groups, the most important skills within Category A Measurement/Evaluation are A4 Providing feedback, A1 Setting goals and objectives, and A3 Identifying performance issues. Likewise, according to the grand mean scores of the three groups, the most important skills within Category C Improvement Implementation are C22 Influencing others and C23 Maintaining formal and informal communication channels.

Resolution to Problem Statement Four

Four research hypotheses (referred to in Chapter 1) were written to determine the significant differences in opinion between employees, supervisors, and managers as to the importance of the categories and individual skills. This section is delineated into four parts according four null hypotheses formulated from the four research hypotheses.

Restatement of Null Hypothesis One. When rating the Taxonomy of Supervisory Skills in Category A Measurement/Evaluation, there will be no significant differences in mean rating scores between employees, supervisors, and managers. $H_{01}: \mu_1 = \mu_2 = \mu_3$.

The researcher rejected Null Hypothesis Two because the F and Dunnett C tests show that there are significant differences when rating skills within Category A Measurement/Evaluation. That is, supervisors tend to rate skills A1 Setting goals and objectives, A2 Measuring actual performance, and A4 Providing feedback as significantly more important than do employees.

Restatement of Null Hypothesis Two. When rating the Taxonomy of Supervisory Skills in Category B Cause/Needs Assessment, there will be no significant differences in mean rating scores between employees, supervisors, and managers. $H_{02}: \mu_1 = \mu_2 = \mu_3$.

The researcher rejected Null Hypothesis Two because the F and Dunnett C tests show that there are significant differences when rating skills within Category B Cause/Needs Assessment. That is, supervisors, employees, or both tend to rate skills B11 Surveying techniques and B15 Evaluating materials as significantly more important than do managers.

Restatement of Null Hypothesis Three. When rating the Taxonomy of Supervisory Skills in Category C Improvement Implementation, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{03}: $\mu_1 = \mu_2 = \mu_3$.

The researcher rejected Null Hypothesis Three because the F and Dunnett C tests show that there are significant differences when rating skills within Category C Improvement Implementation. That is, supervisors tend to rate skills C22 Influencing others and C23 Maintaining formal and informal communication channels as significantly more important than do employees.

Restatement of Null Hypothesis Four. When rating the Taxonomy of Supervisory Skills in Category D Other General Skills, there will be no significant differences in mean rating scores between employees, supervisors, and managers. H_{04}: $\mu_1 = \mu_2 = \mu_3$.

The researcher rejected Null Hypothesis Four because the F and Dunnett C tests show that there are significant differences when rating skills within Category D Other General Skills. That is, supervisors tend to rate skill D30 Practical know-how as more important than do managers.

Recommendations

The preceding section provided conclusions for each of the original problem statements. The synthesis and construction of the Performance Improvement Cycle and Taxonomy of Supervisory Skills resolved the first two problem statements and are the major contributions of this study. Pareto analyses of the data satisfied the third problem statement of identifying which categories and skills are considered to be most important and are thus recommended as primary supervisory skills. Comparative analyses of the data coupled with tests of significance resolved the fourth problem statement of determining significant differences in opinion between employees, supervisors, and managers as to the importance of the skills, thus revealing to what extent consistent agreements exist among employees, supervisors, and managers for applying the Performance Improvement Cycle and Taxonomy of Supervisory Skills.

As a result of this study, two types of recommendations are discussed. The first type of recommendation is in the area of future research. The second type is in the area of practical application.

Future Research

The findings of significant differences of this study lead to several recommendations for further study. They are as follows:

1. It is recommended that further investigation and evaluation take place to determine why supervisors tend to rate their use of certain skills (A1 Setting goals and objectives, A2 Measuring actual performance, A4 Providing feedback, B9 Identifying skills, C22 Influencing others, and C23 Maintaining formal and informal communication channels) significantly more important then do employees. Perhaps this is because supervisors, through familiarity with their jobs, are more aware than employees of the necessity of these supervisory skills.

2. It is also recommended that a further study be designed to determine why supervisors tend to rate their use of specific skills (B15 Evaluating materials and D30 Practical know-how) significantly more important than do managers. Possibly, this is because many of supervisors tend to be promoted from within the ranks and value more so their ability to demonstrate the use of production technologies when training employees. Supervisors may also be more aware than managers of either material quality or material quantity deficiencies. There may also be issues in complying with government regulations in the area of material safety control of which managers are not aware.

3. As a third recommendation for further research, a study should be designed to determine why employees tend to rate their supervisors' use of certain skills (B11 Surveying techniques and B15 Evaluating materials) significantly more important than do managers. Perhaps this is because managers are less aware of the implications of employee input on productivity. Managers may also be less aware than employees of how quantity, quality, or hazardous elements of materials are having an impact on successful production operations.

4. The population for this study was limited to employees, supervisors, and managers of manufacturing firms in the Waterloo/Cedar Falls, Iowa metropolitan area. A replication of this study that involves a sample representing a population in another part of the country (or world) could further confirm the findings and procedures of this study.

