ABSTRACT

THE INFLUENCE OF W. E. DEMING'S MANAGEMENT PRINCIPLES ON ABSENTEEISM IN A FEDERAL PUBLIC HEALTH INSPECTION PROJECT

The Hazard Analysis and Critical Control Points Inspection Models Project (HIMP) appeared to incorporate some of W. E. Deming's principles of continuous quality control in a public sector organization. The introduction of these principles in private-sector companies has resulted in increased employee satisfaction and decreased absenteeism. This study examined absenteeism levels of Food Safety and Inspection Service personnel working in poultry establishments following implementation of HIMP in the public health regulatory agency.

Absenteeism levels of inspection personnel assigned to HIMP and traditional inspection establishments in the first 2 years of implementation, 1999 and 2000, were compared with the absenteeism levels of inspection personnel in these same establishments in the 2 subsequent years of HIMP implementation, 2001 and 2002. Trend analysis of the absenteeism levels during the 4 years demonstrated a downward trend but not a statistically significant decrease in absenteeism levels following the implementation of HIMP.

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THE INFLUENCE OF W. E. DEMING'S MANAGEMENT PRINCIPLES ON ABSENTEEISM IN A FEDERAL PUBLIC HEALTH INSPECTION PROJECT

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Chapter 1

INTRODUCTION

This study examined whether the introduction of a government program called Hazard Analysis and Critical Control Points-Based Inspection Models Project (HIMP) represented an application of W. Edwards Deming's principles of continuous quality improvement in a regulatory public health agency. This research explored the influence of Deming's principles on the reduction of absenteeism.

In 1998 the Food Safety and Inspection Service agency (FSIS) of the United States Department of Agriculture (USDA) developed and introduced HIMP as a food inspection program employing Hazard Analysis and Critical Control Points (HACCP) concepts in meat and poultry slaughter inspection (*Scientific Criteria*, 2003). The HIMP inspection project facilitated the introduction of HACCP to slaughter establishments in an attempt to improve FSIS's ability to prevent or minimize food safety hazards for the consuming public, increase consumer protection, and redeploy scarce personnel resources. HIMP utilizes statistical control of inspection and team building to improve food inspection (Food Safety and Inspection Service [FSIS], 1998).

W. Edwards Deming, statistician and business consultant, perceived businesses as systems that focused on the customer as all-important. He developed, among other things, a management tool consisting of 14 points for managers to follow in their businesses to improve product quality and satisfy customers. Deming's management method for continuous quality improvement has been used primarily by private companies that make distinct products for

distinct customers. A privately owned business's effectiveness is measured by its ability to satisfy its customers' expectation of a quality product (Roehm & Castellano, 1997). FSIS is a federal public health regulatory agency that delivers services and does not have a profit-oriented mission. Can Deming's management methods be applied to government agencies? According to Deming (1986):

> In most governmental services, there is no market to capture. In place of capture of the market, a governmental agency should deliver economically the service prescribed by law or regulation. The aim should be distinction in service. Continual improvement in government service would earn appreciation of the American public and would hold jobs in the service, and help industry to create more jobs. (p. 6)

Can the implementation of the HIMP project in traditional federal food inspection programs incorporate Deming's principles of continuous quality improvement in government service in ways that decrease absenteeism? This is the basic question that is addressed in this study.

Background

The Food Safety and Inspection Service (FSIS) is a federal government regulatory agency under the United States Department of Agriculture (USDA) that has as its primary mission to ensure food safety and protect public health. The agency accomplishes its mission through inspection of all animal, poultry, and egg products produced for consumer consumption by private industry. Under traditional inspection systems, FSIS food inspectors assigned to slaughter establishments perform inspection duties at fixed locations along an evisceration line. The inspectors perform carcass-by-carcass inspection, making dispositions on carcass wholesomeness and sorting carcasses for disease and defects. Dispositions are based on carcass condition: wholesome carcasses are passed so they can be used for food and unwholesome carcasses or carcass parts are condemned (Poultry Products Inspection Regulations, 2004).

FSIS introduced the HIMP inspection project concept in traditionally inspected poultry slaughter establishments in 1998 in an ongoing attempt to meet the agency's goal of ensuring that inspection programs are based on sound scientific doctrine and to focus food inspection on conditions and factors affecting public health (*Scientific Criteria*, 2003). Under the HIMP inspection project, FSIS food inspectors are not assigned to fixed slaughter line positions, performing carcass-by-carcass inspection, but rather are promoted from the slaughter line positions into the new HIMP off-line positions. Inspectors are free to move along the evisceration lines, monitoring operations and verifying establishment compliance with HACCP rules and regulations. Slaughter establishments now assume the responsibility for process control, and their employees perform the disposition and carcass sorting process under the oversight of the inspectors. Inspection of carcasses after the sorting process is performed on a statistical basis (FSIS, 1998).

Attendance by agency personnel is crucial to the implementation of the inspection program in the poultry industry, directly affecting the viability of a poultry provider. Slaughter establishments cannot operate without federal inspection personnel present (Poultry Products Inspection Act of 1957 [PPIA], 2001). Absenteeism among food inspectors is a costly problem for FSIS and, by extrapolation, for the poultry industry. In one single year, 1978, the total cost of absenteeism in the United States for all jobs was between $8.5 and $26 billion (Ivancevich, 1985). Shortages of inspectors have forced establishments to cut back production and adversely affected their ability to comply with their HACCP program regulations (Beers, 2000).

A number of studies have suggested many causes of absenteeism. Sheridan (1985) posited a catastrophe theory, holding that increasing withdrawal of

employees from interest in their work organization leads to unwanted behaviors such as tardiness, increased absenteeism, poor job performance, and eventually leaving the organization. Sheridan suggested that employee withdrawal behavior is caused by perceived job tensions and the level of group cohesiveness in the organization. Wright (1997) also concluded that decreasing interest in an employee's organization could lead to withdrawal, absenteeism, and finally resignation from the job.

Deming theorized that businesses must seek continuous quality improvement in order to improve products and services, company productivity, and customer satisfaction. When organizations adopt Deming's 14-point management method, they incorporate teamwork, statistics, and process control in the pursuit of continuous quality improvement. Employees in such a work setting feel involved in the company culture and committed to the process of continuous improvement. Pride of workmanship and increased job satisfaction result (Gitlow & Gitlow, 1987).

The Problem

The literature has no studies on the application of Deming's management principles to absenteeism including sick leave levels, annual leave levels, and total leave levels. Neither has there been a study of absenteeism in FSIS. The purpose of this study is to determine if the introduction of the HIMP inspection project in FSIS, a regulatory public health agency—representing an application of Deming's management principles in a public sector service agency—would result in decreased absenteeism levels.

Hypotheses

Data on absenteeism of inspection personnel from 1999 through 2002 were analyzed for this study. The absenteeism rates of inspection personnel assigned to HIMP and traditional inspection establishments during the first 2 years of HIMP implementation were compared with the absenteeism rates of inspection personnel in those same establishments during the next 2 years. The following hypotheses were tested:

Hypothesis 1: There is no significant difference in absenteeism levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002.

Hypothesis 2: There is no significant difference in sick leave levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002.

Hypothesis 3: There is no significant difference in annual leave levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002.

Delimitations

Some limitations are to be expected in a study of this nature, in which some variables are beyond the control of the researcher. These variables, however, should not significantly impact the results of the study. The limitations are as follows:

1. This study utilized secondary data. Data were originally collected by FSIS from individual time and attendance records and leave audit reports.
2. The study analyzed leave data of inspection personnel assigned to HIMP and traditional inspection establishments during the first 4 years of

implementation. Leave data of inspection personnel in these establishments prior to the implementation of HIMP in 1999 could not be obtained.

3. The population sample consisted of 294 inspection personnel in 22 HIMP poultry establishments that slaughter young chickens or turkeys. Some of the research population was self-selected.
4. Variables such as pay and grade and changes in pay and grade may impact personnel attendance. For example, workers may try to maximize their income by attending work more frequently.
5. The change in the responsibilities of the inspector that results from implementation of HIMP—from physically demanding to more technical tasks—may impact attendance.
6. Changes in job requirements over time after initial implementation of the new program may impact personnel attendance. Inspectors may initially show an increase in attendance because the job is new and then become comfortable with the position as the novelty wears off.

Definitions

The following terms are words specific to the FSIS, the USDA food inspection agency:

Absenteeism: Number of hours missed from work during a 14-day pay period excluding absences due to military leave (FSIS Directive 4630-2, 1985).

Annual leave: Approved absence from work for vacation or personal use. Annual leave is accrued in 4-hour, 6-hour, or 8-hour increments per pay period, depending on the employee's time in service. The number of annual leave hours an employee can carry over from year to year cannot exceed 240 (FSIS Directive 4630-2, 1985).

Disposition: A determination made by a USDA food inspector on the wholesomeness of a poultry carcass (Poultry Products Inspection Regulations, 2004).

HACCP: Hazard Analysis and Critical Control Points. Every official establishment must conduct a hazard analysis to determine the food safety hazards that are likely to occur in its food production processes and identify the corrective and preventive measures the establishment will apply to control these hazards. Specific locations along the production process where controls have been instituted are called critical control points (FSIS, 1996).

HIMP: Hazard Analysis and Critical Control Points-Based Inspection Models Project, a voluntary HACCP-based inspection system used in slaughter inspection. Establishment personnel perform slaughter sorting duties and identify food safety hazards that could affect the raw product. FSIS inspectors perform oversight and food safety inspection duties (FSIS, 1998).

Inspector: An official of the USDA who has been given the authority to inspect poultry products under the auspices of the Poultry Products Inspection Act (Poultry Products Inspection Regulations, 2004).

Nonpay leave: Temporary non-pay absence from work which may be approved leave without pay or non-approved absence without official leave (FSIS Directive 4630-2, 1985).

Official establishment: Any establishment at which inspection of the slaughter of poultry or the processing of poultry products is maintained according to federal regulations (Poultry Products Inspection Regulations, 2004).

Sick leave: Approved absence from work utilized by USDA employees for medically related conditions affecting the employees or their family members. Sick leave is accrued in 4-hour increments per pay period for the extent of

employment with the agency. There is no limit to the amount of sick leave hours an employee can carry from year to year; the hours are accrued continuously (FSIS Directive 4630-2, 1985).

Traditional inspection: Any inspection required by the regulations to determine whether any poultry or poultry product complies with the requirements of the law and regulations. The inspection is performed by an USDA inspector (Poultry Products Inspection Regulations, 2004).

Theoretical Framework

The theoretical framework used in this study is the management theory posed by W. Edwards Deming. Deming posited that continuous quality improvement would lead to job satisfaction and, therefore, decreased absenteeism. Even though job satisfaction may be measured in numerous ways, this study focused on absenteeism because of its empirical nature and its importance in the HIMP program, where individual attendance has a significant effect on the operation of the establishments monitored. This study examined the application of Deming's principles in a public health agency through the HIMP program. The HIMP was not designed with the intent of integrating the principles promoted by Deming, but it does use those principles.

Deming's principles of continuous improvement have been adopted by public health organizations such as managed care organizations and hospitals. Working toward continuous quality improvement, personnel in public health and healthcare organizations work together to increase institutional knowledge, enhance a sense of commitment and empowerment, and provide improved care and satisfaction for patients (McLaughlin & Kaluzny, 1997).

Summary

In 1998 FSIS introduced a new inspection program, Hazard Analysis and Critical Control Points-Based Inspection Models Project (HIMP), to the poultry slaughter industry. Its purpose was to enhance the agency's ability to minimize food safety hazards and protect consumers. This HACCP-based program was implemented to minimize the introduction of unwholesome product to the public and to allow the department to maximize the use of its scarce personnel resources (FSIS, 1998). Good attendance of inspection personnel in slaughter establishments is critical since the establishments cannot operate without inspectors present. Absenteeism of inspection personnel has become a critical problem for FSIS and the poultry industry (Beers, 2000).

Deming (1986) posited that a business must incorporate continuous quality improvement principles in order to improve products and services, company efficiency, and customer satisfaction. Businesses benefit as employees become more fulfilled and committed to the company's process of continuous quality improvement. Deming's principles have enabled employees and management of a number of businesses to benefit from increased job satisfaction (Gitlow & Gitlow, 1987).

The purpose of this study was to determine whether the same principles can be applied to a public health agency whose goals do not correspond with the goals of the industry it regulates. The researcher sought to determine if the implementation of Deming's principles translate into a change in behavior, namely, a change in work attendance.

Chapter 2

REVIEW OF THE LITERATURE

This study investigated whether the introduction of the Hazard Analysis and Critical Control Points-Based Inspection Models Project (HIMP), characterized an application of W. Edwards Deming's management principles to a federal regulatory public health agency, resulting in a decrease in absenteeism levels. Absence of inspection personnel hinders the ability of a poultry establishment to operate. Per the Poultry Products Inspection Act (PPIA) of 1957, slaughter establishments cannot operate without inspection personnel present. Therefore, high rates of absenteeism adversely affect the ability of an establishment to operate productively (Beers, 2000). Absenteeism among food inspectors has become a critical problem for FSIS and the poultry industry.

The average cost of absenteeism per employee was more than $600 per year from 1999 through 2000. This figure does not reflect costs such as overtime pay, hiring of additional temporary or intermittent workers to cover the absences, and low morale ("U.S. Survey," 2000). Absenteeism has many causes, including low employee morale and low job satisfaction. In public sector organizations in which senior management and accompanying priorities change often, employees may feel a lack of continuity and consistency, a loss of efficiency, and low job satisfaction (Deming, 1986).

Deming introduced principles of continuous quality improvement that help managers of businesses improve products and services, productivity and efficiency, and customer satisfaction. The benefits of continuous quality improvement not only include improved market share, increased productivity, and

higher profit, but also improvement in the morale of a company's employees (Deming, 1982).

This study investigated literature in these areas of concern: implementation of HIMP-based inspection methods, the principles of Deming, application of Deming's principles in public health, absenteeism in public health, and factors linked to absenteeism.

HIMP: HACCP-Based Inspection

The USDA is one of the largest departments within the federal government. USDA serves the country by providing hunger prevention programs; forest and rangeland protection; soil, water, and wildlife conservation efforts; new crop technologies; housing programs; and food safety programs. These efforts and programs are administered by various agencies in USDA (USDA, 2003). As a regulatory agency of USDA, the Food Safety and Inspection Service's (FSIS) primary mission is to ensure food safety and protect public health. FSIS agency personnel assure that meat, poultry, and egg products are wholesome and not adulterated and are properly marked, labeled, and packaged. Meat, poultry, and egg products produced for public consumption are inspected and monitored by FSIS inspectors for safety and wholesomeness (PPIA, 2001).

In 1996, FSIS implemented Hazard Analysis and Critical Control Points (HACCP) concepts in all meat and poultry establishments. The utilization of HACCP concepts in slaughter establishments introduced scientific principles of food safety in slaughter inspection. Under HACCP, management of slaughter establishments identified and evaluated the food safety hazards that could affect the safety of their products and established controls to prevent or abate their occurrence (FSIS, 1996). HACCP principles could not be applied to all activities

in the slaughter process, so inspection of animals and products are still performed through traditional methods.

The HACCP-based Inspection Models Project, HIMP, was designed as an extension of HACCP. Through this project, FSIS established and encouraged new and revised HACCP controls that allowed establishments to assume responsibility for process control, food safety, and consumer protection. Implementing the HIMP project allowed FSIS to use its inspection force in more effective ways to protect public health. Food inspectors performed oversight inspection in slaughter establishments, were redeployed to monitor the safety and wholesomeness of products after they were shipped from the establishments, and filled inspection vacancies (FSIS, 1998).

Under traditional poultry inspection, FSIS food inspectors assumed responsibility for identifying poultry carcass hazards and defects and removing them from production. Food inspectors were assigned to stationary positions along an evisceration line to make carcass dispositions on wholesomeness and defects. These food inspectors performed the total inspection of all carcasses presented by the slaughter establishment. The number of food inspectors required per evisceration line ranged from two to four, and establishments generally had two to four evisceration lines that, in many cases, operated during more than one shift. FSIS food inspectors in traditional poultry establishments assumed responsibility for sorting carcasses for wholesomeness and quality defects, defined corrective actions that establishments must take, and solved many of the production control problems (FSIS, 1999).

With the initial introduction of HACCP in 1996, establishments began to assume responsibilities for instituting process controls and identifying critical control points throughout the slaughter process at locations where food hazards

could occur and controlling or eliminating the hazards (*Scientific Criteria*, 2003). HIMP allowed FSIS food inspectors to concentrate on verifying that the products produced were safe and wholesome. The introduction of the HIMP-based inspection project totally changed the traditional inspection system by requiring poultry establishments to assume responsibility for sorting carcasses for wholesomeness and quality defects. Trained establishment employees identified and sorted carcasses under the oversight of the food inspectors. HIMP was put into practice in the first poultry establishment in 1999 (FSIS, 1999).

Through HIMP, the USDA was able to utilize inspection resources more efficiently in food safety activities. New off-line inspector positions were created and the food inspector was promoted to a position level comparable to that of a technician. The FSIS's inspector's scope of responsibility was extended to include the entire evisceration and other establishment processes. In these new positions, the FSIS food inspectors were free to move along the evisceration line, monitoring and verifying the effectiveness of the establishment's HACCP programs, and to perform other food safety assignments. Food inspectors performed their verification activities based on statistical controls and addressed inspection activities with a team approach. One to two inspectors performed verification inspection activities on each evisceration line and one inspector acted as team leader or coordinator. The team leader also performed verification inspection duties and coordinated the inspection team's efforts to maintain focus on areas of food safety and public health significance. FSIS became more efficient in protecting the public health and redeployed personnel resources to other needed areas (FSIS, 1998).

Although this improved efficiency came as a result of the implementation of some of W. Deming's principles, the literature does not address the HIMP

inspection project and Deming together. However, a discussion of Deming's principles here demonstrates their application in the HIMP inspection project.

Deming's Principles

W. Edwards Deming was a statistician and business consultant who is credited with bringing the concept of continuous quality improvement to the Japanese manufacturing industry, then to the American manufacturing industry. Deming encapsulated his philosophy of continuous quality improvement for businesses into 14 points for management (Davids, 1999). Deming viewed businesses as systems whose primary purpose is to satisfy the customer. He stated that a business system must have clear goals and must communicate those goals to everyone within the organization (Rienzo, 1993). In order to resolve the problems and increase the productivity of a business, management must become intrinsically involved in the development of processes, products, and services. Managers must seek continuous quality improvement for their products and services at every stage of development in order to please their customers (Roehm & Castellano, 1997). Deming posited that management needed new principles with consistent statistical methods in order to achieve continuous quality improvement. Deming (1986) stated that continuous quality improvement leads to better products and service, lowered costs, a better competitive position, happier employees, and creation of more jobs.

The purpose of Deming's management method is to transform and improve the practice of quality management. Anderson, Rungtusanatham, and Schroeder (1994) concluded that Deming's management method encourages the development of an organizational system that fosters cooperation and learning that facilitate the practice of quality management. This in turn leads to continuous quality

improvement of processes, products, and services and to employee job fulfillment, all of which are crucial to customer satisfaction and survival of the business. Anderson et al. defined the relationship between employee fulfillment and product quality as follows:

> The degree to which employees of an organization believe that the organization continually satisfies their needs arises fundamentally from employees' being able to derive pride of workmanship, satisfaction, and commitment from the work they do. (p. 489)

When Deming's management methods are used, employees feel satisfied with their jobs and derive pleasure from or feel positive toward their work. Job commitment is fostered to the extent that employees are motivated to further the organization's goals and improve products and services. Employees feel pride of workmanship from creating quality products, delivering quality service, and having continuous education opportunities available.

Deming developed his management method so that business managers would improve quality and, as a result, improve their entire organizations. This management method was presented as a series of 14 points (Walton, 1986). In his book, *Out of the Crisis*, Deming (1986) lists the following 14 points for management:

1. Create consistency of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business on the basis of price tag alone.
5. Improve constantly and forever the system of production and service.
6. Institute training.
7. Adopt and institute leadership.
8. Drive out fear.

9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the work force.
11. Eliminate numerical quotas for the work force.
12. Remove barriers that rob people of pride of workmanship.
13. Encourage education and self-improvement for everyone.
14. Take action to accomplish the transformation.

Whereas Deming's management strategy of continuous quality improvement was developed primarily for private industries, Deming (1986) stated that the 14 points also apply to service organizations and government service. The senior management of public sector agencies must grasp the importance of consistency of purpose and knowledge in order to become true leaders of their agencies. Integration of the 14 points allow public sector managers to maintain the goals of their agencies, improve efficiency, and increase job satisfaction (Deming, 1986). At least seven of Deming's principles seem to be closely associated with HIMP concepts. Although understated in the literature, Principles 1, 2, 3, 6, 9, 12, and 13 are particularly relevant to HIMP.

Principle 1: Create Consistency of Purpose

FSIS adopted scientific principles and implemented HIMP to improve the agency's ability to ensure a safe food supply and protect public health (FSIS, 1998). FSIS did not develop a new product, but sought to improve its service of food safety and protection of public health. HIMP was intended to be an evolving program utilizing the scientific concepts of HACCP and regulatory requirements to meet its ongoing food safety and public health goals.

The Deming principle of creating consistency of purpose for improvement of product and service applies to the agency's effort to improve food safety.

Deming believed that it is important for top management's leadership to create and communicate a vision for continual improvement in order to enhance the viability of the organization (Anderson et al., 1994). A business must have a focused purpose and long-term commitment to that purpose in order to continually improve its products and services and ensure that resources are allocated to provide for long-range needs. To innovate and improve products and services, employees must know and understand the purpose of the organization (Roehm & Castellano, 1997). If organizations can encourage employees to see how their work and goals contribute to the organizational goals, the employees will see themselves as important to achieving the organization's vision (Wright, 1997)

Principle 2: Adopt the New Philosophy

In implementing HIMP, FSIS management had to commit to continually improving the inspection system that protects the meat and poultry supply. All inspection personnel had to be informed and trained in the new inspection concepts. HIMP was developed through an open, public process that included meetings, teleconferences, news releases, and training materials. The agency's vision of improved, scientific-based inspection for food safety and public health protection was shared with people in the agency, in the industry, and in the public (FSIS, 1999).

In making his second point, adopt the new philosophy, Deming stated that management must make a commitment to change its attitude and strive for continuous improvement in quality and productivity. Along with this change in attitude, management must also get everyone else in the organization involved in the process of continuous improvement of quality (Gitlow & Gitlow, 1987).

Management must lead this transformation, focusing everyone on the vision and goals of the company.

Principle 3: Cease Dependence on Mass Inspection

Under traditional inspection, food inspectors are assigned to fixed locations along the eviscerating line and perform 100% of the carcass inspection. Inspectors make carcass dispositions on wholesomeness, quality defects, and disease and sort the carcasses accordingly. With the introduction of HIMP, FSIS ceased its dependence on mass inspection. Inspectors no longer perform 100% on-line inspection; plant employees perform the carcass sorting. Food inspectors now perform oversight inspection at any point along the eviscerating line and throughout the process. Inspection of carcasses is based on statistical process control focusing on conditions affecting public health (FSIS, 1998).

Deming's third point is that management should be aware of the relationship of variance to the system and understand the difference between variations caused by common sources and those caused by exceptions. The variations cannot be controlled or eliminated by mass inspection (Roehm & Castellano, 1997). Deming (1986) believed that mass inspection is unreliable, expensive, and ineffective, and that only in rare circumstances is mass inspection an acceptable practice. He also stated that inspectors will not agree with one another until their work is brought under statistical control.

Principle 6: Institute Training

All inspectors promoted to the new positions received training in HACCP concepts and the new inspection program. A training program was developed that explained the agency's vision of enhanced, scientific-based inspection and defined

the expectations of the new jobs. The training included formal class work, workshops, instructional materials, and the use of statistical methods. All employees were included in the training: inspectors, veterinarians, supervisors, and management (FSIS, 1999).

Deming posited that all organizations had to institute training. Training should provide managers and employees the tools necessary for evaluating processes and improving systems. The training should offer employees a share in the overall philosophy and vision of the organization. Training should help employees succeed and improve their performance by increasing or improving upon what the employees already know (Gitlow & Gitlow, 1987). Training in statistical thinking is necessary to help employees understand variations (Rienzo, 1993).

Principle 9: Break Down Barriers Between Staff Areas

Inspection personnel in HIMP poultry establishments perform their duties with a team approach. Inspectors perform oversight and direct verification inspection activities on each evisceration line. Another inspector also performs verification inspection activities and assumes the position of team leader. The inspectors share their observations and data with other inspection team members. The team leader helps to coordinate the efforts of the inspection team members to ensure the establishment's HACCP and process control procedures meet regulatory and performance standards. A supervisory public health veterinarian provides direction and supervisory guidance and veterinary medical expertise for the team (FSIS, 1998).

The Deming point of breaking down barriers between staff areas relates to the agency's team approach to inspection. Deming believed that employees in

different staff areas or departments must work together in teams to tackle problems that may occur with the product or service. Employees should understand that they are a part of the organizational system and must work in concert to satisfy the customer and advance the goals of the organization (Roehm & Castellano, 1997).

Principle 12: Remove Barriers to Pride of Workmanship

FSIS has an established mission of ensuring food safety and public health protection. FSIS is attempting to improve its mission by the introduction of HACCP concepts and the HIMP inspection program. In order to get inspection employees involved and help them understand their roles in the new inspection program, information is shared publicly, allowing FSIS inspectors and veterinarians, industry, and the general public opportunities to provide input and comments on the new HIMP program (FSIS, 1999). With the team approach, inspectors are able to help determine the course of action the inspection team takes. This approach is different from traditional inspection in which most inspectors are assigned to fixed positions on the evisceration line and have limited opportunity to participate fully in all inspection activities (FSIS, 1998).

Deming's principle of removing barriers that rob people of pride of workmanship has been adopted by the agency in principle. The agency involves inspectors fully in all HIMP inspection activities. Gitlow and Gitlow (1987) stated that establishing consistency of purpose, developing a vision or mission statement, and involving employees in the mission permit employees to develop identification with the organization. The employees develop pride in being part of an organization that has a mission of continuous quality improvement.

Principle 13: Encourage Education and Self-Improvement for Everyone

FSIS developed an extensive education program for inspection personnel for the new HIMP program to include classroom instruction and workshops, instructional materials and guidebooks, and instruction in statistical process control (FSIS, 1999).

Deming believed that organizations must encourage education and self-improvement for everyone. Deming stated that organizations need people who improve with education and that the organization has a duty to offer opportunities for continued education. He believed that people liked and needed to learn and that learning is the source of innovation for the organization (Anderson et al., 1994). Rienzo (1993) stated that continued education added to employee fulfillment and improved commitment to the organization's vision. It is very important that management and employees are educated in new programs, including the concepts of teamwork and statistical process control (Walton, 1986).