5. Another replication with a wider population of manufacturing firms on a statewide, regional, or national scale would contribute to generalizing the application of

the Performance Improvement Cycle and Taxonomy of Supervisory Skills over a larger population.

6. This study does not report correlations between inexperienced and experienced supervisors. An additional analysis of the data collected in this study may help infer different skills needed by supervisors according to their job experience.

7. Finally, a content validity study would authenticate the practical application of the Performance Improvement Cycle and Taxonomy of Supervisory Skills.

Practical Application

Based upon the findings of this study the researcher makes two recommendations for the application of the Performance Improvement Cycle and Taxonomy of Supervisory Skills.

1. As a recommendation to industry, the Taxonomy of Supervisory Skills should be applied in conjunction with the Performance Improvement Cycle as a benchmark for standard supervisory practices in today's manufacturing environment.

2. As a second recommendation to the educational field, the skills and leadership model disseminated from this study should be considered as partial content for four-year college industrial/technology management programs.

Final Comments

Supervisory skills that surfaced from the data analysis ranging from "considerable" to "very great" importance will contribute to a benchmark for future studies in establishing a standard practice for supervisors, and in planning and developing four-year college programs in industrial/technology management. This study contributes to a knowledge base for better understanding the skills required of production supervisors to improve the performance of today's educated and technologically skilled workforce. However, before any generalizations, decisions, or judgments from the results of this study are made, the researcher recommends the following assumptions, biases and limitations be reviewed.

Assumptions

1. The need that exists for supervisors to be competent in employee performance improvement will continue into the near and distant future.

2. The Taxonomy of Supervisory Skills synthesized from previous research provided an accurate summation of skills for improving employee performance.

3. Employees, supervisors, and managers chosen to participate in this study were able to correctly interpret the data collection instrument.

4. Responses provided by all survey participants in this study were sincere and straightforward.

Biases

1. Nine companies were selected by availability to represent the population. Samples of managers in three of the larger companies of more than 1000 employees were also selected by availability. However, the sample size consisted of more than 50% of the managers employed by the larger companies.

2. The researcher collected data by personally administering the questionnaire to participants. Although the researcher used pre-constructed notes for explaining the purpose of the study and the instructions for completing the data collection instrument

(see appendix B), there remains a slight possibility of contamination and experimenter bias due to the researcher's practical familiarity with the subjects.

Limitations

1. The population for this study was limited to employees, supervisors, and managers of manufacturing firms listed in the Cedar Valley Directory of Manufacturers, classified as Manufacturing, Standard Industrial Classification (SIC) Major Groups 23, 24, 34, 35, 36, 37, and 38 with 100 or more employees (Cedar Valley Economic Development Corp., 1999).

2. The data collected were limited to forced response questionnaire methods and quantitative data analysis. No attempt was made to elicit qualitative input from participants regarding supervisory skills that may be alternatives or additions to what skills were identified on the questionnaire.

3. The study was limited to an investigation of only those supervisory skills needed for improving employee performance. No attempt was made to investigate skills that supervisors may need for other responsibilities.

As a final comment, this study was successful in answering the four problem statements posed in Chapter 1 by synthesizing and constructing the Performance Improvement Cycle and Taxonomy of Supervisory Skills in which to fulfill the modern supervisor's new role of improving employee performance, and thus are the major contributions of this study. It should be noted that all four categories of skill in the Taxonomy were rated by the grand mean of the three groups to be in the area of at least "considerable" importance. In addition, only two of the 30 individual skills, B11

Surveying techniques and D25 Organizational culture awareness, were rated as "some" importance. The other 28 skills were rated between "considerable" and "very great" importance. Although all of the skills were rated relatively high, significant differences in opinions between employees, supervisors, and managers were discovered as to the extent of importance for some of the skills identified in this study. In the researcher's opinion, these significant differences indicate that certain applications of the Performance Improvement Cycle and Taxonomy of Supervisory Skills need further study and evaluation for their ultimate resolution.

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APPENDICES

APPENDIX A

TAXONOMY OF SUPERVISORY SKILLS

Category A Measurement/Evaluation

The following are the skills needed to put the first Phase A Measurement/Evaluation of the Performance Improvement Cycle into motion.

A1. Setting goals and objectives: defining desired results of work groups, processes, or individuals; helping others to establish work standards and define their performance expectations.

A2. Measuring actual performance: measuring an organization's actual performance in relationship to its goals; helping others to measure their actual performance pertaining to their goals.

A3. Identifying performance issues: finding gaps that exist between desired results and actual performance; to identify problems or opportunities for improvement.

A4. Providing feedback: collecting information about actual performance (good or bad) and feeding it back clearly, specifically, and on a timely basis to appropriate employees.

A5. Evaluating impacts of improvement efforts: determining how well an effort to improve performance went according to plan; examining the effects of problems that exist and the efforts to correct them; relying on shared beliefs and assumptions about "right" and "wrong" ways of doing things.