Deming's Principles in Public Health

Deming's principles of total quality management and continuous quality improvement were adopted by industry during the 1980s as means of improving products and services, lowering costs, and achieving a competitive edge. Healthcare organizations did not adopt these principles quite as early. Generally, hospitals and physicians were seller-oriented, setting the standards for quality for the health profession (Casalou, 1991).

The concern for continuous quality improvement emerged as an important issue in healthcare when demands for improvement came from consumer organizations, insurance companies, and patients (Kunst & Lemmink, 2000). Various public sector entities such as healthcare, education, social service, and

government agencies have responded to pressures from customers and the need to be competitive by adopting the principles of continuous quality improvement and total quality management. These public sector organizations adopted the principles in order to improve services and organizational performance (Hsieh, Chou, & Chen, 2002).

McLaughlin and Kaluzny (1997) proposed that healthcare, particularly managed care, needed to adopt the concept of continuous quality improvement in order to provide better products and services for patients and medical providers. Adoption of the principles of continuous quality improvement permitted healthcare personnel to participate and work in concert to satisfy their patients and advance the goals of their organization. Mahlen (1993) found that healthcare organizations that incorporated continuous quality improvement into their processes achieved "superior performance." These hospitals were better able to meet their patients' needs, became more competitive, and utilized personnel and resources more effectively.

Kunst and Lemmink (2000) described criteria for continuous quality improvement programs for healthcare organizations. One criterion was establishing management as the responsible party for increasing the level of quality and improving the level of expertise of employees and professionals through training and career development programs. The researchers suggested that management should periodically review and measure the satisfaction levels of employees and professionals and periodically review and measure the satisfaction levels of patients. Kunst and Lemmink found that adoption of continuous quality management by healthcare organizations enhanced patients' perceived quality of service and improved business performance.

A study in the Veterans Health Administration hospitals by Young, Charns, and Shortell (2001) indicated that the implementation of total quality management principles in these public sector organizations depended on the willingness and receptivity of top management. The pattern of adoption of new concepts in the hospitals was comparable to that of private organizations.

Absenteeism in Public Health

Absenteeism is a considerable problem affecting all industry segments, private industry and government organizations. Recent data from the United States Bureau of Labor Statistics (2000) regarding workplace absence show that the absenteeism rate for government workers is higher than for employees in other industries such as agricultural workers and private nonagricultural workers. In 2000, the absenteeism rate for the total population of 16,215,000 government workers was 4.6%; for the total population of 1,496,000 agricultural workers, 2.6%; and for the total population of 82,135,000 private nonagricultural workers, 3.7%.

Absenteeism, whether due to illness, lack of job satisfaction, familial concerns, or other reasons, adversely impacts an organization's productivity. As previously stated, one 1978 estimate by Steers and Rhodes (as cited in Ivancevich, 1985) suggested that the total annual cost of absenteeism in the United States was between $8.5 and $26 billion. According to Dalton and Mesch (1991), at least 1 million workers a day did not attend their regularly scheduled work in 1986, resulting in an estimated cost of $40 billion for the year.

Many of the costs associated with absenteeism resulted from lost production for the organization, overtime reimbursements to replacement workers, and benefits paid to the absent employee. Administrative costs increased because of

the challenges of managing the vacancies and rescheduling work. Total disruptions to certain sections of industry can result if the amount of absenteeism was high enough (Briner, 1996). Because of the detrimental effect on productivity and the exorbitant cost to industry and public service organizations, the problem of absenteeism has been studied extensively.

Markowich and Silver (1989) surveyed healthcare human resource executives and found absenteeism to be a critical problem affecting healthcare organizations and hospitals. The adverse effects to the organization included the costs for covering for the absent employee, costs of maintaining an absence control program, possible lowered morale of the employees who have to work harder and cover for absent employees, and loss of productivity.

Harrison and Martocchio (1998) reviewed worker absenteeism studies for a 20-year period, from 1977 through 1996. Based on their review of the past research, Harrison and Martocchio established five classes of possible causal factors in absenteeism: personality, demographic characteristics, job-related attitudes, social context, and decision-making mechanisms. They suggested that people with personalities that were incompatible with the organization, such as those that were aggressive and hostile, emotionally unstable, or showed other undesirable traits, were more likely to engage in misconduct such as unwarranted absenteeism.

Demographic factors such as gender, age, family characteristics, and education level were included in many studies and Modelss. Harrison and Martocchio (1998) suggested that employee attitude toward the job or organization was strongly related to worker attendance and absenteeism tendencies. Established group norms and collective attitudes toward absenteeism also affected the attendance behavior of individual workers. Attitude, societal norms, perceived

control, and moral obligations had some influence over the decisions of workers to attend work or not.

A study of nurses and nursing supervisors in a Midwestern hospital was conducted by Gilmore, Ferris, Dulebohn, and Harrell-Cook (1996). The researchers examined the influence of organizational politics on employee withdrawal. Absenteeism was used as a measure of employee withdrawal. The authors hypothesized that organizational politics could create a source of stress for new employees, thus increasing the likelihood of employee absenteeism and turnover. Employees with more tenure were able to adapt to the politics of the organization and had less absenteeism, probably because they had more information about the organization and understood the political environment better.

The expectancy theory (Jurkiewicz, Massey, & Brown, 1998) posits that employee motivation depends on what an employee wants and the expectation that the employee will receive that desired outcome. When employees perceive that they are receiving the positive outcome they desire from the job, they are more motivated to perform well, have better productivity, remain with the company, and have a positive work attendance record. If there is great disparity between what an employee wants and actually receives or gets, the employee becomes dissatisfied with the job or organization. Performance and productivity problems, increased turnover, and increased unwarranted absenteeism may be the result of this disparity.

Jurkiewicz et al. (1998) used this theory as a basis for research in a study comparing employees of public and private organizations. The study demonstrated differences in job motivation factors between public and private workers. In the private sector especially, motivation and job satisfaction were positively associated

with good job performance and attendance. The researchers suggested further research in how motivation affects public employees.

A study conducted by Wright (1997) focused on organizational commitment and performance. Wright evaluated the degree of commitment of experienced or tenured employees to an organization. Those employees with a high degree of commitment to the organization had less turnover and absenteeism.

Organizational commitment was also shown to significantly affect employee absence by Burton, Lee, and Holtom (2002). In a study of customer service representatives of an Internet-based company, Burton et al. utilized the Steers and Rhodes (1978, as cited in Ivancevich, 1985) Models of absenteeism to demonstrate that employees with a higher degree of commitment to the organization were more motivated to attend work.

Sheridan (1985) used the catastrophe theory in a study measuring the effect of nursing employee withdrawal behavior. The catastrophe theory is a mathematical Models measuring the influence of change processes on individuals and organizations. Sheridan used absenteeism as a measure of the nursing employees' withdrawal behavior. The study demonstrated that employee withdrawal from interaction with the organization resulted in decreased job performance, high turnover, and increased absenteeism.

Hackman and Oldham's (1976, cited in Rentsch & Steel, 1998) job characteristics Models was utilized for a 6-year study of the relationship between job characteristics and absence of public service personnel. The Models posited that employees with enriched jobs, task variety, autonomy, perceived control, and task significance were more motivated, performed their jobs better, and were less likely to be absent than employees in unenriched jobs. Rentsch and Steel measured job characteristics, competence, need for achievement, and absenteeism

with a group of civilian personnel working in a Department of Defense organization. Rentsch and Steel's study indicated a strong correlation between job characteristics and absenteeism and was able to demonstrate that past or current job characteristics predicted future absenteeism.

Kelly (1992) used the job re-design theory to explore the effect of job changes on job satisfaction and performance. He conducted a meta-analysis of previously conducted research incorporating some elements of the job characteristics Models. The improved work content that resulted from the job re-design improved employee job satisfaction.

A meta-analysis by Bycio (1992) reviewed previous research on absenteeism to determine the relationship between job performance and absenteeism. Bycio demonstrated that job performance and absenteeism were strongly related and each influenced the other. Bycio found that an employee with a high level of absenteeism may have had poor job performance due to an inability to keep up with job changes. Conversely, an employee with poor job performance may use absenteeism as an avoidance measure.

Watson, Driver, and Watson (1985) studied relationships between single variables and absence measures and accounted for other absence measures at the same time by using multivariate analysis. Their study measured three absence behaviors of employees collected from personnel records: frequency of absences, total time lost, and duration of the absences. The researchers demonstrated the ability to test for more than two variables at a time and enhanced future absenteeism research by improving validity in the studies.

Numerous studies have examined relationships between variables such as job satisfaction, personality, familial concerns, and health and worker absenteeism.

Definite linkages between these variables and absenteeism have been demonstrated.

Factors Related to Absenteeism

Numerous factors are related to the problem of absenteeism. Personal illness and health concerns are common reasons given for absence from work. In a study conducted by Leigh (1991) using data generated during a 1974 University of Michigan's Survey Research Center Quality of Employment survey, health variables were found to be strongly linked with absenteeism. Both economic and health variables were evaluated in the study. Leigh demonstrated that health variables were even more closely related to absenteeism than economic variables. The health variables originally cited in the Quality of Employment survey that were most strongly linked with absenteeism in Leigh's study were excess weight, poor quality of sleep, and hazardous conditions on the job.

Personality characteristics have been linked to the propensity for absenteeism. Employees suffering from emotional instability, aggressiveness, hostility, anxiety, and other undesirable personality traits are more likely to be absent from work (Harrison & Martocchio, 1998; Judge, Martocchio, & Thoresen, 1997). Judge et al. investigated the relationship between personality characteristics and absenteeism with nonacademic employees of a Midwestern university. Their findings supported the assertion that absenteeism can be predicted by worker personality characteristics. As workers became more distressed, they began to withdraw from the organization through increased absenteeism and turnover. The researchers also demonstrated a strong relationship between absence history and future incidence of absence.

Van Yperen, Hagedoorn, and Geurts (1996) and Gilmore et al. (1996) posited that stress from dealing with organizational politics is related to absenteeism. Workers suffered distress due to feelings of inequality with their co-workers or colleagues. Workers then responded to these feelings of inequity by withdrawing from the group through absenteeism and/or leaving the organization. They became dissatisfied with their jobs and the organization. Van Yperen, Hagedoorn, and Geurts investigated the relationship between feelings of inequality with absenteeism in a study with Dutch metal workers. Results of the study supported the assertion that workers who felt deprived or unequally treated were more likely to leave the organization or be absent from work than those who felt advantaged in the organization.

Fichman (1988) utilized the motivation theory in a study involving 465 miners in order to predict attendance and absence rates. Fichman focused on how absence and work attendance affected each other. The study demonstrated that attendance and occurrences of absenteeism were closely related. Unsatisfied desires encouraged workers to switch between periods of attendance and absenteeism. Fichman suggested that organizations could reduce absenteeism if they provided employees the proper tools and inducements or motivations.

Pelled and Xin (1999) concluded from their longitudinal study of employees of an electronics firm that job satisfaction and positive feelings toward one's job reduced the occurrence of absenteeism. Employees withdrew through absenteeism and high turnover from organizations in which they felt dissatisfied or had negative experiences.

Dalton and Mesch (1992) and McCue and Gianakis (1997) also suggested that workers might experience increased absenteeism and leave organizations due to dissatisfaction. Job dissatisfaction could stem from internal organizational

problems or external reasons such as family concerns. Absences from work and quitting were the workers' methods of removing themselves from unacceptable conditions. In a 4-year analysis of public utility companies, Dalton and Mesch examined the availability of employee transfer and absenteeism. The study showed a strong relationship between employees' ability to transfer and absenteeism. The highest rates of absenteeism were among those who had requested transfers but were denied. Conversely, the lowest rates of absenteeism were among those who requested and received transfers.

Kacmar, Wright, and McMahan (1997) investigated the effects of individual perceptions of self-esteem, cognitive ability, and attitude on worker attendance and job performance. Their study demonstrated that those workers with high self-esteem, high cognitive ability, and a positive attitude toward education and training were more motivated, performed at higher levels, and were less likely to be absent from work.

Summary

The study explored the influence of the application of Deming's principles on absenteeism levels in a public health agency. The purpose of the study was to determine if the introduction of a new government program, HACCP-Based Inspection Models Project, or HIMP, represents an application of Deming's principles to a government agency as demonstrated by a decrease in absenteeism. The introduction of the HIMP program created new positions with new responsibilities for FSIS food inspectors. Inspectors are no longer assigned only to mandatory stationary inspection positions on the evisceration line, but have been deployed to perform oversight inspection of the entire evisceration process and other food safety activities (FSIS, 1998). The complexity of the job and scope of

responsibility have been greatly increased. Inspectors work together as a team using a statistical control process to determine the compliance of an establishment with food safety regulations. Kelly (1992), McCue and Gianakis (1997) and Rentsch and Steel (1998) all report a strong relationship between job characteristics and work attendance.

Deming (1986) was a strong proponent of statistical and quality control. He stated that businesses' primary focus should be to satisfy the customer and, in order to achieve that focus, management must become deeply involved in the continuous development and quality improvement of processes, products, and services. Deming developed a management method that provides continuous quality improvement in processes and products. Deming presented his management method as a series of 14 points.

The adoption of Deming's principles not only led to continuous quality improvement of processes and products, but also enhanced employee fulfillment and commitment to the company (Anderson et al., 1994). Deming's principles may have been integrated into the development of the HIMP program. Even though the integration of the principles may not have been intentional, several of these principles appear to have been incorporated into the HIMP inspection program, where employee initiative and job commitment are important to success.

Many public sector service organizations, such as healthcare, education, social services, and government agencies, have adopted Deming's principles of continuous quality improvement due to consumer demand and competition in the marketplace (Hsieh et al., 2002). The incorporation of continuous quality improvement has equipped healthcare organizations to meet patient needs, become more competitive, and utilize personnel and resources more effectively (Mahlen, 1993; McLaughlin & Kaluzny, 1997).

Absenteeism in the public health field is a crucial problem that adversely affects a healthcare organization's ability to remain productive and competitive. Absenteeism increases administrative costs, adding costs for managing vacancies, for maintaining absence control programs, and from loss of productivity (Briner, 1996; Markowich & Silver, 1989). Because of the extensive costs and decreased productivity to organizations, the problem of absenteeism has been the subject of much research

Numerous factors have been reported to be associated with the problem of absenteeism. Among the factors studied are poor health, specific personality characteristics, and dissatisfaction with organizational politics and pressures (Gilmore et al., 1996; Judge et al., 1997; Van Yperen et al., 1996). Various studies have attempted to explain the causes of absenteeism and find methods for reducing absenteeism. The purpose of this study is to determine if the introduction of the HIMP inspection project in FSIS, as an application of Deming's principles in a public sector service agency, resulted in decreased absenteeism levels.

Chapter 3

RESEARCH DESIGN AND METHODOLOGY

This study examined the effect of the implementation of the Hazard Analysis and Critical Control Points-Based Inspection Models Project (HIMP), as an application of Deming's principles to a government agency, on absenteeism levels. This chapter describes the methods and materials used to measure absenteeism levels. Because no operational changes other than the introduction of the HIMP program were made to the inspection program at that time of this research, the introduction of the program is the only factor with a direct bearing on employee attendance.

Population

The study examined the implementation of Deming's principles on absenteeism levels of public health agency inspection personnel. The study compared the absenteeism rate of inspection personnel in HIMP and traditional inspection establishments during the first 2 years of implementation with the absenteeism rate of inspection personnel in those same establishments in the next 2 years. This study involved analysis of secondary data. The data were obtained from summarized leave audit reports of individual time and attendance records. Demographic characteristics such as ethnicity, age, and gender were not captured in the individual time and attendance records nor in the summarized leave audit reports; therefore, these data were not available for use in this study.

The population selected for this study consisted of inspection personnel assigned to the 22 poultry establishments participating in the HIMP inspection

project. The population contained a total of 294 inspection personnel. The inspection personnel in each HIMP establishment were divided among three different positions: oversight verification inspector, team leader inspector, and supervising public health veterinarian. The inspection personnel were located at the 22 poultry establishments in six inspection districts covering 11 states: Alabama, Mississippi, Virginia, West Virginia, Georgia, South Carolina, North Carolina, Arizona, Oklahoma, Missouri, and Texas. States in the Western region of the country had not implemented HIMP during this time. Of the participating poultry establishments, 1 implemented HIMP in 1999, 9 more implemented HIMP in 2000, 10 more implemented HIMP in 2001, and 2 implemented HIMP in 2002.

Data Collection

Secondary absenteeism data were collected for this study. Approval for collection of absenteeism data of inspection personnel was obtained from the Alameda District Manager (see Appendix A). Absenteeism data from attendance and leave audit records generated from years 1999 through 2002 were analyzed to determine if there was a significant difference in work attendance of inspectors working under HIMP and traditional inspection during the first 2 years of implementation, 1999 and 2000, and work attendance of inspectors working under HIMP during the subsequent 2 years, 2001 and 2002. Data indicating the amount and type of absences for inspection personnel assigned to HIMP poultry establishments were collected from summary leave audit reports (see Appendix B).

The summary leave audit reports were provided by the FSIS financial processing center for employees. The leave data obtained from these leave audit reports were categorized by total hours of annual leave and sick leave per year for years 1999 through 2002 for inspection personnel in all poultry establishments

classified as HIMP. Nonpay leave data could not be collected because this information is not maintained in the financial processing center's leave database following the end of each calendar year. In order to maintain confidentiality, personal identifiers – social security numbers and names – were not included in the reports. No names or social security numbers of inspection personnel were divulged in this study.

Data Analysis

This study was a comparison of before-and-after observations on the same or similar inspection personnel. The study compared total leave, annual leave, and sick leave data of inspection personnel obtained during the first 2 years (1999 – 2000) of HIMP implementation with the same type of leave data obtained 2 years after HIMP was in place (2001 – 2002) in 22 poultry establishments. The relationship between HIMP introduction over time and inspection personnel absenteeism and leave levels was examined. Trend analysis was used to test each study hypothesis. Statistical significance was established at the .05 level.

Trend analysis examines the relationship between factors or variables established by the experimenter with variables measured from the subjects. The variables established by the investigator are termed independent or explanatory variables and those measured from the subjects are termed dependent or response variables (HyperStat Online, n.d.). Trend analysis tests different aspects of the relationship between the independent variables and the dependent variables. The linear component of trend can be utilized to test if there is an overall increase or decrease in the dependent (response) variable as the independent (explanatory) variable increases. The investigator is looking for a general pattern and any shifts or deviations from the pattern. By looking at the trend between independent and

dependent variables, one can observe a long-term rising or descending progress over a period of time. Trend analysis can determine the strength of an association between variables but does not provide a definitive statement of cause and effect (Moore, 1995).

Trend analysis of data is represented in graph form with the independent variable as the "x" axis and the dependent variable as the "y" axis. Trend can be further analyzed through time series analysis and regression analysis. Time series analysis shows trend variations for data points taken over time. Regression analysis measures whether the variables of interest are linearly related and describes the change in the dependent variable "y" as the independent variable "x" changes. Evaluation of the equation for the line or least-squares regression provides information about the strength of the relationship of the variables. A numerical measure of the regression equation is called the sample r^2. This measure provides a gauge of how well the regression explains the response of the dependent variable to the independent variable (Daniel, 1999). For this study the dependent variables are total leave hours, sick leave hours, and annual leave hours. The independent variable is the time in years of HIMP implementation.

Summary

This study analyzed whether the implementation of HIMP, as an application of Deming's principles to a public health regulatory agency, resulted in changes in absenteeism levels of inspection personnel. The population selected for study consisted of inspection personnel assigned to the 22 poultry establishments that voluntarily implemented HIMP during the years of 1999 through 2002. This study examined the changes in absenteeism levels of inspection personnel in those establishments by comparing total leave, sick leave, and annual leave hours in the

first 2 years of implementation, 1999 and 2000, with the total leave, sick leave, and annual leave hours in the subsequent 2 years of implementation, 2001 and 2002.

Annual leave, sick leave, and total leave data were obtained from summary reports of individual time and attendance records. The summary reports provided annual leave, sick leave, and total leave hours per year used by inspection personnel in the 22 participating HIMP establishments. Nonpay leave data could not be obtained because this type of information is not maintained in the financial processing center's database following the end of each calendar year. The summary leave reports did not reflect demographic characteristics such as ethnicity, age, or gender, as this type of information is not included in the original individual time and attendance records.

Trend analysis was conducted to examine the changes in annual leave and sick leave levels over time and to determine if a relationship exists between HIMP implementation and absenteeism levels. Trend analysis is performed to determine whether there is a decrease or increase in the dependent variable as the independent variable increases. The dependent variable is measured by the subjects' responses and the independent variable is the factor established by the investigator. Regression analysis of the linear trend measures the strength of the association of the dependent and independent variables (Daniel, 1999). To test each hypothesis, the linear component of trend was examined for changes in the dependant variables, leave levels, as the independent variable, number of years, increased.

Chapter 4

RESULTS AND ANALYSIS OF DATA

The purpose of this study was to determine if the implementation of the Hazard Analysis and Critical Control Points-Based Inspection Models Project introduced an application of Deming's principles to a regulatory public health agency that resulted in a decrease in absenteeism among inspection personnel assigned to these establishments. This chapter presents the analysis of secondary data obtained from the leave audit reports of inspection personnel assigned to HIMP establishments.

Demography of the Sample

The sample for this study was comprised of inspection personnel assigned to HIMP establishments from 1999 through 2002. A total of 294 inspection personnel were included in the study. The inspection personnel were assigned to 22 poultry establishments that were under traditional inspection prior to 1999 and began implementing the HIMP inspection program in 1999. These 22 poultry establishments are located in six inspection districts covering 11 states from the Midwest to the East. The states involved are Alabama, Mississippi, Virginia, West Virginia, Georgia, South Carolina, North Carolina, Arizona, Oklahoma, Missouri, and Texas.

Table 1 shows the number of establishments that implemented HIMP for each year of the study. The HIMP program was implemented in the poultry establishments on a voluntary basis beginning in 1999 and continuing through 2002. The poultry establishments participating in the HIMP program were 20

chicken slaughter establishments and 2 turkey slaughter establishments. The majority of the establishments implemented HIMP in 2000 (40.90%) and 2001 (45.45%).

Table 1

Number of New Establishments Implementing HIMP by Year

Year	Number	%
1999	1	4.55
2000	9	40.90
2001	10	45.45
2002	2	9.10
Total	22	100.00

Summary reports of annual leave and sick leave data were obtained from individual inspector time and attendance records of 294 inspection personnel assigned to the HIMP establishments. The individual time and attendance records detail the hours on duty and hours of authorized and/or unauthorized leave. Demographic characteristics such as ethnicity, age, and gender were not available. This type of information is not included in the original time and attendance records and was not provided with the summarized leave reports. Only sick leave and annual leave hours were available. Nonpay leave hours could not be captured because these data are not maintained in the financial processing center's database following the end of the calendar year.

Table 2 presents the number of sick leave and annual leave hours reported on the summarized reports of individual detailed time and attendance records for inspection personnel in the HIMP establishments during the first 4 years of HIMP

implementation. The annual leave and sick leave hours for the inspectors in the HIMP establishments were summarized for each year and totaled. The parenthetical data indicate the number of individual time and attendance records from which the leave data were obtained.

Table 2

Number of Sick Leave and Annual Leave Hours

Year	Annual Leave Hours	Sick Leave Hours	Total Leave Hours
1999	46,454.0 (2433 records)	30,482.0 (2148 records)	76,936.0
2000	46,513.0 (2443 records)	25,585.0 (1897 records)	72,098.0
2001	40,811.5 (2619 records)	21,646.5 (1976 records)	62,458.0
2002	44,993.0 (2746 records)	24,788.0 (2156 records)	69,781.0

Results of the Hypotheses Testing

The results of the testing of the three hypotheses are presented below. Data used for the analysis of the hypotheses were secondary leave data obtained from leave summary reports. Trend analysis was utilized to determine if a linear relationship existed between sick leave, annual leave, and total leave hours and the years of HIMP implementation. Trend was further analyzed through time series and regression analysis to determine the strength of the relationship between the leave hours and the number of years of HIMP implementation. Results of the time series analysis and time series regression Models are shown in Appendix C. The significance level was established at $\alpha = 0.05$.

Hypothesis 1

Hypothesis 1 stated: There is no significant difference in absenteeism levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002. A linear trend analysis was used to determine if a difference in absenteeism levels occurred between years 1999 and 2000 and years 2001 and 2002. Figure 1 shows the sick leave and annual leave hours by year.

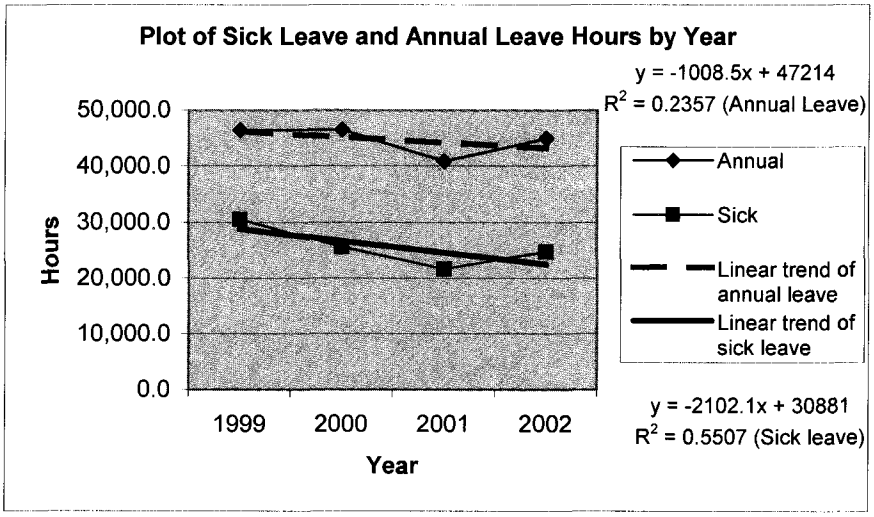

Figure 1. Graph of annual leave and sick leave hours by year.

As Figure 1 illustrates, the trends indicate a decrease in both annual leave and sick leave hours from 1999 through 2001 with a small increase in 2002. The increase does not reach the initial levels of 1999. The total leave hours are 76,936 for 1999, a decrease to 72,098 in 2000, and 62,458 in 2001. The number increased in 2002 to 69,781. The 2002 total is well below the total for 1999. Total leave hours for 1999 and 2000 combined equaled 149,034 hours, whereas total leave hours for 2001 and 2002 combined equaled 132,239 hours. Linear trend lines indicate a considerable downward trend in leave hours from 1999 through 2002.