A6. Company awareness: understanding the vision, strategy, goals, and objectives of the company; linking them to departmental performance measurements.

A7. Understanding human performance: distinguishing between results and effort; recognizing the amount of effort used to achieve results.

A8. Relating to goals of others: looking beyond details to see how a particular effort to achieve departmental goals will effect (or not effect) higher organizational goals and the goals of other departments.

Category B Cause/Needs Assessment

The following are the skills needed to put the second Phase B Cause/Needs Assessment of the Performance Improvement Cycle into motion.

B9. Identifying skills: defining the skills required of people to perform their jobs, and evaluating their actual work skills.

B10. Determining commitment: defining the ethics and motivation required of people to perform their jobs, and evaluating their actual work ethics and motivation.

B11. Surveying techniques: observing or preparing written surveys in a way that gathers useful information to determine the needs of people; to identify the root cause(s) of performance problems.

B12. Questioning techniques: gathering information, or stimulating insight in people through the use of the right questions at the right time (e.g., questions that draw out explanations vs. single word answers).

B13. Evaluating incentives: examining issues such as positive or negative reasons for the way people are performing; considering factors such as rewards or punishments, good or bad working relations, and/or use of appropriate feedback.

B14. Determining instructional needs: exploring the most appropriate and cost effective means of instruction; that is, providing information, knowledge, and/or skills (e.g., writing a memo, vs. holding a meeting, vs. providing on-the-job training).

B15. Evaluating materials: examining issues such as material quality and quantity that are affecting performance, considering factors such as the appropriate use and disposal of hazardous materials.

B16. Evaluating processes: examining issues such as process capability and capacity that are affecting performance; considering safety and ergonomic factors.

Category C Improvement Implementation

The following are the skills needed to put the third Phase C Improvement Implementation of the Performance Improvement Cycle into motion.

C17. Action planning: organizing what action steps should be taken to support the needs of people; to eliminate or address the root cause(s) of performance problems.

C18. Predicting effects of single and multiple actions: analyzing the positive and/or negative consequences of one or more actions intended to correct a performance problem; the effects on different departments within the company, as well as on the company's customers, suppliers, and employees.

C19. Obtaining resources: identifying and justifying the appropriate resources (e.g., money, people) for implementing plans to eliminate or address the root cause(s) of performance problems.

C20. Initiating action plans: Organizing, scheduling, and overseeing the planned actions for supporting the needs of employees; to address the root cause(s) of performance issues.

C21. Stick-to-itiveness: coping with stress resulting from change and from multiple meanings or possibilities; getting desired results despite conflicting priorities, lack of resources, and uncertainty.

C22. Influencing others: knowing how to influence others positively to achieve desired work results.

C23. Maintaining formal and informal communication channels: knowing the various means in which information is communicated throughout the company, and using those various means to implement improvements.

C24. Maintaining working relationships: recognizing how different groups of people function; influencing group members so that their individual needs are addressed as well as their common goals; observing individuals and groups for their interactions and the effects of their interactions with others; helping groups and individuals to discover new insights and points of view.

Category D Other General Skills

The following are other general skills used in all three phases of the Performance Improvement Cycle.

D25. Organizational culture awareness: seeing different departmental organizations as dynamic, political, economic, and social systems that have multiple goals; using this larger perspective as a framework for understanding and influencing events and change.

D26. Computer use: using existing or new computer technology and different types of software and hardware; understanding computer systems and applying them as appropriate.

D27. Communication techniques: communicating effectively in visual, oral, and written form (e.g., reports, work instructions).

D28. Understanding the company's business: demonstrating awareness of the inner workings of the company's functions and how financial business decisions can affect people's performance.

D29. Maintaining a "systems" viewpoint: identifying inputs, throughputs, and outputs of the company, its production processes and jobs; applying that information to implement improvements.

D30. Practical know-how: Understanding the results that are desired from a production process, and having the skill to perform certain manufacturing operations that will efficiently and effectively achieve those results.

APPENDIX B

NOTES FOR ADMINISTERING QUESTIONNAIRE

Thank everyone for coming here today. Introduce yourself and the Industrial Technology Department at UNI. Read the following to participants before they begin:

I assume you have been told, but if not, I am here to ask you to participate in a survey. Your company has authorized this survey, but let me take a minute to explain more. I am asking for your help. As part of my final doctoral research at UNI, I have listed 30 skills that may or may not, in my opinion, be important to the job of a first-level supervisor.

Make sure everyone understands the term "first-level supervisor".

I would like your opinions concerning the importance of these 30 skills as you feel they pertain to the job of a first-level supervisor. Your answers in this survey will help in establishing what it is that makes a good supervisor in today's manufacturing industry, and in identifying subject matter for college courses in supervision. In order to obtain a comprehensive assessment, this survey is being given to a representative sample of first-line production supervisors, second-level production managers, and nonsupervisory production employees in your company.

Let me assure you that your completion of this questionnaire is voluntary and results are anonymous. If you choose to participate none of the information you supply will be associated with you individually. Your answers will be held in strict confidence and viewed by no one but me. Again, none of the information you supply will be used to identify you or any other individual. I will provide a report to your company, but the results will only be reported in summary fashion. That is, to show on the average how employees, supervisors, and managers rated the skills.

Hand out the questionnaires. Hand out pencils.

Do not use ink or ballpoint pens. Use the no. 2 pencil provided. Erase completely and cleanly any answer you wish to change. Do not make any stray marks on this questionnaire. It should take about 20 minutes to complete. Are there any questions?

If not, begin.

Collect the completed questionnaires by having the participants put them face down in a box. Remember to thank everyone again.

APPENDIX C

SUPERVISORY SKILLS SURVEY

Please Read Each Section Before You Begin

This survey asks employees to share their opinions concerning the importance of certain job skills required of first-level supervisors to improve the performance of people, their work, and their work place. In order to obtain a comprehensive assessment, questionnaires are being given to a representative sample of first-level production supervisors, second-level production managers, and nonsupervisory production employees in your company.

Completion of this questionnaire is voluntary and results are anonymous. None of the information you supply will be used to identify you or any other individual. Results will only be reported in summary fashion.

Marking Instructions

- DO NOT use ink or ballpoint pens.
- Erase completely and cleanly any a
- Do not make any stray marks on thi

INCORRECT MARKS

CORRECT MARK

O O O ●

INCORRECT MARKS

Privacy Notice

Collection of the requested information is authorized by your company. Your participation in this survey is completely voluntary and none of the information you choose to supply will be associated with you individually.

Report Request

If you would like a copy of the reports published as a result of this survey, please address your request to:

Doug Hotek
Department of Industrial Technology
University of Northern Iowa
Cedar Falls, IA 50614-0178

Section 1. Some General Information About You

The information you supply in this section will be used to help study the opinions of people from different job levels. The following two questions should be answered based on <u>your own job</u>.

1. What is your current job position?

- O First-level supervisor (You report to a second-level manager).
- O Second-level manager (A first-level supervisor reports to you).
- O Nonsupervisory employee (You report to a first-level supervisor).

2. How long have you held your current job position (including previous employment)?

- O Less than 1 year
- O 1-2 years
- O 3-5 years
- O 6-10 years
- O More than 10 years

CONTINUE ON NEXT PAGE

Section 2. Your Rating Of Supervisory Skills

You should answer the items in this section according to your own opinion about the typical job of any first-level supervisor. Each item below is a description of a skill. Using the following rating scale of 1 to 5, PLEASE RATE TO WHAT EXTENT YOU FEEL IT IS IMPORTANT FOR A FIRST-LEVEL SUPERVISOR TO BE ABLE TO PERFORM EACH SKILL.

RATING SCALE
1 = To no extent
2 = To a little extent
3 = To some extent
4 = To a considerable extent
5 = To a very great extent

A. Measurement/Evaluation	Extent Of Importance: No Extent	Little Extent	Some Extent	Considerable Extent	Very Great Extent
1. **Setting goals and objectives**: defining desired results of work groups, processes, or individuals; helping others to establish work standards and define their performance expectations.	①	②	③	④	⑤
2. **Measuring actual performance**: measuring an organization's actual performance in relationship to its goals; helping others to measure their actual performance pertaining to their goals.	①	②	③	④	⑤
3. **Identifying performance issues**: finding gaps that exist between desired results and actual performance; to identify problems or opportunities for improvement.	①	②	③	④	⑤
4. **Providing feedback**: collecting information about actual performance (good or bad) and feeding it back clearly, specifically, and on a timely basis to appropriate employees.	①	②	③	④	⑤
5. **Evaluating impacts of improvement efforts**: determining how well an effort to improve performance went according to plan; examining the effects of problems that exist and the efforts to correct them; relying on shared beliefs and assumptions about "right" and "wrong" ways of doing things.	①	②	③	④	⑤
6. **Company awareness**: understanding the vision, strategy, goals, and objectives of the company; linking them to departmental performance measurements.	①	②	③	④	⑤
7. **Understanding human performance**: distinguishing between results and effort; recognizing the amount of effort used to achieve results.	①	②	③	④	⑤
8. **Relating to goals of others**: looking beyond details to see how a particular effort to achieve departmental goals will effect (or not effect) higher organizational goals and the goals of other departments.	①	②	③	④	⑤