The trend analysis appears to show a significant decrease in total leave hours each year following the implementation of HIMP. The correlation value of r at -0.66609 indicates the negative association. However, utilizing regression analysis to construct the linear regression line (least squares), significance could not be established. The r^2 value for total leave hours was 0.44368, indicating a weaker fit or association between total leave hours and years. The figures did not provide enough evidence to conclude that the variables were strongly correlated. Consequently, the null hypothesis failed to be rejected. Table 3 depicts the correlation and regression results.

Table 3

Correlation and Regression Results

Leave Hours	Correlation, r	Y Intercept, a	Slope, b	r^2
Total Leave	-0.66609	6292874	-3110.5	0.44368
Sick Leave	-0.74206	4230776	-2102.1	0.55066
Annual Leave	-0.48553	2062097	-1008.5	0.23574
Sample size, n = 4	Sig., $\alpha = 0.05$	df = 2		

Hypothesis 2

Hypothesis 2 stated: There is no significant difference in sick leave levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002. No significant difference was found in sick leave levels of inspection personnel working under HIMP and traditional inspection in years 1999 and 2000 as compared to sick leave levels in years 2001 and 2002.

The trend for sick leave hours from 1999 to 2002 indicates a decrease in the amount of sick leave taken from work. The graph of the number of hours of sick leave per year shows an obvious change in sick leave levels. Figure 2 shows a sharp decline in sick leave hours from 1999 through 2001 with a small increase in 2002. A time-series analysis using the natural log of the hours to smooth the curve indicates a significant decline in sick leave hours. The small increase in sick leave hours in 2002 is well under the sick leave hour total for 1999.

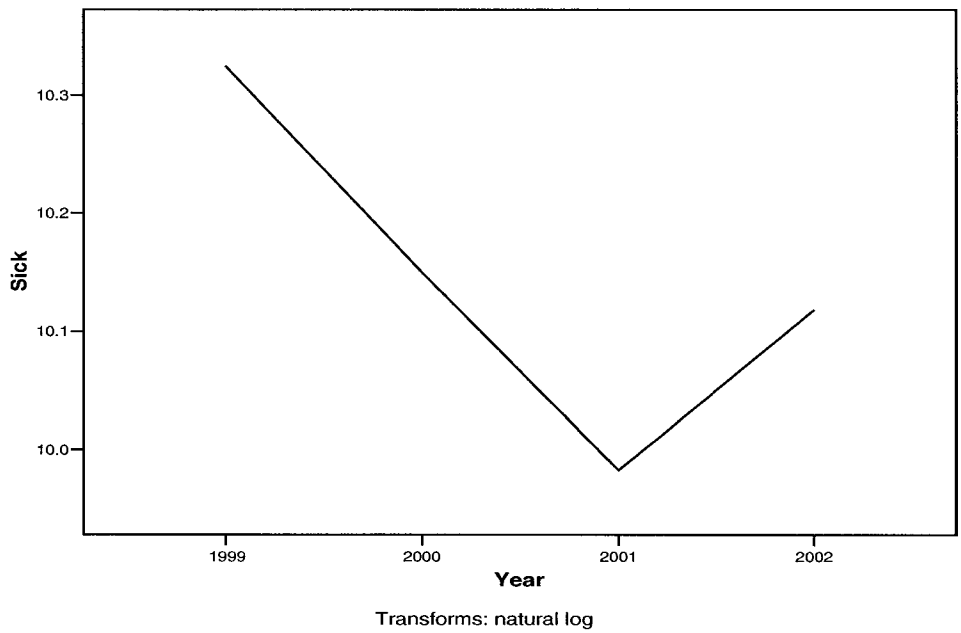

Figure 2. Graph of sick leave hours by year.

Figure 2 depicts the regression line for sick leave hours by year of HIMP implementation. For sick leave the regression line equation was y = -2102.1x + 30881 and r^2 equaled 0.5507. This means that 55% of the total variation in the "y" axis, sick leave, can be accounted for by the linear relationship. Although there

was a considerable difference in the sick leave levels of 1999 and 2000 as compared to sick leave levels of 2001 and 2002, further evaluation of r^2 did not provide enough evidence to conclude that the variables were strongly correlated.

Table 3 presents the correlation and regression results. The correlation value *r* at -0.74206 shows a negative association between sick leave and HIMP years. The relationship between sick leave and years of HIMP implementation may be linear but is not strong enough for the variable *year of implementation* to be of much value in predicting or estimating the variable *sick leave level.* The analysis did not provide enough evidence to conclude significance of the implied correlation. Consequently, the null hypothesis failed to be rejected.

Hypothesis 3

Hypothesis 3 stated: There is no significant difference in annual leave levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002. The trend in annual leave hours from 1999 through 2002 is a decrease in the amount of annual leave taken. As Figure 3 illustrates, annual leave hours declined gradually from 1999 through 2000. There was a significant decrease in annual leave hours from 2000 through 2001. The hours increased in 2002, but they were not back to the levels of 1999 and 2000. A time-series analysis using the natural log of the hours indicates that the shift occurred in 2001, when hours of annual leave decreased sharply then increased in 2002 but remained well below the earlier levels.

Figure 3 shows the regression line for annual leave hours compared by year of HIMP implementation. The equation for the regression line is $y = -1008.5x + 47214$ and r^2 equals 0.2357. Only about 24% of the variation in the "y" axis, annual leave hours, can be accounted for by the linear relationship. There is a

weak fit between the variable *annual leave hours* and the variable *years of implementation*. Table 3 (p. 42) gives the correlation and regression results. The correlation value of *r* at -0.48553 indicates a negative association between annual leave and HIMP years. However, this figure is not enough to conclude that the variables were strongly correlated. Significance could not be established; consequently, the null hypothesis failed to be rejected.

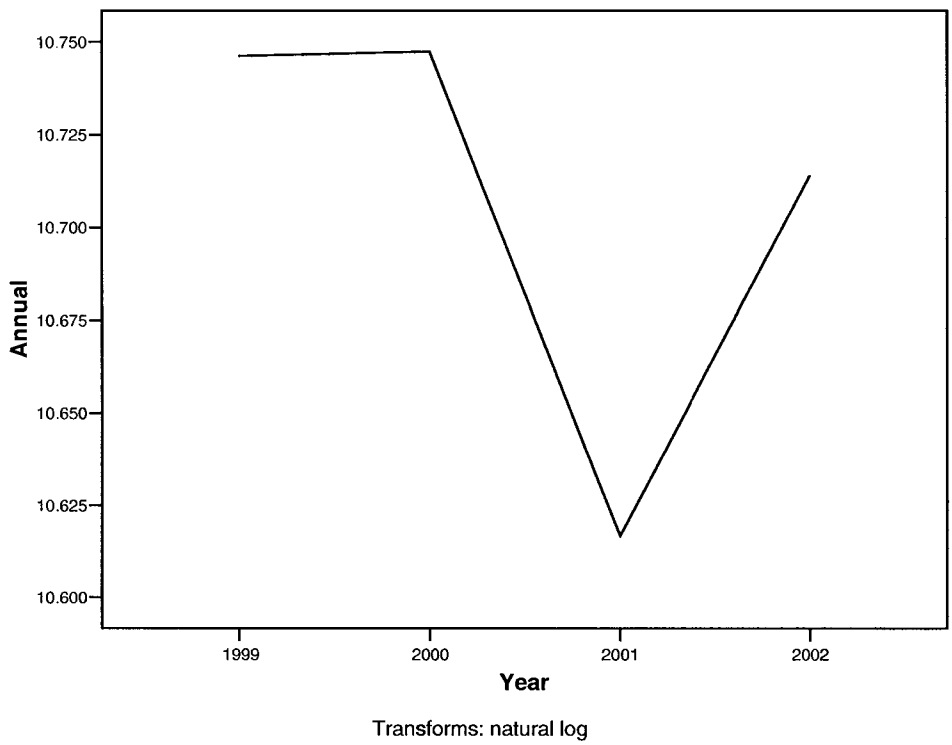

Figure 3. Graph of annual leave hours by year.

Summary

This study utilized secondary leave data of inspection personnel assigned to HIMP poultry establishments. The study analyzed leave data of 294 inspection

personnel assigned to HIMP and traditional inspection establishments during the first 4 years of implementation, 1999 through 2002. The findings indicate that there was a change in absenteeism levels as measured by sick leave, annual leave, and total leave hours of inspection personnel working under HIMP and traditional inspection in 1999 and 2000 as compared to the same inspection personnel working under HIMP in 2001 and 2002.

The trend analysis suggested that the variables of sick leave, annual leave, and total leave hours correlated negatively with the years of HIMP implementation, indicating a downward trend in absenteeism as the number of HIMP years increased. Examining the trend further through correlation and regression analysis revealed r^2 values for sick leave, annual leave, and total leave that were much greater than the significance levels established at 0.05. Time series analysis and time series regression analyses confirmed that, although the associations were present, they were weak and could not be considered statistically significant (Appendix C). Consequently, the null hypotheses failed to be rejected.

Chapter 5

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

The purpose of this study was to determine if the implementation of the Hazard Analysis and Critical Control Points-Based Inspection Models Project (HIMP), demonstrated an application of W. Edwards Deming's management principles in a federal public health agency, resulting in a decrease in absenteeism. HIMP was introduced in slaughter establishments as a means of enhancing the agency's ability to decrease food safety hazards and protect the health of the consuming public and to maximize the agency's scarce personnel resources. Incorporating Deming's management principles of continuous quality management usually results in greater employee commitment to company goals and higher employee satisfaction with the job and the company.

Absenteeism adversely affects the ability of FSIS to meet its mission of public health protection. Deming contended that following his principles of management was likely to increase job satisfaction for employees, leading to better attendance at work.

This study analyzed leave data of inspection personnel to determine if a relationship exists between the implementation of the new inspection program and the level of absenteeism. Secondary data were obtained as summarized sick and annual leave hours from the agency's financial processing center. A trend analysis was conducted to determine absenteeism levels changed significantly from the initial 2 years of HIMP implementation as compared to the subsequent 2 years.

Discussion

As mentioned in Chapter 1, the USDA did not develop HIMP inspection with Deming's principles in mind. HIMP was initiated to facilitate Hazard Analysis and Critical Control Points (HACCP) concepts in slaughter inspection as a way to prevent or minimize the introduction of food safety hazards to the consuming public, protect public health, and re-deploy scarce personnel resources. It is this last purpose – re-deploying scarce personnel resources – that is the focus of this research. This is where the Deming principles can be applied to maximize the talents and energies of a workforce that is already stretched and "stressed." How does HIMP affect employee workload? Does it influence how employees see themselves? In other words, how do organizations get the most for their personnel dollar?

HIMP indirectly applies some of Deming's 14 management points for improving quality and improving the entire organization by fulfilling the employees' need to feel appreciated and a part of the organization. Studies have shown that if employees feel they have ownership or investment in the decision-making process of their companies, the odds of the enterprise being successful increase dramatically. Not only will such employees devote more energy to trying to ensure the success of the company's mission, but also such employees will come to work. Employee absenteeism is the focus of this research. What causes employees to miss work? Does some component of HIMP provide some intrinsic value to employees that would encourage them to want to come to work?

Employees miss work for various reasons, such as medical problems, family illnesses and death, and personal problems. Other reasons are related to the perceptions and attitudes of employees regarding absenteeism. These perceptions could be based on social norms, perceived control, and moral obligation. Harrison

and Martocchio (1998), reviewing worker absenteeism over a 20-year period, suggested five classes of factors in absenteeism: personality, demographic characteristic, job-related attitudes, social context, and decision-making mechanisms.

Testing of the hypotheses found correlations between levels of absenteeism, sick leave, and annual leave, but no correlations that were significant.

Hypothesis 1 stated: There is no significant difference in absenteeism levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002. Although a difference in the absenteeism levels of the inspection personnel over time was evident time series analysis and regression trend analysis results did not lead to a rejection of the hypothesis.

Hypothesis 2 stated: There is no significant difference in sick leave levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002. The relationship between sick leave hours and years of HIMP implementation was linear, with levels of sick leave obviously decreasing over time, but the time series analysis and regression trend analysis did not provide sufficient evidence to lead to a rejection of the hypothesis.

Hypothesis 3 stated: There is no significant difference in annual leave levels of inspection personnel working under HIMP and in traditional inspection between years 1999 and 2000 and years 2001 and 2002. Results showed that annual leave hours decreased from 1999 to 2001 and rose slightly in 2002. However, time series analysis and regression trend results did not provide sufficient evidence to lead to a rejection of the hypothesis.

Hypotheses 1, 2, and 3 are similar in that they looked at the differences in absenteeism during the same time intervals – the 2 initial years of HIMP

implementation and the subsequent 2 years of HIMP implementation. Even though the types of absence levels studied were different, the premise behind the comparison was the same. A linear regression line was calculated using the number of leave hours (sick, annual, or total) as the dependent variable and the year(s) the leave data were recorded as the independent variable. Some differences in sick and annual leave levels during the period examined were noted. The trend analysis showed a sharp reduction in sick leave levels for the first 3 years, 1999 – 2001, then a small increase in the 4th year, 2002. Annual leave levels decreased moderately in the 2nd year, 2000, then sharply in the 3rd year, 2001. An upward slope in annual leave hours was shown in the 4th year, 2002.

It is possible that inspection personnel were being trained and acclimated during the initial implementation of HIMP. Inspection personnel were adapting to the introduction of a new philosophy, receiving education and self-improvement opportunities at agency expense, and enjoying more autonomy and responsibility. All of these gains are in line with Deming's contention that his management principles of continuous quality improvement lead to improved efficiency and job satisfaction. The increase in annual and sick leave in the 4th year may be due to a leveling off effect, whereby employees have fully adjusted to the new positions and possibly begun to settle back into previous leave usage behavior. Or the increase may be due to other factors that the researcher was unable to determine given the limitations of the study and the limited range of data available for study.

Limitations

This study had some limitations that may affect the statistical outcomes. One limitation was the lack of leave data from years prior to the implementation of HIMP. Leave data from the agency were available for the years 1999 through

2002. Leave data for prior years were stored by another agency and were not attainable in a timely manner. Utilizing leave data from years prior to the implementation of HIMP could have affected the results.

The lack of available nonpay leave data also may have been a limiting factor in this study. Nonpay leave data, whether approved leave without pay or nonapproved absence without official leave, are not preserved in the same manner as paid leave data (annual and sick leave). The balance of hours are not carried from year to year as sick and annual leave are. Nonpaid leave falls under different personnel rules and is affected by personnel actions taken by the human resource offices.

Individual leave records for each of the 294 inspection personnel assigned to the HIMP establishments were not available for analysis. Access to the individual records may have provided some nonpay leave data since this information is a part of the record for a certain period of time. The results obtained from following individuals through the years of implementation could be different from the data obtained from summarized reports.

Implications for Public Health Practice

Absenteeism in the public health field is a critical problem that adversely affects a healthcare or public sector organization's ability to remain productive and ensure that healthcare needs are met. Likewise, absenteeism of FSIS inspection personnel adversely affects the agency's ability to meet its mission of ensuring food safety and public health for the consumer of meat, poultry, and egg products. The absence of inspection personnel restricts the establishments' production and compromises the establishments' ability to comply with its HACCP programs (Beers, 2000).

Because of the adverse effect of absenteeism on productivity and customer service and its exorbitant cost to industry and public service organizations, the problem of worker attendance has been studied extensively. Many studies of worker absenteeism link absenteeism to job-related attitudes, organizational commitment, job characteristics, and job satisfaction (Burton et al., 2002; Harrison & Martocchio, 1998; Jurkiewicz et al., 1998; Rentsch & Steel, 1998). These studies demonstrated that when workers felt committed to the organization, were satisfied with their jobs, and perceived that their purpose was significant, they were less likely to be absent.

Private healthcare and public service organizations recognize the need to increase productivity and service, achieve a competitive edge, and reduce costs. Many healthcare organizations adopted Deming's principles of continuous quality management due to demands from consumer organizations, insurance companies, and patients. Public service organizations adopted the principles to improve services and improve organizational performance (Hsieh et al., 2002). By adopting Deming's management principles of continuous quality improvement, healthcare personnel within an organization work together as teams to satisfy the patient and further the goals of the organization

Introduction of some of the programs, procedures, and policy guidelines utilized by FSIS were not specifically seen as an employment of Deming's principles. They just made logical and regulatory sense. However, a review of certain aspects of HIMP suggests that several of the 14 points of Deming's principles can be found incorporated in HIMP. The HIMP inspection program initially required FSIS to institute more training (Deming's Principle 6), break down barriers between staff areas to initiate the agency's team approach to inspection (Deming's Principle 9), and remove barriers that rob people of pride of

workmanship in order to fully integrate inspection employees in all HIMP inspection activities (Deming's Principle 12). HIMP also required FSIS to adopt a new philosophy and encourage inspection employees to adopt the agency's vision of improved, science-based inspection for protection of public health (Deming's Principle 2), encourage education and self-improvement for all employees (Deming's Principle 13), and replace dependence on mass inspection with statistical process control focusing on conditions that affect public health (Deming's Principle 3).

Others of Deming's 14 managerial points may be used in HIMP to certain degrees, but those listed above played a crucial role in the successful implementation of the HIMP program and indirectly address the issue of absenteeism that adversely affected the agency's ability to effectively meet its mission of public health protection. The analysis of the data appears to indicate that FSIS employees may be responding favorably to the increased autonomy, increased job depth, and increased scope of responsibility that HIMP affords. In order to work in the new HIMP positions, inspection personnel were given more professional training, higher salaries, and more responsibility. It is assumed but not fully supported in the research analysis that these benefits have translated into less absenteeism and increased job commitment, directly enhancing FSIS's ability to ensure food safety and public health protection.

Recommendations

The results of the study indicated that absenteeism decreased as HIMP was implemented in the poultry establishments. The sample may not have been large enough to provide conclusive evidence that the variables *sick leave*, *annual leave*, and *total leave* were strongly correlated with the variable *years of HIMP*

implementation. Based on the study findings, the following suggestions are recommended for future studies.

1. Attempts should be made to obtain leave data from years prior to HIMP implementation for comparison with leave data produced during the years subsequent to HIMP implementation. Comparing the leave data from before and after HIMP implementation would present a clearer picture of the relationship between absenteeism levels and implementation of HIMP.
2. Individualized leave data of the inspection personnel assigned to the HIMP plants should be obtained to provide a more comprehensive picture of absenteeism levels for sick leave, annual leave, and nonpay leave.
3. Nonpay leave data for the periods prior to HIMP implementation and after should be obtained.
4. A survey should be conducted of the inspection personnel assigned to the HIMP plants to determine their level of job satisfaction and commitment to the agency's goals. A survey could detect similarities between Deming's management principles and the HIMP inspection program.
5. Further trend analyses of leave data should be extended over a much longer time period, 5 to 10 more years, to determine the strength of correlation between leave levels and HIMP implementation in the stabilized program.

Even though the data sources utilized for this study were limited, the results showed obvious differences over time in absenteeism rates after the implementation of HIMP. Data did not fully support the presumption that the implementation of the new inspection program was strongly associated with a decrease in sick and annual leave hours. The main purpose of this study was to investigate whether the implementation of HIMP, as an application of Deming's management principles to a public health agency, resulted in changes in

absenteeism levels. The evaluation of the association of absenteeism with a new public health inspection program may be beneficial in supporting the review of new programs aimed at improving personnel attitudes, performance, and attendance in FSIS.

Summary

This study investigated whether the introduction of a new government program, HIMP, represented an application of Deming's management principles in a regulatory public health agency, as shown through a decrease in absenteeism levels. HIMP was introduced in 1998 as a much improved inspection method that would enhance FSIS's ability to accomplish its mission of food safety and protection of public health and to better manage the agency's scarce personnel resources. Implementation of HIMP changed the inspection jobs and increased training and education opportunities.

Through these and other changes, HIMP indirectly applied some of Deming's 14 management principles. HIMP encouraged employees to feel more committed to the agency's mission of food safety, feel more satisfied with their jobs, and perceive themselves as a part of the organizational team. When employees are more satisfied with their organization and their specific job, they are less likely to be absent from work.

Absenteeism was the focus of this study. The levels of sick leave, annual leave, and total leave were examined over time to determine if changes in leave levels resulted from or were closely associated with the implementation of HIMP. Three hypotheses were tested using trend analysis to determine if there were significant changes in absenteeism levels from the initial 2 years of HIMP implementation as compared to the subsequent 2 years. Regression analysis was

utilized to examine the strength of the correlation of the trend analysis. Although there were decreases in sick leave, annual leave, and total leave levels over time, analysis did not lead to the rejection of the hypotheses.

This study did not demonstrate that the introduction of HIMP had a statistically significant effect on absenteeism of inspection personnel. However, the data did show decreases in absenteeism and sick and annual leave when HIMP was implemented. It is not clear if the decreases in sick and annual leave levels were due to the newness of the program or some other factor(s) this study did not take into account. Given the history of the adoption of Deming's principles – that the adoption usually results in changed philosophies of organizations – it is likely that HIMP over time would lead to decreases in absenteeism. These decreases would be due to employees perceiving themselves as valuable members of the corporate team and consequently becoming more vested in the outcome of the organization's mission.

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APPENDICES

APPENDIX A

APPROVAL LETTER

USDA United States Department of Agriculture | Food Safety and Inspection Service | Alameda District 620 Central Avenue, Bldg. 2C Alameda, CA 94501

3 December 2003

Chairperson of the Human Subjects Committee
Department of Health Science
California State University, Fresno
Thomas Administration, Room 121, M/S TA52
Fresno, CA 93740

To Whom It May Concern:

This letter is written at the request of Phyllis Adams, DVM, who is in the process of completing her thesis requirement for an MPH degree. After discussing the parameters of confidentiality and the impact this information may have on the department and its personnel, I am approving the collection of absenteeism and related data to be used for the sole purpose of completing her MPH requirements.

If there are questions regarding this approval please contact me at 510-337-5000. I will be also serving as a secondary reader on this paper. Thank You!

Sincerely,

Murli Prasad, DVM, PhD
Alameda District Manager

APPENDIX B

SUMMARIZED HIMP INSPECTOR LEAVE REPORTS

HIMP inspector hours FY-1999

Transaction Code	*Total Hours*
61	
Summary for 'TC' = 61 (2433 detail records)	
Sum	*46454*
62	
Summary for 'TC' = 62 (2148 detail records)	
Sum	*30482*
Grand Total	*76936*

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Transaction Code 61 = Annual Leave
Transaction Code 62 = Sick Leave

HIMP inspector hours FY-2000

Transaction Code	*Total Hours*
61	
Summary for 'TC' = 61 (2443 detail records)	
Sum	*46513*
62	
Summary for 'TC' = 62 (1697 detail records)	
Sum	*25585*
Grand Total	*72098*

Transaction Code 61 = Annual Leave
Transaction Code 62 = Sick Leave

HIMP inspector hours FY-2001

Transaction Code	*Total Hours*
61	
Summary for 'TC' = 61 (2619 detail records)	
Sum	40811.5
62	
Summary for 'TC' = 62 (1976 detail records)	
Sum	21646.5
Grand Total	62458

Transaction Code 61 = Annual Leave
Transaction Code 62 = Sick Leave

HIMP inspector hours FY-2002

Transaction Code	*Total Hours*
61	
Summary for 'TC' = 61 (2746 detail records)	
Sum	*44993*
62	
Summary for 'TC' = 62 (2156 detail records)	
Sum	*24788*
Grand Total	*69781*

Thursday, March 18, 2004 *Page 1 of 1*

Transaction Code 61 = Annual Leave
Transaction Code 62 = Sick Leave

APPENDIX C

STATISTICAL ANALYSES

Time Series Analysis

Time series analysis was used for the following reason:

> "Time series analysis accounts for the fact that data points taken over time may have an internal structure (such as autocorrelation, trend or seasonal variation) that should be accounted for."[1]

Given this, it was determined that time series analysis, using autocorrelation and smoothing of the data was an appropriate analytic method. The Box-Jenkins univariate time series method was used to create the models that follow[2]. Time is the implicit predictor variable.

First, the data was "smoothed" (removal of "noise" or random error) to increase the reliability of the autocorrelation estimates and Box-Ljung statistic[3]. Double exponential smoothing was employed to account for the trend inherent in the data. Stationarity[4] could not be assumed, as the data showed a downward trend in preliminary analysis. This trend was previously determined using trend analysis methods available in Excel.® This second smoothing updates the trend, which is expressed as the difference between the last two values (hence, there are 2 lags for four time periods).

Models and analysis

Analysis 1: **Autocorrelations**: Totall_1 EXPONENTIAL SMOOTHING (Total leave)

```
     Auto-  Stand.
Lag Corr.  Err. -1  -.75  -.5 -.25   0  .25  .5  .75  1 Box-Ljung Prob.
                ▫⇩⇩⇩⇩⇧⇩⇩⇩⇩⇧⇩⇩⇩⇩⇧⇩⇩⇩⇩⇧⇩⇩⇩⇩⇧⇩⇩⇩⇩⇧⇩⇩⇩⇩⇧⇩⇩⇩⇩▫
1  .233   .500  .                   ⇔*****              .        .434
.510
2 -.336    526               *******⇔                            1.792
.408

Plot Symbols:      Autocorrelations *     Two Standard Error Limits.
Standard errors are based on the Bartlett (MA) approximation.

Total cases:  4     Computable first lags:  3
```

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[1] "Engineering Statistics Handbook", p. 105, Chapter 6, http://www.itl.nist.gov/div898/handbook/pmc/section4/pmc4.htm, downloaded 6/16/04.
[2] "Engineering Statistics Handbook", p. 105, Chapter 6, http://www.itl.nist.gov/div898/handbook/pmc/section4/pmc4.htm, downloaded 6/16/04.
[3] "Engineering Statistics Handbook", Chapter 6, http://www.itl.nist.gov/div898/handbook/pmc/section4/pmc4.htm, downloaded 6/16/04.
[4] Stationarity is defined as a flat-looking series, with no trend, constant variance over time, and no periodic fluctuations or seasonality.

Analysis 2: **Partial Autocorrelations**: Totall_1 EXPONENTIAL SMOOTHING (Total leave)

```
   Pr-Auto- Stand.
Lag Corr. Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1
               ▫⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩▫
1  .233  .500  .                 ⇔*****                .
2 -.413  .500  .           ********⇔                   .
```

Plot Symbols: Autocorrelations * Two Standard Error Limits.

Total cases: 4 Computable first lags: 3

Analysis 3: **Autocorrelations**: Annual_1 EXPONENTIAL SMOOTHING (Annual)

```
     Auto- Stand.
Lag Corr. Err.-1  -.75  -.5 -.25   0   .25  .5   .75   1  BoxLjungProb.
              ▫⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩▫
1  .280  .500  .                 ⇔******               .        .629
.428
2 -.370  .538             *******⇔                             2.275
.321
```

Plot Symbols: Autocorrelations * Two Standard Error Limits.
Standard errors are based on the Bartlett (MA) approximation.