CONTINUE ON NEXT PAGE

	Extent Of Importance				
B. Cause/Needs Assessment	No Extent	Little Extent	Some Extent	Considerable Extent	Very Great Extent
9. **Identifying skills**: defining the skills required of people to perform their jobs, and evaluating their actual work skills.	①	②	③	④	⑤
10. **Determining commitment**: defining the ethics and motivation required of people to perform their jobs, and evaluating their actual work ethics and motivation.	①	②	③	④	⑤
11. **Surveying techniques**: observing or preparing written surveys in a way that gathers useful information to determine the needs of people; to identify the root cause(s) of performance problems.	①	②	③	④	⑤
12. **Questioning techniques**: gathering information, or stimulating insight in people through the use of the right questions at the right time (e.g., questions that draw out explanations vs. single word answers).	①	②	③	④	⑤
13. **Evaluating incentives**: examining issues such as positive or negative reasons for the way people are performing; considering factors such as rewards or punishments, good or bad working relations, and/or use of appropriate feedback.	①	②	③	④	⑤
14. **Determining instructional needs**: exploring the most appropriate and cost effective means of instruction; that is, providing information, knowledge, and/or skills (e.g., writing a memo, vs. holding a meeting, vs. providing on-the-job training).	①	②	③	④	⑤
15. **Evaluating materials**: examining issues such as material quality and quantity that are affecting performance, considering factors such as the appropriate use and disposal of hazardous materials.	①	②	③	④	⑤
16. **Evaluating processes**: examining issues such as process capability and capacity that are affecting performance; considering safety and ergonomic factors.	①	②	③	④	⑤

CONTINUE ON NEXT PAGE

C. Improvement Implementation

	Extent Of Importance				
	No Extent	Little Extent	Some Extent	Considerable Extent	Very Great Extent
17. **Action planning**: organizing what action steps should be taken to support the needs of people; to eliminate or address the root cause(s) of performance problems.	①	②	③	④	⑤
18. **Predicting effects of single and multiple actions**: analyzing the positive and/or negative consequences of one or more actions intended to correct a performance problem; the effects on different departments within the company, as well as on the company's customers, suppliers, and employees.	①	②	③	④	⑤
19. **Obtaining resources**: identifying and justifying the appropriate resources (e.g., money, people) for implementing plans to eliminate or address the root cause(s) of performance problems.	①	②	③	④	⑤
20. **Initiating action plans**: Organizing, scheduling, and overseeing the planned actions for supporting the needs of employees; to address the root cause(s) of performance issues.	①	②	③	④	⑤
21. **Stick-to-itiveness**: coping with stress resulting from change and from multiple meanings or possibilities; getting desired results despite conflicting priorities, lack of resources, and uncertainty.	①	②	③	④	⑤
22. **Influencing others**: knowing how to influence others positively to achieve desired work results.	①	②	③	④	⑤
23. **Maintaining formal and informal communication channels**: knowing the various means in which information is communicated throughout the company, and using those various means to implement improvements.	①	②	③	④	⑤
24. **Maintaining working relationships**: recognizing how different groups of people function; influencing group members so that their individual needs are addressed as well as their common goals; observing individuals and groups for their interactions and the effects of their interactions with others; helping groups and individuals to discover new insights and points of view.	①	②	③	④	⑤

CONTINUE ON NEXT PAGE

	Extent Of Importance				
	No Extent	Little Extent	Some Extent	Considerable Extent	Very Great Extent

D. Other General Skills

25. Organizational culture awareness: seeing different departmental organizations as dynamic, political, economic, and social systems that have multiple goals; using this larger perspective as a framework for understanding and influencing events and change.	①	②	③	④	⑤
26. Computer use: using existing or new computer technology and different types of software and hardware; understanding computer systems and applying them as appropriate.	①	②	③	④	⑤
27. Communication techniques: communicating effectively in visual, oral, and written form (e.g., reports, work instructions).	①	②	③	④	⑤
28. Understanding the company's business: demonstrating awareness of the inner workings of the company's functions and how financial business decisions can affect people's performance.	①	②	③	④	⑤
29. Maintaining a "systems" viewpoint: identifying inputs, throughputs, and outputs of the company, its production processes and jobs; applying that information to implement improvements.	①	②	③	④	⑤
30. Practical know-how: understanding the results that are desired from a production process, and having the skill to perform certain manufacturing operations that will efficiently and effectively achieve those results.	①	②	③	④	⑤

END

APPENDIX D

HUMAN SUBJECTS REVIEW LETTER OF APPROVAL

The University of Northern Iowa

July 9, 1999

Mr. Douglas Hotek
401 Derbyshire Road
Waterloo, IA 50701

Dear Mr. Hotek:

Your project, "The Importance of Human Performance Improvement (HPI) in the Practice of First-Line Manufacturing Management," which you submitted for human subjects review on July 6, 1999, has been determined to be exempt from further review under the guidelines stated in the UNI Human Subjects Handbook. You may commence participation of human research subjects in your project.

Your project need not be submitted for continuing review unless you alter it in a way that increases the risk to the participants or you change the subject pool. If you make any such changes in your project, you should notify the Graduate College office.