Total cases: 4 Computable first lags: 3

Analysis 4: **Partial Autocorrelations**: Annual_1 EXPONENTIAL SMOOTHING (Annual)

```
   Pr-Auto- Stand.
Lag Corr. Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1
               ▫⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩▫
1  .280  .500  .                 ⇔******               .
2 -.487  .500  .         **********⇔                   .
```

Plot Symbols: Autocorrelations * Two Standard Error Limits.

Total cases: 4 Computable first lags: 3

Analysis 5: **Autocorrelations**: Sick_1 EXPONENTIAL SMOOTHING (Sick)

```
     Auto- Stand.
Lag Corr. Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1 BoxLjungProb.
               ▫⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩▫
1   .199   .500  .                 ⇔****                 .        .318
.573
2  -.320   .520               ******⇔                            1.549
.461
```

Plot Symbols: Autocorrelations * Two Standard Error Limits.
Standard errors are based on the Bartlett (MA) approximation.

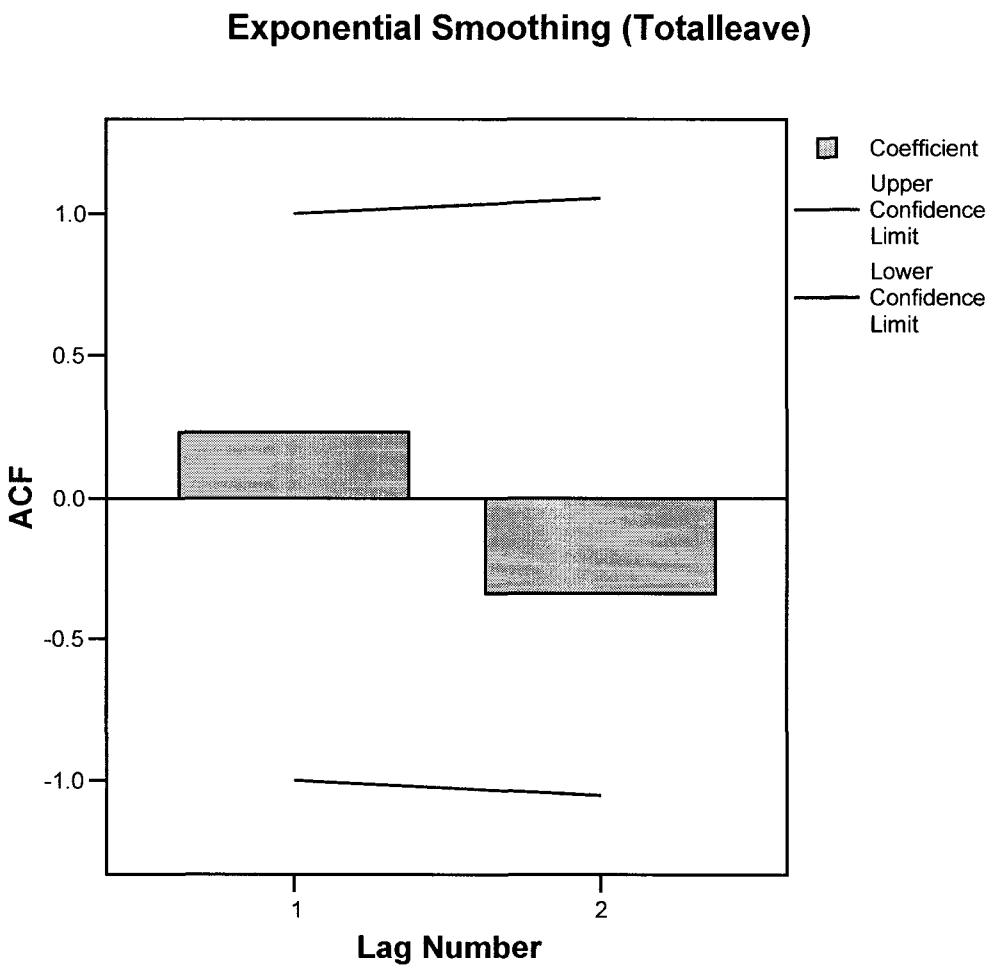
Total cases: 4 Computable first lags: 3

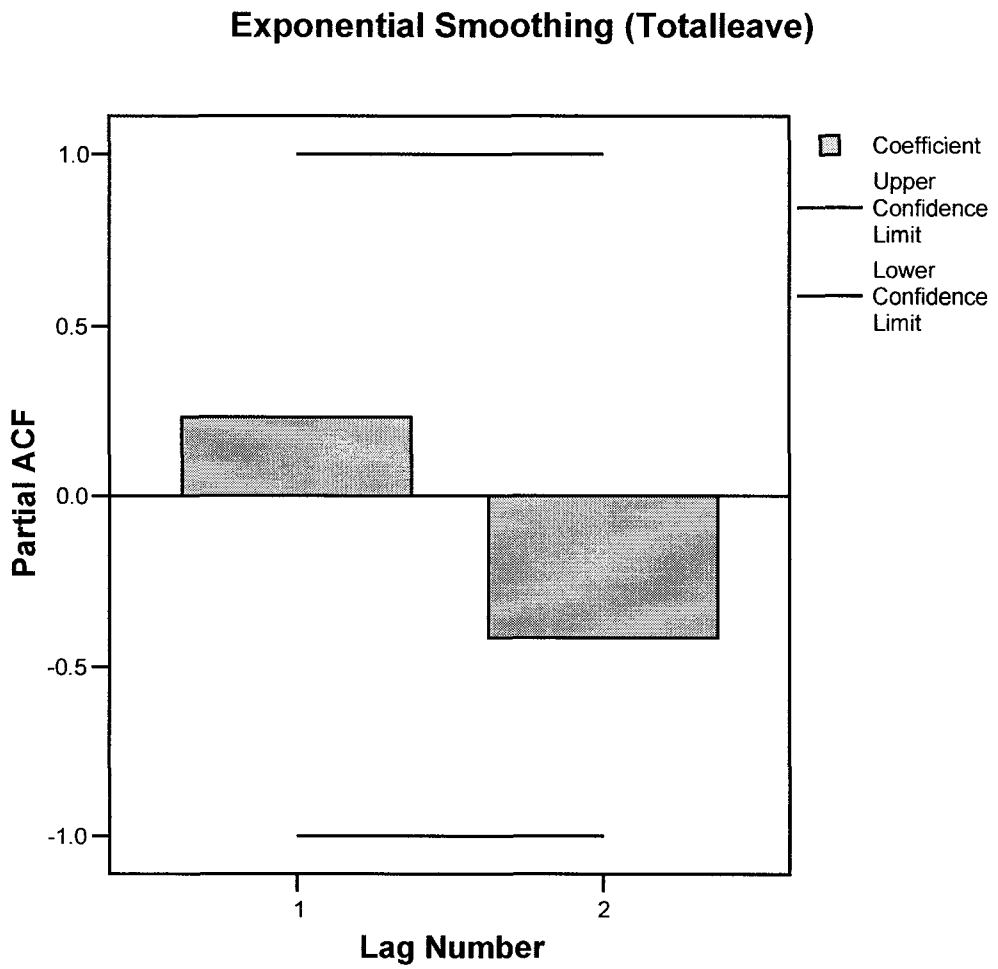
```
Analysis 6: Partial Autocorrelations:   Sick_1   EXPONENTIAL SMOOTHING
(Sick)

   Pr-Auto- Stand.
Lag Corr. Err. -1   -.75   -.5 -.25    0    .25  .5    .75    1
               ⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩⇳⇩⇩⇩⇩
1  .199  .500  .                  ⇔****                    .
2 -.375  .500  .           *******⇔                        .

Plot Symbols:      Autocorrelations *     Two Standard Error Limits.

Total cases:  4     Computable first lags:  3
```

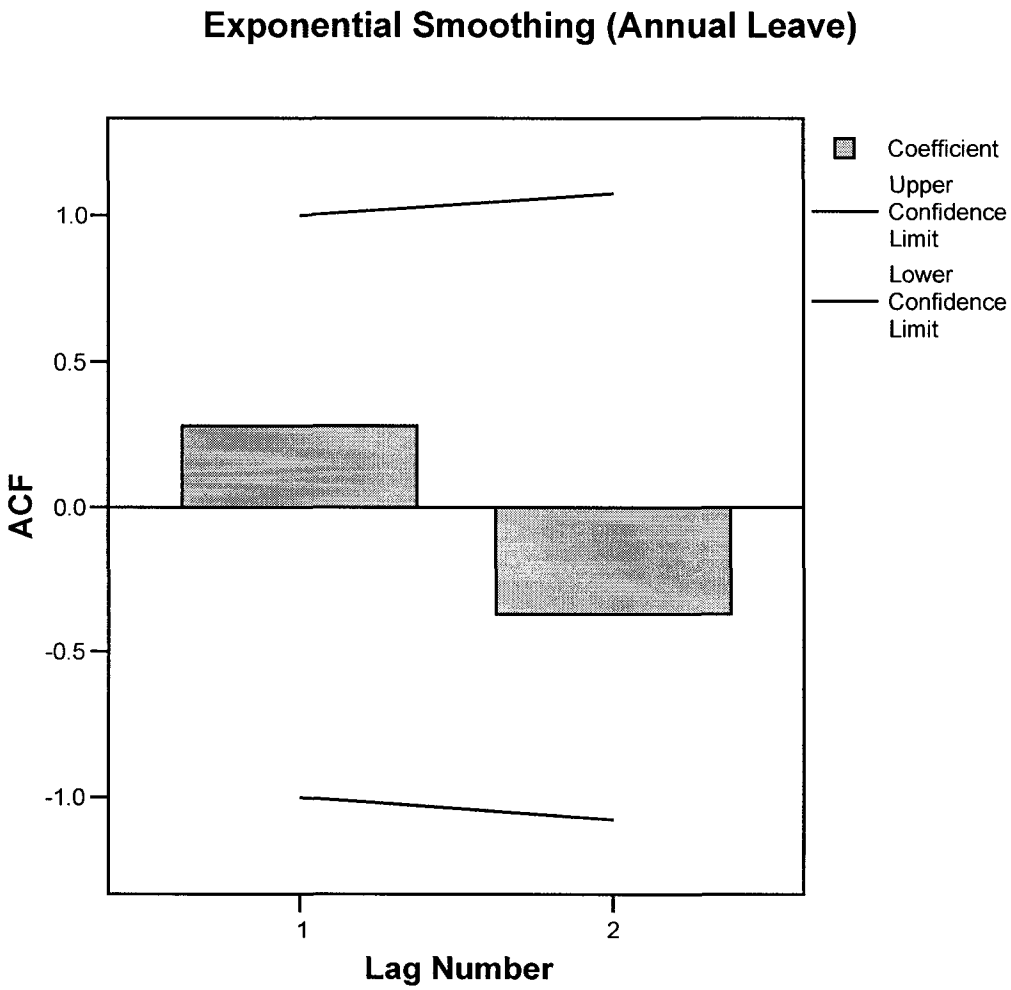
The data demonstrate a downward trend and negative correlations between points within Lag 2; however, this trend is not statistically significant. The Box-Ljung statistics, analogous to an F-score, do not reach alpha of .05 or less. The lags refer to the four years, the first lag being a composite of the first two years (1999-2000) and the second lag refers to the last two years (2001-2002). The graphs that follow show pictorially that the second two years are lower in hours of total, annual and sick leave. The confidence intervals are 95% intervals for the auto-correlations, which give the population range of the leave hours. One can be 95% confident that the true correlations are between the lower and upper limits.

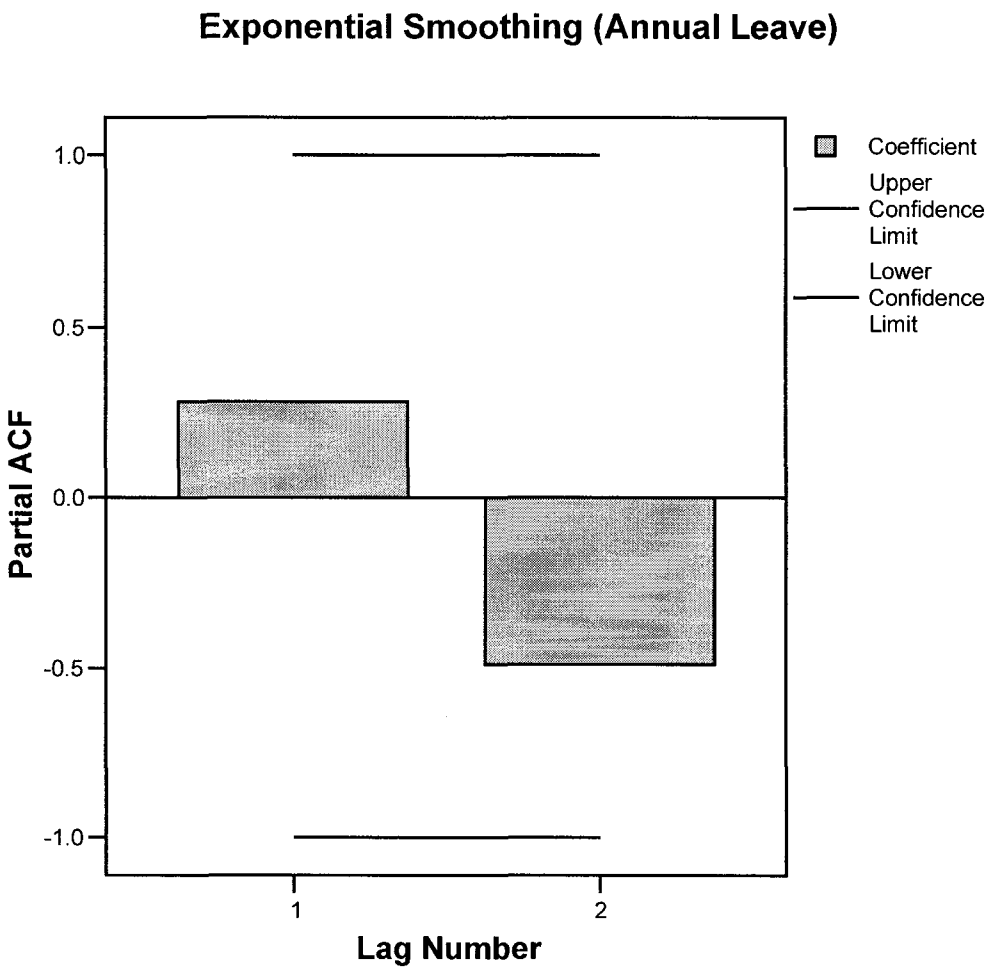
The auto-correlations and the partial-correlations of lag 2 are negative, again evidence of decreases over time. These decreases are not statistically significant. Thus, from the data, it can be concluded that the trend is decreasing, but that the null hypothesis must be accepted. Such changes are not statistically significant.

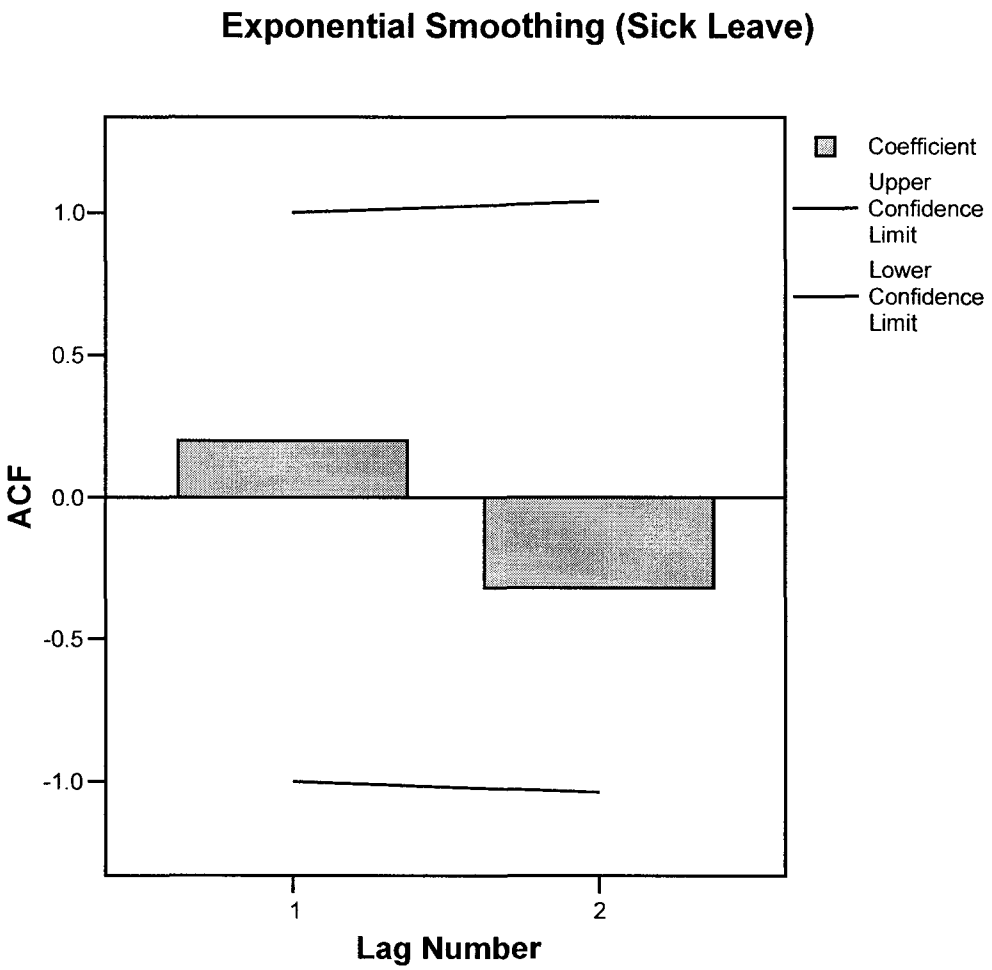
A weakness of the data is the paucity of data points. Box-Jenkins models are strongest when there are at least 50 data points. As an alternative, regression time series was also performed, again showing no statistically significant time effect on leave hours. This is shown in the data that follows the graphical presentations.

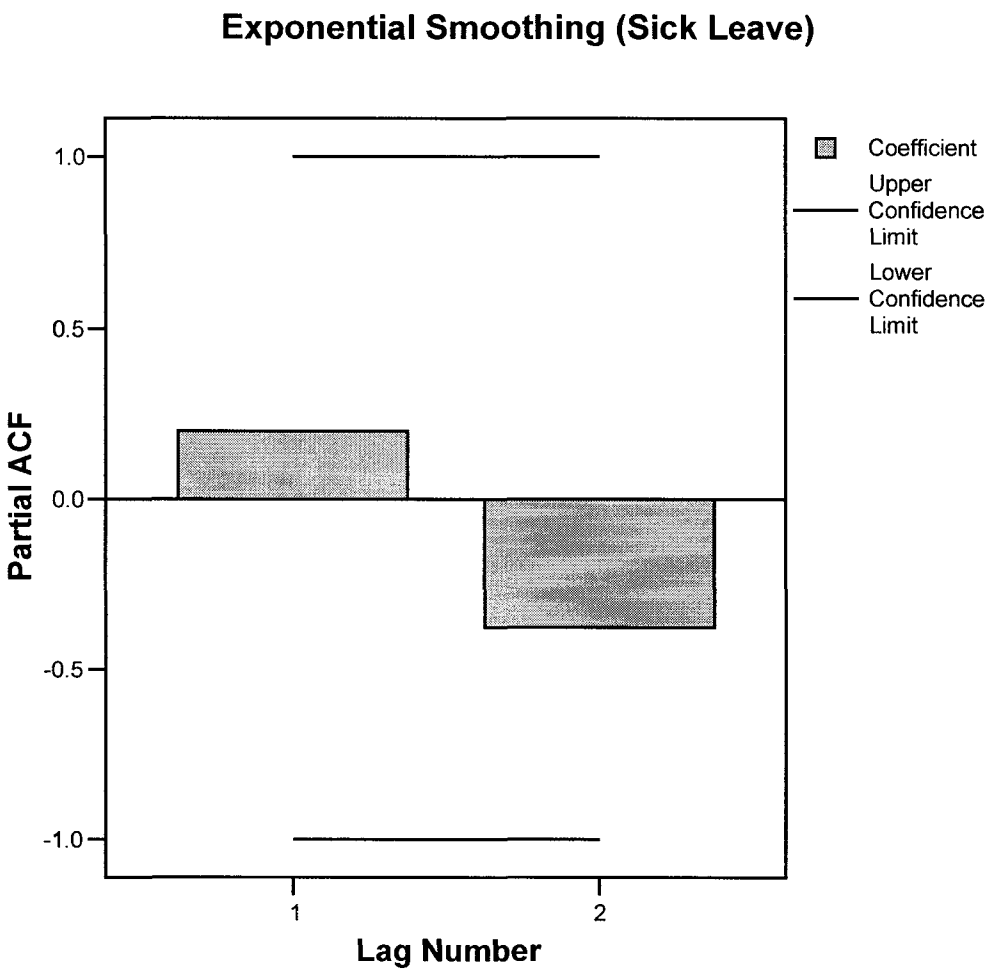


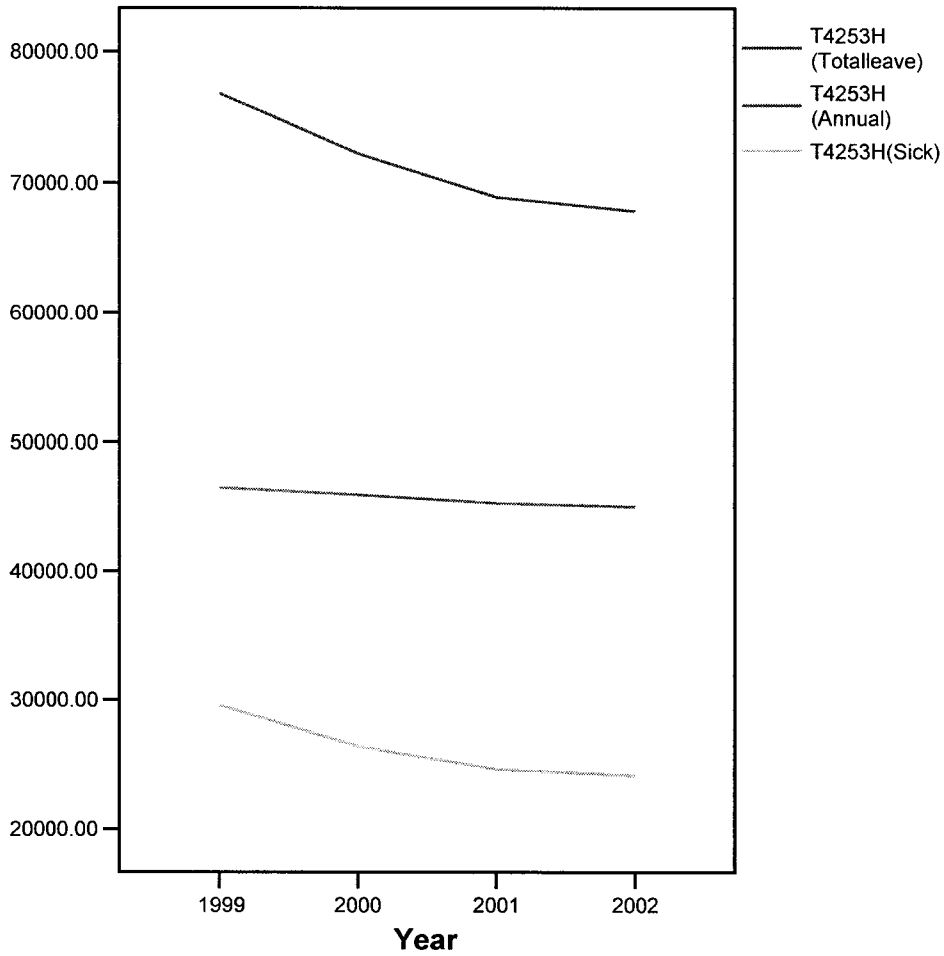












Time Series Regression Model

The statistical program Stata® Version 7 was used to perform the regression analysis. This may be more interpretable than the Box-Jenkins method, and does not have the stringent requirements of numerous time points. Again, the F-value and the t-value for the time (L1) are not statistically significant for any of the leave variables. The adjusted R-squared values suggest a downward trend, albeit not statistically significant (note negative values on R-squared).

Regression of Total Leave on Time

```
      Source |       SS       df       MS       Number of obs =       3
-------------+------------------------------   F(  1,     1) =    0.07
       Model |  2872917.29     1  2872917.29    Prob > F      =  0.8406
    Residual |  43921355.4     1  43921355.4    R-squared     =  0.0614
-------------+------------------------------   Adj R-squared = -0.8772
       Total |  46794272.7     2  23397136.3    Root MSE      =  6627.3

------------------------------------------------------------------------------
TOTALLEA     |  Coef.     Std. Err.    t    P>|t|    [95% Conf. Interval]
-------------+----------------------------------------------------------------
TOTALLEA     |
          L1 | .1626102   .6358053    0.26   0.841  -7.916062   8.241282
_cons        | 56048.75   44985.59    1.25   0.431  -515547.4    27644.9
------------------------------------------------------------------------------
-------
```

Regression of Annual Leave on Time

```
      Source |       SS       df       MS       Number of obs =       3
-------------+------------------------------   F(  1,     1) =    0.08
       Model |  1260736.32     1  1260736.32    Prob > F      =  0.8267
    Residual |  16173411.8     1  16173411.8    R-squared     =  0.0723
-------------+------------------------------   Adj R-squared = -0.8554
       Total |  17434148.2     2  8717074.08    Root MSE      =  4021.6

------------------------------------------------------------------------------
-------
ANNUAL       |  Coef.    Std. Err.     t     P>|t|   [95% Conf. Interval]
-------------+----------------------------------------------------------------
-------
ANNUAL       |
          L1 | -.2424398  .8683456   -0.28   0.827  -11.27582   10.79094
_cons        | 54916.91   38791.54    1.42   0.392  -437976.4   547810.2
------------------------------------------------------------------------------
-------
```

Regression of Sick Leave on Time

```
      Source |       SS       df       MS      Number of obs =       3
-------------+------------------------------   F(  1,     1) =    0.07
       Model |  552258.576     1  552258.576   Prob > F      =  0.8376
    Residual |  8119745.92     1  8119745.92   R-squared     =  0.0637
-------------+------------------------------   Adj R-squared = -0.8726
       Total |  8672004.50     2  4336002.25   Root MSE      =  2849.5

------------------------------------------------------------------------------
       SICK |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
       SICK |
         L1 |   .1187148   .4552028     0.26   0.838    -5.665185    5.902615
      _cons |   20931.25   11906.01     1.76   0.329      -130349    172211.5
------------------------------------------------------------------------------
```