If you decide to seek federal funds for this project, it would be wise not to claim exemption from human subjects review on your application. Should the agency to which you submit the application decide that your project is not exempt from review, you might not be able to submit the project for review by the UNI Institutional Review Board within the federal agency's time limit (30 days after application). As a precaution against applicants' being caught in such a time bind, the Board will review any projects for which federal funds are sought. If you do seek federal funds for this project, please submit the project for human subjects review no later than the time you submit your funding application.

If you have further questions about the Human Subjects Review system, please contact me. Best wishes for your project.

Sincerely,

Norris M. Durham, Ph.D.
Chair, Institutional Review Board

I/office/humansub.frm

c: Dr. David A. Walker, Associate Dean
Dr. John Fecik

Graduate College 1 Seerley Cedar Falls, Iowa 50614-0702 (319) 273-2748 FAX: (319) 273-2243

APPENDIX E

INITIAL LETTER REQUESTING ACCESS

June 24, 1999

(company name and address omitted)

Dear Mr. (name omitted):

I would like to ask for your help. I would appreciate the opportunity to survey you, your first-line supervisors, and a random sample (about 20%) of your line employees. In return, I am willing to contribute to your company's management development goals. For participating in the survey, I will provide to (company name omitted) a copy of the report published as a result of the survey. As an added benefit to, I am willing to meet with your managers to discuss the findings of my research and specific implications relevant to your company's goals and objectives.

The survey is a simple multiple-choice questionnaire that should take less than a ½ hour to complete. All answers to the questionnaire will be kept confidential; no names of individual responses will be reported. If desired, your company's identity will also be kept confidential.

(Company name omitted) is one of a number of industrial firms in which I would like to survey as part of my doctoral research at the University of Northern Iowa. My research will identify management skills important to the practice of first-line supervision for a "systems approach" to helping employees perform in an increasingly complex workplace. This systems approach is commonly called Human Performance Technology (HPT). The purpose of my study will be to determine what agreements exist between first-line supervisors, line employees, and second-level managers as to how important skills in HPT are in the practice of first-line supervision. The anticipated results of the study will provide a specific set of skills that may contribute to a standard practice for first-line management and/or to future management training and development programs.

I will gladly answer any questions you may have and further explain my research. Your help in this matter will be greatly appreciated.

Sincerely,

Doug Hotek
Doctoral Candidate

APPENDIX F

SPLIT-HALF RELIABILITY ESTIMATES FOR PILOT STUDY DATA

Table 37. Reliability Estimate for Items in Category A: Measurement/Evaluation

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

		Mean	Std Dev	Cases
1.	A1	4.5000	.5898	24.0
2.	A3	4.4583	.7790	24.0
3.	A5	4.0000	1.0215	24.0
4.	A7	4.4583	.8836	24.0
5.	A2	3.8750	.8502	24.0
6.	A4	4.2500	.9441	24.0
7.	A6	4.1250	.8502	24.0
8.	A8	3.7500	1.0734	24.0

Correlation Matrix

	A1	A3	A5	A7	A2
A1	1.0000				
A3	.4258	1.0000			
A5	.4330	.4371	1.0000		
A7	.2920	.5027	.7707	1.0000	
A2	.3902	.3528	.5006	.6004	1.0000
A4	.4685	.4877	.4959	.5863	.5823
A6	-.0434	.3693	.2003	.2098	.2632
A8	.4808	.3510	.6344	.5386	.6313

	A4	A6	A8
A4	1.0000		
A6	.2844	1.0000	
A8	.4934	.3216	1.0000

N of Cases = 24.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Part 1	17.4167	6.7754	2.6030	4
Part 2	16.0000	8.0000	2.8284	4
Scale	33.4167	25.2971	5.0296	8

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

Reliability Coefficient   8 items

Equal-length Spearman-Brown = .8335

Table 38. Reliability Estimate for Items in Category B: Cause/Needs Analysis

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

		Mean	Std Dev	Cases
1.	B9	4.3333	.9631	24.0
2.	B11	3.5417	1.0624	24.0
3.	B13	3.8333	1.3077	24.0
4.	B15	4.2917	.7506	24.0
5.	B10	4.0000	1.0215	24.0
6.	B12	3.8750	.8999	24.0
7.	B14	3.9583	.8587	24.0
8.	B16	4.2917	.8065	24.0

Correlation Matrix

	B9	B11	B13	B15	B10
B9	1.0000				
B11	.4533	1.0000			
B13	.5984	.4434	1.0000		
B15	.5213	.0659	.4060	1.0000	
B10	.5745	.6811	.5859	.3402	1.0000
B12	.5017	.2558	.6466	.3782	.4257
B14	.2278	.4548	.3807	.2220	.6940
B16	.5411	.3151	.7490	.2843	.2639

	B12	B14	B16
B12	1.0000		
B14	.5556	1.0000	
B16	.5916	.3322	1.0000

N of Cases = 24.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Part 1	16.0000	9.6522	3.1068	4
Part 2	16.1250	7.8533	2.8024	4
Scale	32.1250	31.2446	5.5897	8

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

Reliability Coefficient   8 items

Equal-length Spearman-Brown = .8821

Table 39. Reliability Estimate for Items in Category C: Improvement Implementation

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

		Mean	Std Dev	Cases
1.	C17	4.3333	.9631	24.0
2.	C19	3.7083	1.0417	24.0
3.	C21	4.4167	.7173	24.0
4.	C23	4.4167	.7173	24.0
5.	C18	4.1250	.8999	24.0
6.	C20	4.0833	.9286	24.0
7.	C22	4.6667	.7614	24.0
8.	C24	4.2917	.8587	24.0

Correlation Matrix

	C17	C19	C21	C23	C18
C17	1.0000				
C19	.1445	1.0000			
C21	.5455	.1115	1.0000		
C23	.6084	.1115	.3239	1.0000	
C18	.4515	.0870	.1852	.3200	1.0000
C20	.3565	.7454	.3373	.4025	.0911
C22	.5139	.4203	.5838	.3450	.0635
C24	.5608	.0020	.2177	.5706	.2321

	C20	C22	C24
C20	1.0000		
C22	.5329	1.0000	
C24	.3499	.4877	1.0000

N of Cases = 24.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Part 1	16.8750	5.5924	2.3648	4
Part 2	17.1667	5.5362	2.3529	4
Scale	34.0417	20.1286	4.4865	8

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

Reliability Coefficient   8 items

Equal-length Spearman-Brown = .8943

Table 40. Reliability Estimate for Items in Category D: Other General Skills

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

		Mean	Std Dev	Cases
1.	D25	3.2917	1.2329	24.0
2.	D27	4.1250	1.0347	24.0
3.	D29	3.8333	1.0901	24.0
4.	D26	3.7500	.8969	24.0
5.	D28	3.6250	1.0555	24.0
6.	D30	4.6250	.6469	24.0

Correlation Matrix

	D25	D27	D29	D26	D28
D25	1.0000				
D27	.3451	1.0000			
D29	.3289	.3276	1.0000		
D26	.3834	-.0117	.2224	1.0000	
D28	.2882	.2836	.7368	.3100	1.0000
D30	.3067	.6577	-.0308	.0562	.0398

	D30
D30	1.0000

N of Cases = 24.0

Statistics for	Mean	Variance	Std Dev	N of Variables
Part 1	11.2500	6.2826	2.5065	3
Part 2	12.0000	3.0435	1.7446	3
Scale	23.2500	14.9783	3.8702	6

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (S P L I T)

Reliability Coefficient   6 items

Equal-length Spearman-Brown =.7852

APPENDIX G

LETTER OF ACCESS RECOMMENDATION

(company name and address omitted).

December 14, 1999

Dear (name omitted):

I am writing to introduce you to Douglas Hotek. Doug is an experienced engineer and working towards a doctor of industrial technology degree at the University of Northern Iowa. He is in the process of doing research for his final dissertation. The nature of his research is of interest to us at (company name omitted) and I believe that it may be of interest to you as well.

Doug is studying a relatively new management approach called Human Performance Technology. Specifically, his goal is to identify the skills required by today's first level supervisors to improve employee performance in an increasingly complex workplace. Achievement of that goal will require gathering of opinions directly from first level supervisors, wage employees, and second level production managers.

Results of Doug's initial pilot study, which was performed here at (company name omitted) has promoted a better understanding of what makes a good supervisor. He outlined and prioritized for us a comprehensive set of supervisory skills that are considered (by our supervisors, wage employees, and second level manager) to be important for improving employee performance. He also provided us with a model and recommendations for supervisors to achieve those skills.

Doug's letter is attached for your examination and consideration. I believe it will be of interest to you and has potential benefit to your organization.

Best regards,

(name omitted)

APPENDIX H

LETTER REQUESTING ACCESS

December 15, 1999

(company name and address omitted)

Dear Mr. (name omitted):

I would like to ask for your help. In return, I am willing to contribute to your company's management development goals. Your company is one of a number of manufacturing firms in which I would like to survey a representative sample of first-level production supervisors, their wage employees, and second-level production managers. The survey is part of my doctoral research at the University of Northern Iowa. My research will identify skills important to the practice of first-level supervision for improving employee performance in an increasingly complex workplace. For participating in my study, I will provide you with a copy of the report published as a result of my survey. As an added benefit to you, I am willing to meet with your (and/or your managers) to discuss specific findings and implications relevant to your company's interests.

The purpose of my study is to determine the opinions of supervisors, their wage employees, and production managers as to how important skills for improving employee performance are in the practice of first-level supervision. The anticipated results of the study will provide a set of specific skills that may contribute to a standard practice for first-level supervisors and/or to future management training and development programs.

The survey takes no longer than 20 minutes to complete. All answers on the survey will be kept confidential; no names of individual responses will be reported.

I will call you during the week of January 3rd 2000 to make an appointment to meet at your convenience; to answer any questions you may have and further explain my research. Your help in this matter will be greatly appreciated.

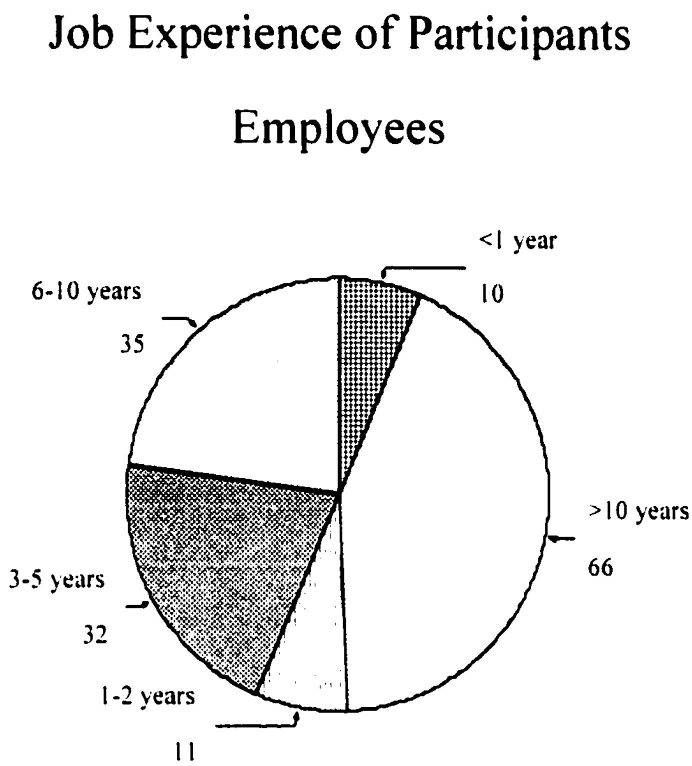
Sincerely,

Douglas R. Hotek
Doctoral Candidate, University of Northern Iowa

p.s. Enclosed is a letter of recommendation from (name omitted), President of (company name omitted).

APPENDIX I

JOB EXPERIENCE OF PARTICIPANTS

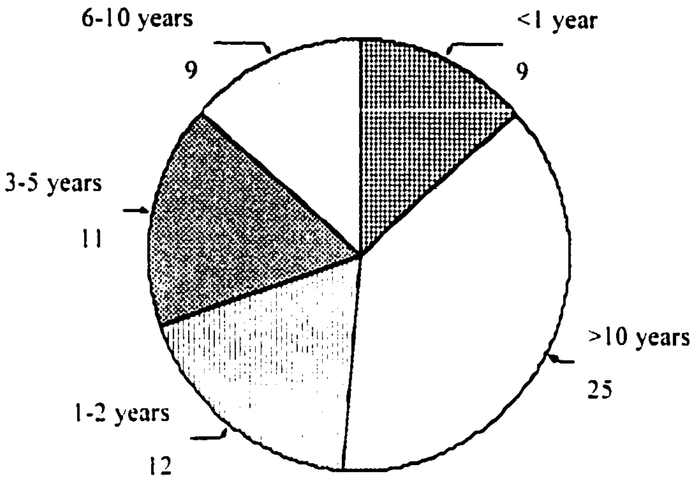


Sample of 154

Figure 17. Job experience of employee participants in this study. A pie chart displays the number of employee participants in this study and their years of experience at their current job positions.

Job Experience of Participants

Supervisors

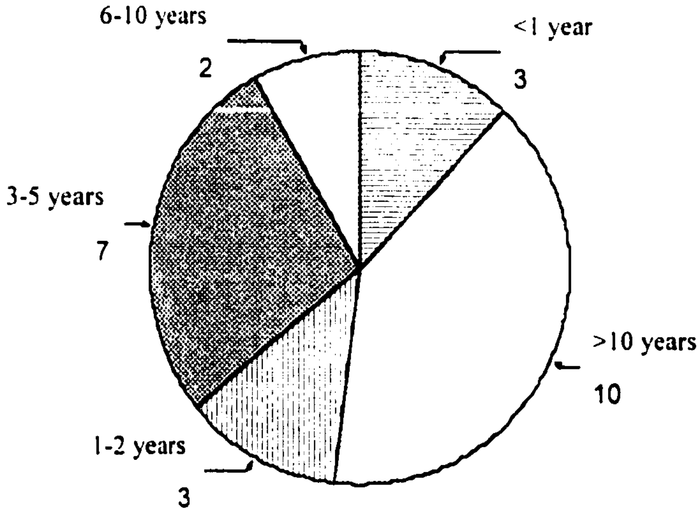


Sample of 66

Figure 18. Job experience of supervisor participants in this study. A pie chart displays the number of supervisor participants in this study and their years of experience at their current job positions.

Job Experience of Participants

Managers



Sample of 25

Figure 19. Job experience of manager participants in this study. A pie chart displays the number of manager participants in this study and their years of experience at their current job positions.